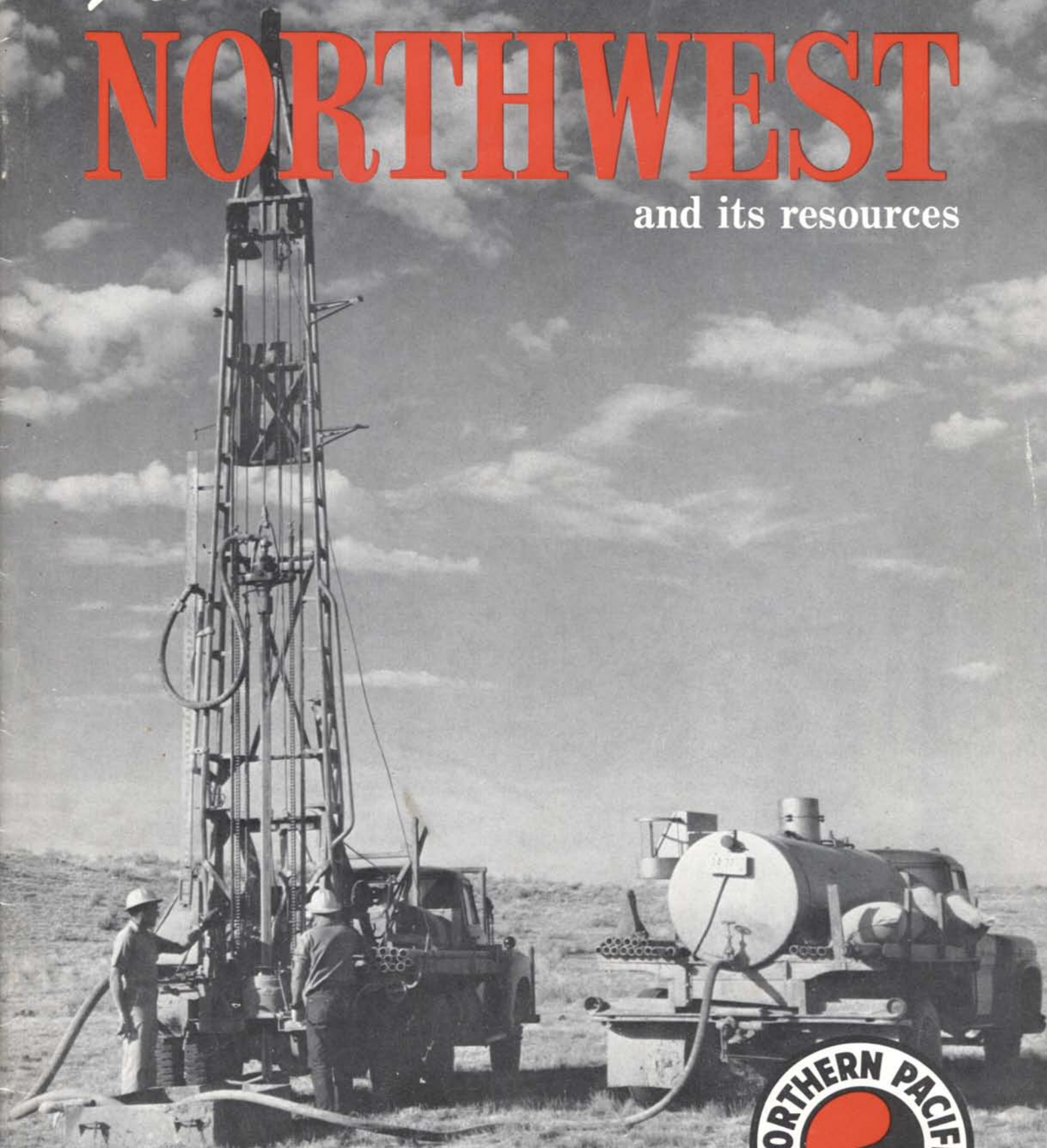


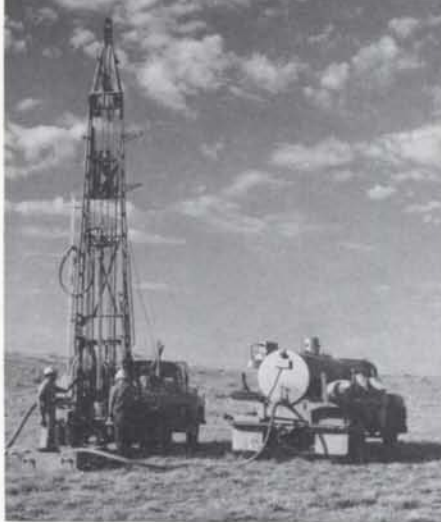
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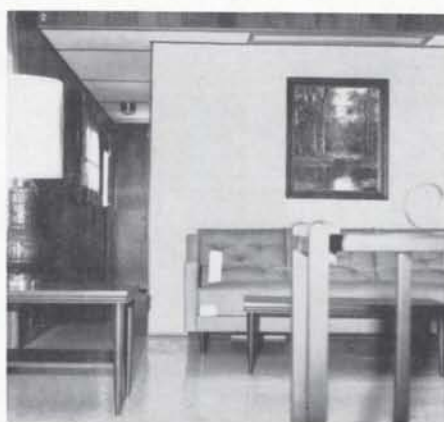
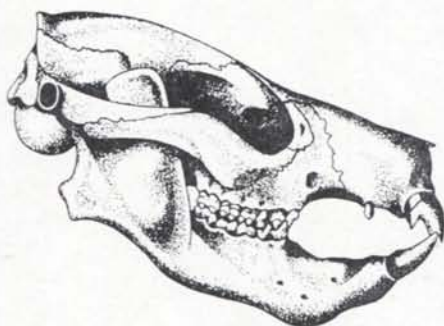
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MARCH-APRIL, 1967

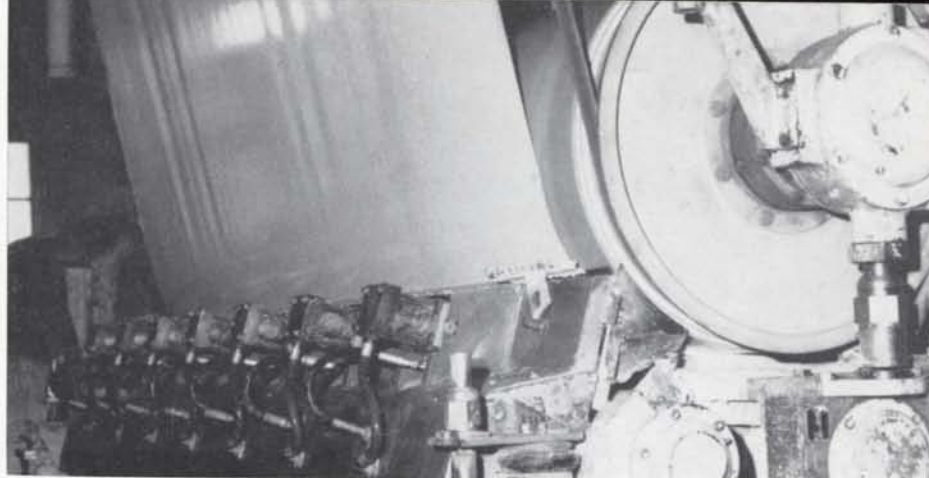


Expert drillers, under contract to the Northern Pacific, drill for coal in Pumpkin Creek lignite field of southeastern Montana. While surveying field in 1965 an NP mining engineer and a geologist found what has been called 'the best fossil