NEWSLETTER

NDGS

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June, 1975

DRILLING PERMITS ISSUED BY THE NORTH DAKOTA GEOLOGICAL SURVEY--

From the last printing of the newsletter to April 28, 1975, there have been 68 permits to drill issued by the Oil and Gas Section of the Survey. Permits issued each month are listed in the Monthly Oil Production Report. Anyone desiring this information should subscribe to that publication.

NORTH DAKOTA CRUDE OIL SUPPLIES--

C. B. Folsom, Chief Petroleum Engineer for the North Dakota Geological Survey, reports that North Dakota has technically recoverable crude oil reserves of 658 million barrels as of January 1, 1975. The term "technically recoverable" includes those proven reserves that can be recovered with the use of present technical knowledge, available equipment, and current operating practices. About half of these reserves are the result of the initiation of enhanced recovery projects.

The estimate was arrived at by the volumetric method, where enough data was available, and by analogy in new fields. The economics of recovery were not considered. Actual recovery of this potential crude oil reserve will depend on: (1) Governmental policies, (2) Crude oil prices and price controls, (3) Availability of hardware, and (4) Manpower.

In addition to its "proven" reserves, North Dakota has great potential for additional discoveries if investors of risk capital can be induced to invest that capital in North Dakota, rather than in other areas, and in exploratory drilling, rather than in less risky ventures.

The recent increases in the price of crude oil have definitely had their effect on exploratory drilling in the state. Governmental policies in Saskatchewan and Alberta have created considerable interest in the possibilities of oil exploration in the state by reducing the profitability of oil production in those provinces.

It had been hoped that the higher prices would extend the life of marginal wells (wells that produced an average of less than 10 barrels per producing day during December, 1974), but many operators found it was to their long-term advantage to plug these wells and recover as much casing as possible since there was a serious shortage of casing for new wells. The casing problem is abating and this "salvage" problem should ease in the future unless a "price roll-back" is enacted by Congress.

A shortage of manpower also hampered exploratory drilling activity in 1974. The decline of enrollment in Petroleum and Geological Engineering, which occurred in the 1960s, was a major factor; and, although enrollments are now on the increase, they will not be an effective factor in industry until 1975 or 1976.

OIL AND GAS RESERVES DROP DURING 1974--

According to the American Petroleum Institute, proved reserves of oil and gas continued to decline during the past year even though increases in oil prices did help to encourage drilling and extended the life of some oil fields. Nationally, our proved reserves of recoverable crude oil dropped from 35.3 billion barrels a year ago to 34.25 billion barrels on January 1, 1975. Production last year of 3.043 billion barrels of crude oil exceeded gross additions to reserves by 1.05 billion barrels. Current natural gas reserves of 237.1 trillion cubic feet are down by 12.8 trillion cubic feet. Production was 21.3 trillion cubic feet, the first time production has dropped since 1946.

NORTH DAKOTA'S RED WING CREEK FIELD--

In 1972, oil was discovered in a highly deformed and uplifted geologic structure in McKenzie County, North Dakota. The oil field has proven to be a good one, producing about 1.5 million barrels since the original discovery well was drilled. Speculation about the origin of the feature, which is now known as the Red Wing Creek structure, has not ended, but it is likely that the structure was caused by the impact of a very large meteor.

In the Red Wing Creek structure, Mississippian age strata are uplifted 3,000 feet above surrounding sediments of comparable age. The deformed Mississippian carbonates and evaporites are underlain and overlain by relatively undeformed formations. Approximately 6,000 feet of geologic section is disturbed. The geologic structure is about six miles in diameter with a circular to slightly elliptical shape in plan view and a sombrero shape in cross-sectional view. It is not apparent from the surface using conventional geologic exploration techniques.

According to a report prepared by R. L. Brenan, B. L. Peterson, and H. J. Smith for Union Oil Company of California, the generation of forces necessary to create a structure the size of Red Wing Creek in a matter of seconds staggers the imagination. In order to scale the event, some comparisons are necessary. The 60 ton meteorite which impacted on limestone at Grootfontaine, Southwest Africa, formed a crater only five feet deep. The reason for this is that relatively small meteors decelerate to terminal velocity at some altitude in the earth's atmosphere depending on the meteor's mass and entry velocity. They all, therefore, strike the earth's surface at about the same speed, well below their original (cosmic) speed. The differences in the size of the craters produced are due to the different masses involved and the competency of the rocks the meteors hit.

Meteorites of large mass (100 tons and up) have a theoretical terminal velocity at an altitude below the earth's surface and thus impact at a significant fraction of their cosmic velocity. The meteorite that excavated Meteor Crater was equivalent to a sphere with a diameter of about 80 feet and a mass of 63,000 tons. Even so, not enough shock stress was generated to produce the central uplift of a typical complex cryptoexplosion structure like that at Red Wing Creek. Based on a comparison of estimates for other cryptoexplosion features, the Red Wing Creek structure must have been formed by a meteor about 1,500 feet in diameter, with a mass of 350,000,000 tons, impacting at about 35,000 mph.