discovery in North America in the past 20 years.' Remains of 29 animals included tooth parts of *Plesiadapus dubius*, whose skull is illustrated below. P. 3



Homes that follow their owners, P. 8

Blackduck fells pulpwood record, P. 10



Here's where the Northwest Paper Company brings an ancient art up to date, P. 13



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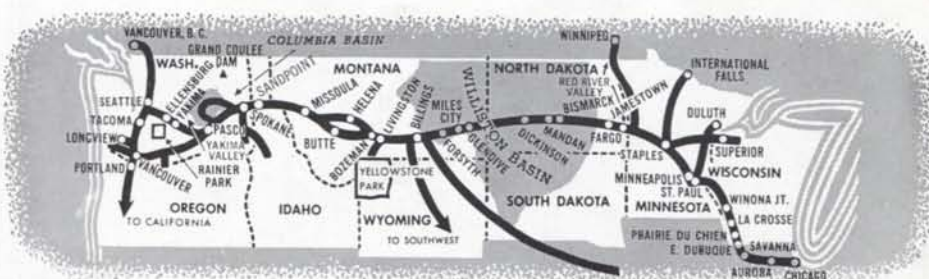
NORTHERN PACIFIC RAILWAY COMPANY

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Carmichael displays vertebra of 10-foot champsosaur at fossil discovery site.

NP geologists map coal, score vital fossil find

Animal bones lying about the countryside are not a particularly uncommon sight in southeastern Montana. Skeletal remains of cattle, sheep, deer and even old bison are relatively abundant thereabouts. Yet, when part-time geologist-full-time teacher Eugene Tuma kicked up a large vertebra one summer day in 1965 near Olive, Mont., it was a rare enough find to make him forget his survey work and call out excitedly to his boss, Northern Pacific mining engineer Virgil Carmichael.

Leaving his transit for the moment, Carmichael joined Tuma, only to become infected with the same excitement. After a hasty examination of the oddity, both agreed that it bore two characteristics which marked it as a fossil: it was remarkably heavy for its size, and it was discolored to a shiny, dark brown. They concluded further that the bone probably came from some kind of reptile. Tuma guessed that it might be from the spine of a crocodile-like animal called a *Champsosaurus*. If so, the

bone had to be more than 50 million years old.

With these tentative conclusions, the two geologists proceeded in the manner of all geologists who become suddenly aware that they are on the threshold of discovery. They set out to find the source of this solitary bone. For fossils are a form of buried treasure, not readily found on the surface. They reasoned, therefore, that their vertebra had washed down from higher ground, likely from a site overlain by even more earth. In short, they looked for a hill, of which there

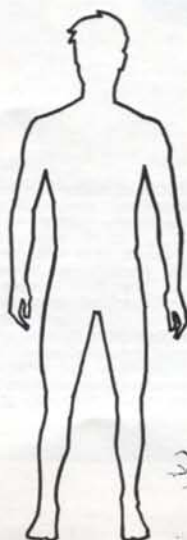
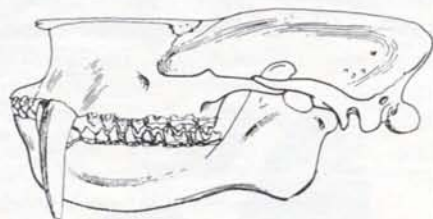
were only two within the perimeter of their search.

As the hunt progressed, more vertebrae were found, as well as some pieces of turtle shell. These turned up with increasing frequency until the men stumbled upon the outcrop itself about two-thirds of the way up the side of a small promontory. It lay some 100 feet from where the vertebra had come to rest.

There could be no doubt that they had found the source. Spread over the hill's apron were countless snail shells, an almost sure sign of a fossil cache. On hands and knees, then, their faces only inches from the ground, they found more vertebrae and turtle shell, fish scales, teeth from an astonishing variety of animals and other bone fragments which they could not identify.