The meteor that formed the Red Wing Creek structure impacted in Triassic time, about 200 million years ago. It is possible that, in contrast to the continuing bombardment of small meteors, at certain times in the past the earth has periodically been bombarded by swarms of asteroid-size objects, which impact at high velocities, creating cryptoexplosion features. These encounters are probably relatively infrequent, occurring at intervals of some millions of years. The more forceful impacts not only create central uplifts, but in some cases they trigger volcanic activity, salt flowage and solution, faulting, and perhaps isostatic adjustment of basement rock.

Other meteor-impact structures in the Williston basin include the one at Viewfield, Saskatchewan, which is somewhat smaller than the Red Wing Creek structure, but apparently about the same age, and a structure located at Hartney, Manitoba, which is also Jurassic to Triassic in age.

THE ROLE OF OIL IN THE ENERGY SHORTAGE--

If present trends continue, we can expect to move toward a major fuel supply shortage in the not too distant future. By now, all of us are familiar with the talk of imminent shortages in our fuel supplies. The winter of 1973-1974 dramatically warned us that one of the first problems to affect the average homeowner in a fuel shortage is the availability of home heating fuel. And, of course, we all know that gasoline doesn't sell for 30¢ a gallon any more.

Let's see if we can pinpoint some of the problems. For many years, the nation's most important energy source has been petroleum. We use over 17 million barrels of oil every day. Just that one day's supply would fill almost 43,000 tank cars of a train 560 miles long. In the United States, oil production has increased to meet consumption ever since the first oil well was completed in 1858. Since 1970, however, we have been using more oil than we find, and production is declining.

The National Petroleum Council estimates that we had total discoverable oil reserves of 810 billion barrels in 1858. Of this, we had found 425 billion barrels or 52.5 percent by 1971, more than half of the oil that originally existed in the United States. We had produced about 115 billion barrels of oil by 1975, and even though a lot of oil remains in the ground, recoverable reserves are estimated at only about 32 billion barrels. This last figure will rise as our technical ability to get oil out of the ground improves.

In 1962, our "proved" reserves -- oil recoverable under existing economic and operating conditions -- amounted to about 12 times that year's production. In 1960, we consumed 10 million barrels of oil each day. At that rate, we used as much oil in 1960 as we used during the entire decade of the 1930s. During the decade of the 1960s, we used as much oil as we had used from 1858 to 1960. Today, proved reserves are down to only nine times annual production. Here in North Dakota, where the production of petroleum dates to 1951, the amount of crude oil produced in the state reached a maximum of about 27 million barrels in 1967, but, since then, it has declined, and by 1974, less than 20 million barrels of crude oil were produced annually. As of April 28, 1975, North Dakota had 1,920 producing oil wells. The state ranks 11th in the United States in total known petroleum reserves.

Oil exploration and drilling are high-risk activities. Out of every 100 wells drilled in search of new oil fields, only nine find any oil and gas, and only two make discoveries of commercial significance. Most of the "easy" oil (oil that is indicated by relatively clear geologic clues, is found close to the surface, and is readily produced) has been discovered. Producers must now drill deeper and deeper wells in more difficult terrain. Drilling costs multiply as the bit goes deeper into the earth.

REGIONAL ENVIRONMENTAL ASSESSMENT PROGRAM--

The Regional Environmental Assessment Program (REAP), which was established as an environmental research program by the 1975 North Dakota Legislature to collect information on the state's resources, people, and environment and make it more accessible, will require considerable input by the North Dakota Geological Survey. REAP is intended primarily as a guard against careless resource development, and especially coal development. State officials hope that a central data bank will help them to determine what areas of the state would be endangered by development.

The legislature appropriated $2 million from the general fund to get the REAP office started, and state officials expect as much as $3 million more in federal participation. The assessment program would provide state planners and lawmakers with information on potential impact and alternatives to development. The system is expected to be able to predict air and water quality changes, impacts on population, wildlife and agriculture, and new responsibilities of local and state governments. It is hoped that REAP will provide the state with enough management and environmental information for impending decisions on coal and energy development.

Dr. A. W. Johnson, dean of the University of North Dakota Graduate School, was appointed first director of the Regional Environmental Assessment Program by the North Dakota Legislative Council on May 6, 1975.

GAS - FROM - COAL PLANT PLANNED FOR NORTH DAKOTA--

According to the April 7, 1975 Oil and Gas Journal, the American Natural Gas System has asked the Federal Power Commission for permission to build a $778-million coal-gasification plant in the state. The plant would be built for the American Natural Gas Coal Gasification Company and would be in operation by late 1981. It would supply 250 million cubic feet per day of high-Btu gas to Michigan Wisconsin Pipe Line Company.

The gasification plant would require about 12 million tons of lignite coal/year. The coal mine alone would cost about 126 million dollars (based on 1974 dollars). Twelve million tons of coal is about equal to the amount of coal we had expected would be mined in all of North Dakota during 1975; although it is likely now that, in view of the strike by coal miners, production won't reach that figure this year.

ENERGY - USED AND LOST--

Fossil fuels or hydrocarbons, our most important source of energy, may be thought of as stored solar energy. Oil and natural gas have been accumulating since the beginning of Cambrian time, about 600 million years ago. Our North Dakota oil ranges in age from about 500 to 200 million years old. Coal has been forming since Carboniferous time, about 300 million years ago. North Dakota lignite was deposited about 50 million years ago.