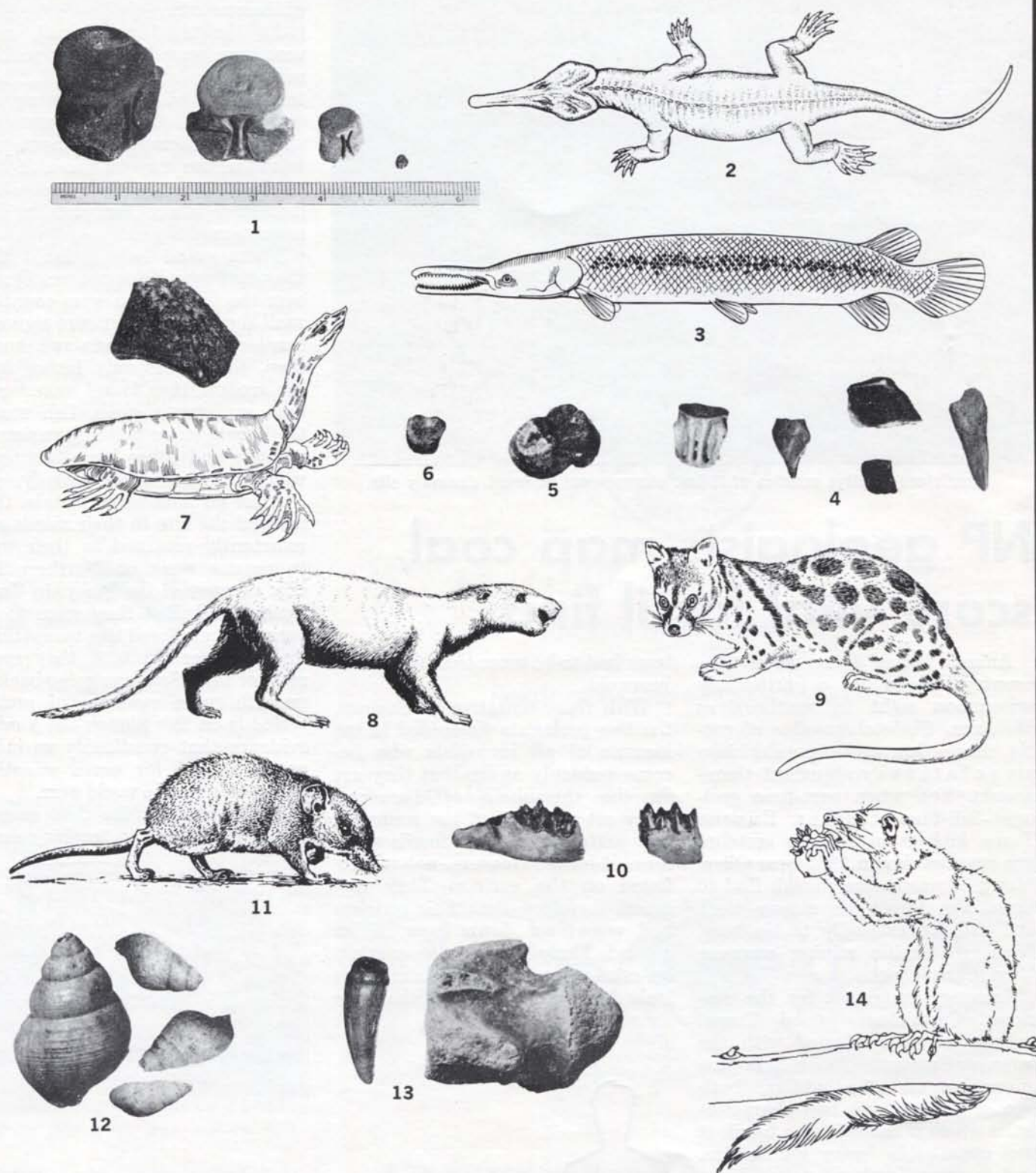
After an hour or so of this, they marked the site in their minds and reluctantly returned to their tools to resume work on Northern Pacific's survey of the Pumpkin Creek lignite field. But they were to return to their fossil dig many times that summer. In fact, they spent most of their Sundays going back to unearth more evidence of prehistoric life on this planet, the kind of evidence that constitutes an indispensable tool for earth scientists and geologists the world over.

At the end of the field season, Tuma went back to teaching earth



Outline of man indicates size of *Titanoides primaevus*, an herbivorous mammal of the extinct order Pantodonta. It was the largest of Olive fauna.





Fossils and reconstructions of Olive fauna: 1. Vertebrae of 2. *Champsosaurus* n. sp. (new species). 3. Species of *Lepidostens*, an alligator garfish. 4. *Lepidostens* vertebra and scales. 5. Molar from 'Anacodon' n. sp., a lumbering bear-sized mammal. 6. Small molar of *Thryptacodon antiquus*, an archaic hooved ungulate. 7. Shell fragment and sketch of species of *Aspideretes*, a soft-shelled turtle. 8. *Neoplagiaulax* n. sp., a multituberculate (so named for its tooth structure), longest lived mammals in earth history in surviving about 110 million years. 9. *Protictus* cf. *haydenianus*, very close to being a civet. 10. Teeth in jaw fragment of *Paleosinopa* n. sp., an insectivore. 11. *Entomolestes siegfriedti*, a very little hedgehog. 12. Clockwise from largest: *Campeloma nebrascensis*, *Campeloma edmontonensis*, *Lioplacodes nebrascensis* and *Lioplacodes linnaeformis*, all snails. 13. Tooth and vertebra of a species of *Crocodylus*, a direct