In 1974, fossil fuels supplied 94 percent of our energy needs. Oil supplied 45.8 percent, natural gas 30.4 percent, and coal 18.0 percent. Non-fossil fuels supplied only 5.8 percent of our energy in the United States. This fraction breaks down into 4.2 percent hydroelectric power, and 1.6 percent nuclear power. Energy consumption in the U.S. fell 2.2 percent in 1974, the first decline since 1952. The decrease can be attributed to the Arab oil embargo, higher energy prices, the economic slowdown, successful conservation efforts, and a relatively mild winter. The use of gasoline was down 2.1 percent.

How was the energy used? Since petroleum supplies nearly half of our energy, it is convenient, for our present discussion, to look at each energy source in terms of its equivalent energy value relative to petroleum. In other words, a 42-gallon barrel of oil, which has a heat value of approximately 5,800,000 British thermal units (Btu), is equivalent in terms of energy value to 853 pounds of North Dakota lignite, which contains approximately 6,800 Btu per pound. Therefore, a ton of lignite has a heating value roughly equal to two barrels of oil.

For the year 1970, the U.S. consumed total energy equivalent to 29.7 million barrels of oil each day. Of this, oil itself actually supplied 13.9 million barrels per day. These 13.9 million barrels of oil were used as follows: one million for the generation of electric power; 1.5 million for residential and commercial uses; 2.5 million for industrial purposes; 1.5 million for non-energy purposes (such as in the production of chemicals); and 7.4 million for transportation.

Natural gas supplied Btu-energy equivalent to 10.7 million barrels of oil daily. Of this, 1.9 million barrels equivalent were used for the generation of electric power; 3.5 million for residential and commercial use; 4.5 million for industrial uses; 0.3 million for non-energy uses (such as in the production of fertilizer); and 0.3 million for transportation.

Coal supplied Btu-energy equivalent to 7.4 million barrels of oil daily. Of this, 3.7 million barrels equivalent were used for electric generation; 0.9 million were exported; 2.5 million were used for industrial purposes; 0.2 million for residential uses; and 0.1 for non-energy uses.

Hydroelectric power supplied energy equal to 400,000 barrels of oil daily while nuclear power amounted to 100,000 barrels of oil daily. Geothermal power supplied energy equal to 3,000 barrels of oil daily.

The total amount of fuel used for generating electricity in 1970 amounted to energy equivalent to 7.1 million barrels of oil daily. However, in the process of converting oil, gas, coal, etc., to electricity, we suffered conversion losses equivalent to 4.6 million barrels of oil daily. As a result, usable electricity equivalent to only 2.5 million barrels of oil remained to be consumed. This electricity was used as follows (again figures given in oil equivalent): 1.3 million barrels to residential and commercial users; 1.2 million barrels to industry; and 7,000 barrels to transportation.

Somewhat less energy was lost in utilizing fossil fuels for residential and commercial purposes. In all, energy equivalent to 7.5 million barrels of oil was used by residential and commercial interests, and of this only 1.9 million barrels were lost due to conversion processes.

Industry used 9.9 million barrels of oil equivalent and lost 2.4 of this in conversion processes. Fossil fuels that were used for transportation were least efficiently used. Of 7.7 million barrels of oil equivalent that went into transportation, 5.8 million barrels were wasted each day.

Our total use of oil, gas, coal, and non-fossil fuels in 1970 adds up to an oil equivalent of 31.6 million barrels daily, 11.534 billion barrels for the year. Of this, 693.5 (6.0%) million barrels were used for non-energy purposes (production of chemicals, etc.), 5.475 billion barrels (47.5%) were used as energy, and 5.365 billion barrels (46.5%) were lost forever due to conversion processes.

INTEREST IN POTASH CONTINUES--

It appears certain that potash demand will continue to exceed current production capability, prices will continue to climb, and it will be necessary to add production to meet projected demands. Total world demand for potash can be expected to grow to about 33 million tons K_2O by 1980, up 75% from the 1970 level. U.S. production will increase only slightly (see table) and most of the increased U.S. demand for potash will have to come from Canada unless we develop new production. Currently, domestic production is centered in New Mexico, but the capacity for expansion there is limited. Governmental controls in Saskatchewan, the chief Canadian potash producer, have tended to turn interest toward Williston basin potential in North Dakota.

The following table was taken from the Saskatchewan Mineral Spotlight (vol. 11, . 4) and was prepared by R. J. Heath, Manager, Economics and Development, Canpotex Ltd.

World Supply and Demand of Potash by Major Areas
(millions of short tons K_2O)

AREA	1960 Supply	1960 Demand	1970 Supply	1970 Demand	1980 Supply	1980 Demand
Canada	-		3.93		9.60	
U.S.A.	2.64		2.74		2.80	
Sub Total - North America	2.64	2.44	6.67	4.66	12.40	8.60
West Europe	4.31	3.92	5.71	5.20	7.70	7.70
East Europe	3.08	2.30	6.16	5.44	12.45	11.00
Latin America	-	.15	-	.61	-	1.75
Asia	-	.75	-	1.60	-	2.78
Oceania	-	.09	-	.19	-	.40
Africa	-	.05	-	.30	-	.50
Other	.90	-	.10	-	.40	-
TOTAL WORLD	10.93	9.70	18.64	18.00	32.95	32.73

Here in the Survey offices in Grand Forks, we are noticing that the increased interest in potash we reported in our last Newsletter has picked up in recent months. In response to the numerous inquiries, Sid Anderson, Chief of the Subsurface Section of the Survey, has drawn three new isopach (thickness) maps of the tash beds in the North Dakota portion of the Williston basin. These maps are not yet published, but they can be examined at our Grand Forks office.