ancestor of today's crocodiles. 14. The half-ape *Plesiadapis dubius*, a pro-simian, squirrel-like primate or lemur ancestral to rodents. Approximate sizes of above: 4-6 and 10-13—X1 (life-size); 8—X1½; 3, 9 and 14—X1¼. Also found at Olive locality but not shown here were remains of a species of *Lamna*, a shark; *Ectopodus powelli* and *Mesodma silberlingi*, both multituberculates similar to No. 8; a species of *Kindleia*, a bowfin (fresh-water dogfish); an unidentified large salamander; an indeterminate pond turtle; an alligator; *Carpolestes nigridens*, *Carpolestes aquilae* and *Phenacolemur jepseni*, all half-apes or lemurs; *Haplaletes* cf. *diminutivus*, a hooved mammal about the size of a squirrel; an unidentified Teleost, another fish, and a third insectivore, similar to Nos. 10 and 11, cf. *Protentomodon ursirivalis*. (Sketch of No. 14 after Simons; No. 11 photo from *Traite de Zoologie*; No. 8 by W.F.N., 1965.)

sciences at Forsyth, Mont., high school (he's one of only six men who are qualified to teach earth sciences in Montana high schools). Carmichael headed back to his St. Paul office to complete the work of correlating coal beds and preparing maps of the lignite field. But he took along a collection of fossil specimens, including a few he felt would prove to be those of primitive mammals. So one of the first things he did was place the discoveries in the hands of Dr. Robert E. Sloan, associate professor of geology and geophysics at the University of Minnesota.

Early in 1966, Professor Sloan made a preliminary report to the mining engineer: "Here is the faunal list for the fossil locality you and Mr. Tuma discovered and which we plan to call 'Olive locality and fauna' in print. (Faunas are named for places; this one is best named for Olive, since the name hasn't been used before, and Olive is the closest geographical feature found on common road maps.)

"The age of the Olive fauna is either latest Paleocene (Clarkforkian) or earliest Eocene (Graybullian). The absence of Perissodactyls (horses and tapirs) which are the most common elements of the early Eocene fossil faunas, suggests that it is of Paleocene age, as does its stratigraphic placement. A few more teeth should decide it one way or the other."

Sloan's list was made up of the Latin names for class, order, family and species, where known, of a shark; a bowfin (freshwater dogfish); alligator garfish; an unidentified large salamander; two turtles, and a crocodile, plus the *Champsosaurus*, which represents discovery of a completely new species, one that grew twice as long as the average of all previously discovered champsosaurs. The list also identified some of the bones as those of a multituberculate, an insectivore and two condylarths. Thus, Carmichael's hunch that he had found fossils of some of the earliest mammals was correct.

Last summer he was back in the field again, this time to survey, map and drill the Foster Creek lignite field. He hired a new assistant, Loren Williams, who since has joined NP's staff of geologists on a fulltime basis (Williams is another



Dr. R. E. Sloan examines Olive fauna with binocular microscope in his laboratory.

of the few qualified to teach the earth sciences in Montana). Having in mind Professor Sloan's statement that a few more teeth might enable him to pin down the age in which these fossils were deposited, Carmichael decided to send back some of the soil from the dig. In this way, even microfossils could be found. Late in September, then, he and Williams shoveled about 600 pounds into cartons and expressed it to Minneapolis.

At the university, Sloan and several of his graduate assistants ran this material through a process designed to recover specimens which can't be seen with the unaided eye. This involved placing the soil in window screen boxes and sieving it under water to get rid of sand and clay. The remainder—shells, bone fragments, teeth, siderite chips, etc.—was then placed in a tank of 10 per cent formic acid solution for etching.

After a week of this there was left a residue of coarse grit finer than 1/4-inch. This was carefully spread out one grain deep and gone over with a magnifying glass, then with a binocular microscope that magnified everything 15 times. In this fashion, 53 tiny teeth and tooth fragments were recovered. Then Sloan and his people had to sit down to the time-consuming task of finding out what these were.

In this instance, the results were even more startling than in the first

study. Sloan found no fewer than three brand new animals. Furthermore, the teeth did, indeed, enable him to establish that the stratum in which they were found was laid down early in the Cenozoic era, during the last quarter of the Paleocene epoch. This places the dig in the very lowest segment of the Sentinel Butte Member of the Fort Union Formation.