SURFACE MINING VS UNDERGROUND MINING--

It may be somewhat surprising to some to learn that approximately 15 percent of the land that has been spoiled due to coal mining in North Dakota is the result of underground mining. A total of 2,253 acres of land have subsided over what were once underground mines. It should be pointed out to those who advocate underground mining of North Dakota's lignite as an alternative to surface mining that underground mining can spoil the land in a way that may be more permanent and dangerous than does surface mining. The soft silt, sand, and clay materials in which the lignite occurs collapse easily. Underground mining of lignite within about 200 feet of the surface will nearly always result in eventual collapse of the overlying areas.

Underground mining of the lignite requires that a substantial amount of the coal be left behind to serve as drift roofs to keep the overlying sediments from caving. As a result, the recovery of coal in an underground North Dakota mine was generally less than 50 percent (North Dakota's last underground lignite mine closed in 1970) compared with 80 or 90 percent in a modern surface mine. Productivity per worker is also much higher in surface mines than in underground mines. In North Dakota, where thick coal beds are overlain by relatively thin overburden composed of soft rocks and unconsolidated material, the productivity averaged about 76 tons per man day in 1970 (this is probably even higher today). This compared with a national underground mine productivity rate of less than 14 tons per man day.

Surface mining has several other advantages over underground mining. It is much safer for the workers. Accidents resulting from falling objects, the most common cause of injury in mining, are a greater hazard in underground mines, particularly in soft sediments that don't stand up well. Finally, the incidence of "black lung," a disabling disease caused by prolonged breathing of coal-dust-laden air, is much lower for workers in surface mines than in underground mines.

RECLAMATION OF SURFACE MINED LAND--

The two main environmental concerns associated with large-scale mining of lignite coal in western North Dakota are: (1) the damage that may result to the agricultural productivity of the mined land, and (2) possible damaging effects to the quantity and quality of groundwater supplies in and near mined areas.

Insuring a return to full agricultural productivity is, in most people's opinion, the most important consideration in determining the type and rate of coal development in North Dakota. Surface mining might, in some cases, affect the quality of groundwater because of displacement and mixing of materials during the mining operation. However, acid groundwater, a serious problem in many eastern U.S. coal areas, is not a problem in North Dakota. In many areas, the coal serves as an aquifer or otherwise plays an important role in groundwater recharge. It is possible that, without adequate precautions, the amount of water available may be curtailed as a result of mining activities. In other instances, the total dissolved solids of both surface and groundwater may be increased by leaching from spoil materials or waste-disposal facilities.

The North Dakota Public Service Commission was given jurisdiction over surface mining and reclamation by the 1969 Legislature. As amended and strengthened in 1971, 1973, and 1975, the law insures better reclamation and supervision of mining operations. The reclamation law effective July 1, 1975, requires, among other things, a mining permit; a soil survey of the mine area; a reclamation plan; a performance bond; both limited and extended mining plans, which describe such things as the amount of area to be mined, the number of tons of coal to be mined, and various other data such as geologic and soils information. The operator is required to regrade the disturbed land to approximately its original shape or to a rolling topography. He has to save, segregate, and respread a suitable plant growth material to a depth of up to five feet if it is available, in such a manner as the Public Service Commission requires. The operator has to impound, drain, or treat all runoff water so as to reduce erosion and pollution. Reclamation is carried out according to the plan approved by the Public Service Commission and has to be accomplished in three years. If the reclamation is unsatisfactory, the reclamation may be extended from year to year for a period of five years.

It will be the duty of the North Dakota Geological Survey to function as a regulatory agency for the Public Service Commission to insure that the surface mining statutes are properly carried out. We already act in such a capacity in administering the State's oil and gas laws for the Public Service Commission.

The most recent law requires a substantial per-acre bond to insure that reclamation is carried out properly. Baukol-Noonan, Inc., of Minot has testified that they have spent as much as $1,300 to $1,500 per acre on reclamation in the Center, North Dakota area, and still they are not satisfied with the results. According to Thomas Gwynn, geologist formerly with Montana Dakota Utilities and Knife River Coal Company, reclamation costs $600 per acre for leveling and re-establishing vegetation and another $400 per acre for each foot of topsoil saved and replaced.

The National Academy of Science, in 1973, stated that areas receiving ten inches or more annual rainfall can usually be rehabilitated if landscapes are properly shaped and if techniques demonstrated successful in disturbed rangeland have been applied. Results of tests on overburden material left as "spoils" on surfaces after surface mining in some North Dakota areas show that the chemical and physical properties of these materials provide a poor environment for plant growth. Treatments showing promise for reclamation include fertilization in combination with the use of topsoil vegetative (straw) mulches and possibly gypsum as a calcium amendment. Means must also be developed for reducing the texture, sodic, and fertility limitations before appreciable growth and survival of desirable perennial plants can be obtained under the semi-arid climate of the northern plains. Adequate, long-term data on the reclamation of surface-mined land in a semi-arid climate has not been available in the past. There is a consensus of opinion among many experts, however, that no land has yet been adequately reclaimed in North Dakota.

A comparison of unmined areas with spoil banks that have naturally revegetated since the areas were mined over fifty years ago shows that the diversity of plants is considerably higher at the unmined sites. Mined sites, including even the oldest spoil banks, have sparser vegetation and a reduced growth form and vigor of plant species. Although salinity due to sodium is a serious problem in the revegetation and reclamation of spoil materials, high magnesium levels may be an added problem. Soil manipulation and treatment of spoil areas should be based on the regional characteristics of species diversity and abundance, influence of climate and the peculiarities of the local soil-plant-animal interrelationships rather than on uniformly legislated requirements.

Working through the Mined Land Planning Group, a group of scientists appointed by Governor Link, the North Dakota Geological Survey and North Dakota Agricultural Experiment Station have begun research to develop the techniques required to arrive at realistic reclamation goals. These studies, which have been funded by the Old West Regional Commission, have had the support and active cooperation of a number of mining companies and potential coal developers, especially the North American Coal Corp. and the Natural Gas Pipeline Company of America.

Three subprojects of the overall study are being conducted by the North Dakota Agricultural Experiment Station. These studies are related to revegetation, root-zone hydrology, and the characterization of overburden characteristics. The fourth subproject is being conducted by the North Dakota Geological Survey and is directed at developing techniques to determine the detailed stratigraphy of overburden and utilization of the data in planning reclamation procedures. Survey personnel involved in the project are Stephen Moran and Gerald Groenewold, assisted by Leroy Hemish and Curtis Anderson of the Department of Geology at the University of North Dakota. The Survey study is also designed to examine techniques for monitoring groundwater conditions for regulatory purposes.

One principle that has emerged early in these studies is that each mining area must be considered individually. Legislation and regulations may define a set of general guidelines within which each site can be evaluated, but because of the variability among areas in such things as geology, climate, soils, and hydrology, it is not possible to devise detailed regulations that will apply to reclamation everywhere in the State.

SOME OF THE LEGAL ASPECTS OF MINERAL VS LAND RIGHTS--

One of the basic problems involved in coal leasing is ownership of the coal rights versus ownership of the surface rights. In a majority of the situations, the surface ownership is different from the coal ownership. Federal agencies own and control over two million acres in North Dakota. Over one million acres are under management of the Forest Service. Another half million acres are owned by the Corps of Engineers and about a quarter million acres by the Bureau of Sport Fisheries and Wildlife. Native American Indians own about 900,000 acres, while state school lands amount to about 75,000 acres.

According to the Bureau of Land Management, the federal government owns approximately a quarter of all the coal rights in the state of North Dakota. Under existing law, 37½ percent of the resources received by the federal government are returned to the state, mainly for education; 52½ percent goes to the Bureau of Reclamation for reclamation projects; the remaining 10 percent goes into the Treasury. The surface owners who have bought these federal lands own none of the mineral rights; the federal government has retained 100 percent ownership of the coal and other mineral rights.

The Federal Land Bank owns 50 percent of the mineral rights on two million acres. Many of these acres were acquired during the 1930s when large numbers of farmers lost their farms to foreclosures. The Bank felt it necessary to retain these 50 percent rights to help recoup losses incurred on the foreclosures and subsequent resale. These sales were approved by local boards of directors who are also farmers in the area. All the federal monies have since been repaid and the Federal Land Bank is now a private operation with agriculture as its business. The Federal Land Bank has assets of about one billion dollars. The farmer is not advised when the Land Bank leases their 50 percent share to a mining company. The Land Bank operates under a law which states that the mineral rights owner has "dominant estate" and surface rights owner has the "inferior estate."

A lease is both a contract and a conveyance in which the mineral owner (lessor) and the mineral developer (lessee) enter into contractual rights and duties. It includes the right to use the land surface for mining purposes, and it conveys full ownership of the specified minerals that are removed from the land.

The whole topic of coal leasing in North Dakota is complex and with few legal precedents. Coal leases are written between the owner of the mineral rights (lessor) and coal and oil companies (lessee) and do not require any previous approval or notification of the surface owner. The lessor is generally granted a royalty on each ton of saleable coal. The lessee is under no obligation to remove all the coal, only that which is saleable, even though all the coal is subject to the lease. Three forms of compensation are usually involved in a mineral lease: rent for use of the land surface, royalties for minerals produced, and payment for damages to crops, buildings, wells, and roads. Compensation clauses should be included in the lease to assure that all are paid for. Compensation can consist of goods, money or services performed. In most cases, where there is a ten cents a ton royalty, eight cents goes to the mineral owners and two cents goes to the surface owner. Usually, the federal government receives seventeen and one half cents a ton under its leases, the state receives fifteen cents a ton. Individuals have signed leases for royalty payments ranging from eight, ten, or twelve cents a ton. Mineral leases should be recorded in the office of the register of deeds in the county where the land is located, although law does not require it.