As to a specific point in time, Sloan said the fossils are roughly 61 million years old, give or take one or two million years. This age he derives from potassium argon dates determined for volcanic ash beds found at four different localities in Edmonton, Alberta; Montana, and Colorado, all associated with animals identical with or similar to those from the Olive locality.

These findings contribute much to geologic study in this country. "For instance," Sloan said, "this means there has not been much erosion of the Fort Union Formation at this place; at most there was 200 to 300 feet above the fossils. (The Fort Union spreads over much of the West, but chiefly over the western Dakotas, most of eastern Montana and parts of Wyoming and Alberta. It averages about 1,200 feet thick, and it's the prime source of North Dakota and Montana coals.) The Olive fossils also tell us a certain amount . . . about the correlation of these coal beds."

Until recently, the Fort Union in



Rugged Montana badlands demanded use of four-wheel-drive Jeep and bravery.

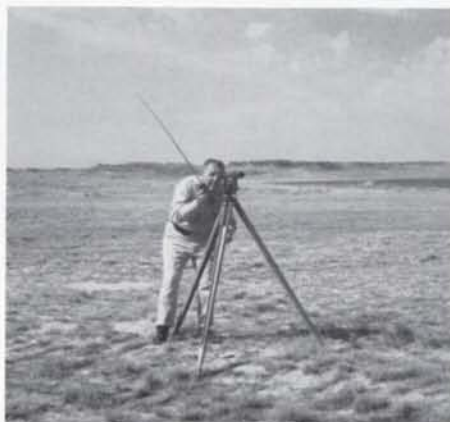
this general area has yielded abundant plant fossils, but almost no vertebrate remains. Farther west, fossils from a startling array of small, primitive mammals are found in it. Clarkforkian deposits are not especially fossiliferous; in fact, the Clarkfork fauna is known from a total of only 50 specimens. Thus, the Olive locality is a "real find."

Do the remains of any other creatures lie hidden in that Montana hill? In the next few years we'll know. Professor Sloan is planning an expedition to the locality himself. Every ounce of soil in the Tuma-Carmichael fossil dig will be sifted for additional evidence. Only then will the professor and the world he represents be satisfied that they have learned all they can from the Olive locality.

Some localities have come to light in the same manner as this one. "But certainly not all of them," Sloan said. "Very often we find our localities by learning from ranchers about an occurrence of freshwater clam and snail shells.

"When we go into an area, we want everybody to know what we're doing there. Frequently I'll appear before groups of local residents to explain our presence. In the course of my discussion I'll ask if anybody has seen shells in the area, and quite often someone in the audience can lead us to an important discovery. You see, those shells usually are a clue to something hidden deeper in the earth. In other words, no matter what the source of information, we'll follow it up."

In effect, this same situation obtained at the Olive locality. When Carmichael and Tuma arrived on the scene, snail shells were everywhere in evidence, far outnumbering the other fossils. However, if it hadn't been for the wandering ver-



Carmichael radios instructions to his rodman several hundreds yards away.



Loren Williams uses aneroid at top of a coal outcrop, which can be seen beyond.

tebra, it is doubtful that the discovery would have been made until a hunter or a rancher or even a coal miner had chanced upon the more obvious shells.

Part II

A coal miner in southeastern Montana? Why not? Off and on, coal has been mined on a small scale in this vicinity for more than 50 years. Northern Pacific geologists have been making sorties into the general area since before the turn of the century. But the expeditions led by Carmichael into the Colstrip

area in 1964, the Pumpkin Creek territory in 1965 and the Foster Creek field last year have yielded the most complete information on these coal reserves to date.

These last mentioned studies have taken a combined three years to complete, and they have led to the location, measurement and mapping of 3.8 billion tons of strip-pable lignite; that is, coal that can be recovered relatively easily by strip mining. It was done through a masterful combining of history and modern geological exploration.

"... along the east and south side of the river there is no road of any description, and travel this way is almost impossible except on foot or on horseback."

Thus wrote NP geologist V. A. Gilles in March, 1924, following an outcrop-survey of lignite in western North Dakota. His reports of field expeditions in 1923, '24 and '25, along with those of eastern Montana surveys by other NP geologists in 1916 and 1928, were required reading for Carmichael before he followed in their footsteps.

After studying these maps and reports, he selected the areas to be covered by modern methods. Then NP's land agent at Miles City, Mont., Herman Leibinger, assisted by going to the Custer County court house to obtain a complete list of land surface owners in these areas. (In some cases, the railway company had sold the land but retained rights to the coal beneath the surface.) With the list in hand, Carmichael wrote to each property owner to inform them of the survey and of a personal visit that would be paid them by the engineer.

"These visits serve a twofold purpose," Carmichael said. "First of all, it's the courteous thing to do. After all, running a level net and drilling a few holes doesn't disturb the property in any way, but it's easier to make this clear in a personal confrontation. Secondly, visiting 50 farm and ranch homes spread over a vast area gives us an opportunity to make what I like to call a preliminary survey of the terrain we'll be covering when we get down to business. At this time we can make note, for example, of any US Geological Survey bench marks that may have been established and which we can use later.

The level net he refers to is a

system of establishing accurate bench marks as a record of the elevation above sea level at numerous points. A net always starts from an established bench mark or known elevation and encompasses a number of others to control the accuracy of those being established. Ultimately, the countryside is blanketed with them, scarcely more than a half mile apart.

"We go in with surveying aneroids—barometers, you'd call them. These are used to measure changes in air pressure, which varies with the elevation between given points. Starting at a bench mark, we set the current air pressure reading on three aneroids. One is left at that station, and one goes with each of two survey crews. The man who stays at the bench mark notes any changes in pressure during the day and relays these to the field men by radio so their aneroid readings may be adjusted later to reflect the changes."

In the Foster Creek field alone 227 bench marks were established in this manner. From each of these stations, many other elevations were established by using the level net for control. Such elevations are an aid to determining topography and interpreting the geology of the area. Readings are noted in log books and on another modern geological tool, aerial photographs.

Northern Pacific uses photos purchased from the Agricultural Stabilization and Conservation Service. If there are gaps in the ASCS files, photos are taken by NP's pilot-photographer, Harry Tutmark. A distinctive feature of these photos is that they are taken in a blanket-series of matched, stereo pairs. When viewed with special glasses, each pair provides a 3-D display of the terrain. They are used before a field trip to make a base map and again at the end as the basis for plane table maps.

After the surveying and preliminary mapping have been completed, drill hole sites are selected and drilling is begun. This has been done under a contract with Ray Mohl, of Beulah, N.D., who has more than 20 years of experience in drilling coal fields. Drilling reveals depth of ground cover and the thickness of coal seams beneath it. Too, every third or fourth drill core



Carmichael cites drilling progress for E. E. Thurlow, NP's Manager of Mineral Development and Eastern Lands.

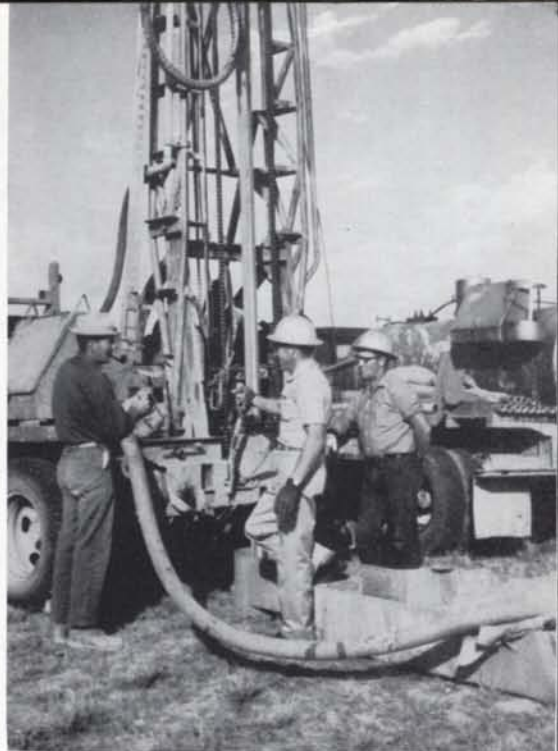
is pulled, broken into manageable sections, wrapped in plastic to preserve its moisture content, then placed in boxes in the same order in which it came from the ground. This represents a ready exhibit of seam thickness and affords an opportunity to analyze the coal to learn its constituents, such as moisture, sulphur, carbon, etc.