According to Robert Beck, UND Law School Professor, unless the surface owner controls all the mineral rights, he cannot prohibit mining or leasing. Court cases from other states suggest that the most likely controversy to arise between the mineral owner and the surface owner will probably concern the amount of land surface that the mineral owner can use in developing the minerals.

These are some of the phrases used in coal leases and their definitions:

Surface lease: a mining lease taken from the surface owner who has no coal ownership.

Coal lease: a mining lease taken from a coal owner either with or without surface ownership.

Bonus: a sum of money paid to the lessor to induce him to sign the lease.

Royalty: the money paid to the lessor for each unit of coal production. This is usually expressed as cents per ton, but it can be figured in terms of a percentage of the market price per ton.

Advance royalty: any sum paid to the lessor prior to the actual mining, which is recoupable by the lessee out of the royalty paid to the lessor at the time when mining occurs.

Rental: an amount of money usually paid in annual installments. It is paid to the lessor by the lessee to delay mining for a time. Rental is generally $1.00 an acre.

Many people who sign lease contracts do not realize that rental and bonus monies are sometimes considered advance royalty and may be deducted from any royalty that becomes due when mining takes place. Leases should include: (1) The name of the parties, (2) The price paid or to be paid as rents or royalties, (3) The time and manner of payment, (4) A description of the land being leased, and (5) The length of time covered by the lease.

THE METRIC SYSTEM IS COMING!--

Nobody seems to be certain just when it will happen, but most people agree that the arrival of the metric system in the United States cannot be stopped. Here in Grand Forks, we are reminded of it daily as we listen to the Winnipeg radio stations where temperatures are given in degrees Celsius. ("It should get up to 16 degrees today, real shirt-sleeve weather," the man says, and we stop short.) Youngsters are being acquainted with metric measurement in their schoolwork, because educators know that students will be living in a metric world. The United States is the only major industrial nation not yet committed to the metric system.

The plodding foot (32 cm) steps of the metric system can be heard approaching, and it seems to us that it might be helpful to familiarize our readers with some aspects of the system. The metric system isn't really new. The French devised it in 1790, largely for scientific purposes. The system is based on the meter, which was originally defined as one ten-millionth part of the distance from one of the earth's poles to the equator. More recent measurements have amended this, and the meter is today defined as the distance between two lines on a platinum-iridium bar kept at the International Bureau of Weights and Measures near Paris. It is equal to 1,650,753.73 wavelengths of the orange-red light of excited krypton of mass number 86. Since it was devised, scientists at work in their labs and in the field have used the metric system every day. But nonscientists have also used the metric system extensively. Here are a few examples:

Perhaps the most popular film size is 35 millimeters. Most movie film is 8 or 16 millimeters.
Drugs are prescribed in milliliters and milligrams.
Skis are measured in centimeters and many swimming pools are measured in meters, as are the heights of most diving boards.
Money is based on 10, just as in the metric system.
Many imported cars and bicycles require metric tools.

Of course, much that we consider American was inherited from England, and that includes our present system of weights and measures. England borrowed the base of 12 (12 inches per foot) from the Romans, and the Colonies continued to use English "refinements." For example, the yard goes back to early Saxon kings and refers to a sash or girdle worn about their waists. The word "yard" comes from the Saxon word for "gird" or "waist." King Henry I standardized the yard by proclaiming that it was the distance from the tip of his nose to the end of his thumb, with his arm extended at his side. Queen Elizabeth I declared that a mile was 5,280 feet.

Here are some general "definitions" to help you put metric measurement into perspective:

Meter--a little longer than a yard.
Liter--a little more than a quart.
Gram--about the weight of a paper clip.

Our changeover to the metric system should be made bearable through a gradual introduction of the system and a changeover time expected to span a decade. During the adjustment period, the new and old measures may be used side by side, although there is disagreement whether this is the best way to make the change; some people think a total change may be more effective. When the changeover is complete, however, it shouldn't startle any of us to hear such statements as:

"Give him a centimeter and he'll take a kilometer."
"The Vikings went for it on fourth down with two meters to go."
"Save Energy - Set Your Thermostat at 20 degrees."
"We don't turn on the air conditioner until the temperature reaches 25 degrees."
"I'm going to keep it down to 90 from now on, because I can't seem to get better than about 5 kilometers to the liter."

Personally, I like the metric system. We may have to retain parts of our present land measurement system, because we can't redo our township-section-line roads with kilometer-line, or every-other-kilometer-line roads or anything like that.

Another purely personal thought: why change the name of the Centigrade temperature system to Celsius? Naming a temperature scale after Gabriel Fahrenheit wasn't very bright, and naming one after Otto Celsius is just as bad. On the other hand, calling it Centigrade reminds us that this thermometric scale is based on one hundred equal parts between freezing and boiling.

The conversion table that follows may help us to visualize the metric system a little better.

METRIC - ENGLISH CONVERSIONS

Metric	U.S. Equivalent
Length	
1 millimeter	0.0394 inches
1 centimeter	0.3937 inches
1 meter	39.37 inches
1 meter	3.2803 feet
1 meter	1.0936 yards
1 kilometer	0.6214 miles
25.4 millimeters	1 inch
2.54 centimeters	1 inch
0.3048 meters	1 foot
0.9144 meters	1 yard
1.6093 kilometers	1 mile
Area	
1 sq. centimeter	0.1550 sq. inches
1 centare (1 sq. meter)	1,550 sq. inches
1 centare	10.7639 sq. feet
1 centare	1.1960 sq. yards
1 are (100 sq. meters)	119.5990 sq. yards
1 hectare (10,000 sq. meters)	2.4710 acres
6.4516 sq. centimeters	1 sq. inch
0.0929 sq. meters	1 sq. foot
0.8361 sq. meters	1 sq. yard
0.4047 hectares	1 acre
259.0045 hectares	1 section (1 sq. mile)
Mass - Weight	
1 milligram	0.0154 grains
1 gram	0.0022 pounds
1 gram	0.0353 ounces
1 kilogram (1000 grams)	2.2046 pounds
1 metric ton (1 million grams)	2204.6226 pounds
0.0283 kilograms	1 ounce
28.3495 grams	1 ounce
453.5924 grams	1 pound
0.4536 kilogram	1 pound
907.1847 kilograms	1 U.S. ton

(Conversion Table continued)

Metric	U.S. Equivalent		
Capacity	Cubic	dry	liquid
1 decaliter (10 liters)	0.35 cu. ft.	1.14 peck	2.6417 gallons
1 liter	61.02 cu. in.	0.908 qt.	1.057 qt.
1 deciliter (0.1 liter)	6.1 cu. in.	0.18 pt.	0.21 pt.
7.646 hectoliters (0.7646 cubic meters)	1 cubic yard		
2.832 decaliters	1 cubic foot		
3.521 decaliters	1 bushel		
3.7845 liters	1 gallon		
0.9454 liters	1 quart		
16.3871 cubic centimeters	1 cubic inch		
0.0283 cubic meters	1 cubic foot		

Some Other Useful Conversions

1 Btu (British thermal unit)	252 calories
1 barrel (bbl)	42 gallons (158.9868 liters)
1 Bbl crude oil	Approx. 5,800,000 Btu
1 Kilowatt hour (Kwh)	3,412 Btu
1 cubic foot natural gas (CH_4)	1000 Btu
1 ton lignite	13,600,000 Btu
1 acre-foot of lignite	1,750 tons
1 kilowatt	0.745712 horsepower
1 acre	43,560 sq. feet

$^{o}F = 9/5\ (^{o}C) + 32$

$^{o}C = 5/9\ (^{o}F - 32)$

Names and Symbols for Metric Prefixes

Prefix	Meaning
tera (10^{12})	One trillion times
giga (10^{9})	One billion times
mega (10^{6})	One million times
kilo (10^{3})	One thousand times
hecto (10^{2})	One hundred times
deca (10)	Ten times
deci (10^{-1})	One tenth of
centi (10^{-2})	One hundredth of
milli (10^{-3})	One thousandth of
micro (10^{-6})	One millionth of
nano (10^{-9})	One billionth of
pico (10^{-12})	One trillionth of

BISMARCK CHOSEN FOR SOLAR PROJECT--

Bismarck, North Dakota, has been included in a list of a dozen U.S. cities chosen for solar heating demonstration projects. The Energy Research and Development Administration (ERDA) said that two companies, General Electric Co., and Inter-Technology Corp., will develop and recommend a demonstration plan of solar heating and cooling projects, which will integrate solar energy systems with specific types of non-residential buildings in various climatic regions of the country. The contracts are estimated at $800,000 for each company. The goal is to stimulate a marketable use of solar heating and cooling systems for residential and commercial buildings.

Of the various solar applications, heating and cooling is the one that can make the most immediate impact. Solar energy has the potential to make significant near-term and long-range contributions to the solution of our energy problems. John M. Teem, ERDA chief of solar, geothermal, and advanced energy systems, said that, if 10 percent of the new building starts in the U.S. were equipped with solar heating and cooling systems by 1985, about 30 million barrels of oil would be saved annually.

THE GEOLOGIST IN THE STATE GEOLOGICAL SURVEY--

The variation in size of State Geological Surveys is startling to some. They range from no survey at all (Hawaii) and a total staff of one half-time professor in one state, to the Illinois Geological Survey with 69 professionals and 85 technical people in full-time employment. Budgets are also quite variable, ranging in 1973 from a low of $22,000 upward to the giants of Alabama, California, Georgia, and Illinois, each of which had a total budget of over two million dollars for that year. The "average" state survey has 17.6 full-time, 2 part-time, and 3.2 temporary professionals who are supported by 12.3 full-time, 2.6 part-time, and 5.7 temporary non-professionals. Its total budget would be $832,653. (Statistics taken from an article by John W. Roid, State Geologist of Colorado, writing in The Professional Geologist, publication of the American Institute of Professional Geologists.)

Most State Geological Surveys are dynamic growing organizations. Total state survey employment rose from 689 professionals in 1969 to 862 in 1973. The North Dakota Geological Survey has grown substantially in recent years. Our Legislators have realized the need for geologic knowledge and we have been able to show that applied geology can provide meaningful solutions to land use, mineral development, and environmental conservation problems. Our staff has risen by five in the past year; we now employ 30 full-time people. However, it should be pointed out that most state geological surveys do not have duties comparable to those of the NDGS in administering the State's oil and gas laws. We regulate both drilling of oil wells and oil and gas production for the ~~Public Service Commission~~. About a third of our staff is involved with these duties.

Several professional aspects of state survey work may not be apparent to outsiders. First, all of our geologists are commonly thrust into a role of working between and with governmental decision-makers at all levels, and the geological factors which do or should have an impact on specific critical decisions and actions. Though our geologists are not allowed to consult for either industry or private individuals, they often act as consultants to governmental agencies ranging from the Governor and the legislature down to local planning commissions. Major projects are usually referred to consultants, and our geologists serve as go-betweens to evaluate and interpret the consultant's work for a governmental agency.

Most surveys strive for professional recognition for the work of their personnel, and the North Dakota Geological Survey is no exception. Necessity demands quick publication and distribution if the public is to get value for its tax money. In public geologists' work, the results must be made quickly available to the people that need it. This includes press releases and newspaper or TV coverage, as well as the more classic bulletin seen by the professional colleagues.

Educational aspects of the work are a two-way street. A geologist must keep himself up-to-date, and must continue his education with seminars, technical meetings, and extensive evening reading. Some of our geologists take formal graduate courses leading to advanced degrees. The geologists are also forced into being educators of laymen, the general public, and the politicians. If they do not understand the geology, we cannot expect these people to utilize geology properly in making intelligent decisions. Newsletters such as this one may help make a contribution to such understanding or at least point the way to what is available. We hope so.

NDGS CORE AND SAMPLE LIBRARY--

The North Dakota Geological Survey maintains a library of samples that were obtained from wells drilled throughout the state. Most of the samples, which include cuttings obtained during the drilling as well as large amounts of core material, were taken from exploratory oil wells, although cuttings from water wells are also stored in the library. All the materials in the core library are available for anyone who wants to work with them.

The core library is a metal building located several blocks east of the Survey offices. It measures 80 x 120 feet. The list that follows is a partial inventory of materials stored in the core library. It was compiled in 1973 and does not reflect substantial amounts of samples that have been added since then.

Cuttings from exploratory oil wells	10,626 boxes
Cuttings from water wells	3,067 boxes
Core samples	39,181 boxes
Duplicate samples	3,470 boxes
Missile site samples	930 jars

In addition, the core library is used as a storage area for six of the Survey's vehicles, a trailer, and a drilling rig.

NEW PUBLICATIONS--

The North Dakota Geological Survey has recently published several new items, including three bulletins in the county groundwater studies series. These include a report on the geology of Benson and Pierce Counties by C. G. Carlson and T. F. Freers, a report on the geology of Cavalier and Pembina Counties by B. M. Arndt, and a report on the geology of Griggs and Steele Counties by J. P. Bluemle. All three of these reports are available from the Survey offices in Grand Forks.

Three new maps that were in press when the December, 1974, Newsletter was published are now available. These maps, which were described in the December Newsletter, show the surface geology, bedrock geology, and relief of North Dakota. Each map measures approximately 6 x 10 inches.

One new publication in our Educational Series is nearly ready. It is a description f the natural science of the western North Dakota prairie and includes information on the geology, vegetation, animal life and climate of the area. Entitled "The Prairie - Land and Life," the publication was prepared in cooperation with the National Forest Service in Dickinson, North Dakota, and it will be printed by the Forest Service. Another publication in the Educational Series that should be ready soon is the "Guide to the Geology of Northwest North Dakota."

Our new, updated list of publications is now available.

We have completed a new color slide program accompanied by a commentary. This program is entitled "The Story of Lignite in North Dakota" and includes a discussion of the origin of lignite as well as some of the problems involved in reclaiming land after mining. Two of our slide programs are no longer available. They are: "Reclamation of Mined Lands" and "The Story of Energy." We are, however, preparing a slide program dealing with energy and another dealing with the conservation of energy.

SURVEY NEWS--

The most important change that has occurred here in recent months involves the move of our coal geologist, John Ferguson, from Grand Forks to our Bismarck office, where he joins Wes Norton and Ken Kallestad. Most of the lignite action is centered in the Bismarck area, and it was necessary to have John there to answer the numerous inquiries we handle daily.

Mike Arndt, Gerry Groenewold, and Stephen Moran of the Survey staff jointly presented several papers to the North Dakota Academy of Science in Valley City on April 26. The talks elaborated on the efforts of these men at using applied geology to help improve reclamation procedures of surface-mined lands.

Our new wall-sized (9' x 15') map of North Dakota is nearing completion. When finished, the ½-inch to a mile map will show the location of every oil well in the state as well as all non-producing exploratory wells, crude and finished products pipelines, coal fields, and other vital information. Sid Anderson and Karol Knudson spend some time each week locating wells on the map, and that's a time-consuming task with over 5000 wells that need to be shown. If you happen to be near the Survey office, be sure to stop by and see the map.