Northern Pacific sends its cores to the US Bureau of Mines office at Grand Forks, N. D. There the cores are sawed in half, lengthwise, with half being returned to the NP where it is placed on file for future reference. The other half is sent to the Bureau's laboratory at Pittsburgh for analysis. Here is a typical analysis, that of the core taken from No. 9 hole in the Sawyer Bed of the Pumpkin Creek field:

Length of core	..32.5 feet
Moisture	31.13 per cent
Volatile matter	..28.48 per cent
Fixed carbon	..33.58 per cent
Ash	6.81 per cent
Sulphur	0.30 per cent

All drill holes are located on the aerial photos in the field, then transferred to the map as a means of developing cover limit lines. These then show the ratio of coal to cover and furnish a means of determining whether the underlying coal can be mined economically. Cover limit lines are drawn like the more familiar contour lines but connect points of equal depth with an interval of, say, 50 feet between lines. In other words, one line will show 50 feet of cover, another 100, the next 150 feet, etc.

Today, lignite is being used more and more each year for electric



Williams discusses drilling log data with Ray Mohl and partner, Julius Benz.



Section of lignite drill core is shown with plastic-wrapped segments in box.

power generation. However, scientists are also looking ahead to a day when these vast reserves will be utilized in gasification and to produce other forms of energy. So confident are the coal and oil producers of a great future for lignite that all of the coal lands mentioned above are already under lease.

As March, 1967, comes to a close, the job of preparing maps from last summer's work is still underway. But as soon as it's done, NP's geology division will begin putting things together for another field season. It's likely, too, that not a few of the men will be wondering whether there's another fossil discovery in their future. □

They make instant houses in Minnesota's far north

"There is a magic in that little word, home; it is a mystic circle that surrounds comforts and virtues never known beyond its hallowed limits."

Poet Robert Southey (1774-1843) might well have had today's mobile homes in mind when he wrote these words, for they do, indeed, boast comforts and virtues that seem almost incredible to one who has never been in one. And there is a kind of magic about them, too, in that they make it possible to set up housekeeping anywhere on a moment's notice, or even to create a whole community of homes and people almost overnight.

"Instant housing" is the term applied to modern mobile homes by C. C. Woodard, vice president and general manager of the Minnesota division of *Detroit Mobile Homes, Inc.*, Red Lake Falls, Minn. As an example of this aspect Woodard tells of a residential area comprised of 28 mobile homes that was established at Red Lake, Ontario.

Red Lake, a village of just over a thousand souls, lies near the far western border of Canada's third largest but most populous province, some 180 miles north of International Falls, Minn. After the town had been selected as the site for a multi-million-dollar taconite plant, it became obvious that there weren't sufficient accommodations available for the many men required to build the huge complex. The contractor solved the problem through the simple expedient of bringing in the 28 mobile homes for housing and an additional 10 which, with the walls of interior units removed, were placed side-by-side to

serve as a great messhall.

What is a mobile home? As defined by the MHMA (Mobile Homes Manufacturers Association), the industry's voluntarily-supported watchdog organization, it is "a movable or portable dwelling constructed to be towed on its own chassis, connected to utilities, and designed without a permanent foundation for year-round living. It can consist of one or more units that can be telescoped when towed and expanded later for additional capacity, or of two or more units, separately towable but designed to be joined into one integral unit."

Actually, of course, this doesn't fully describe a mobile home; it merely points up the only real difference between conventional housing and the mobile kind. Taken blindfolded into one of the new *Detroit* "12-wide" units at the Red Lake Falls plant, it is doubtful that anyone other than a mobile home resident would realize immediately that he was in one. And if that home was one of the expansible kind, a man would go back outside



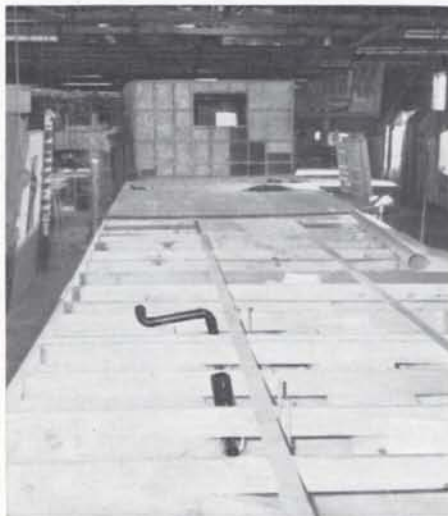
to see for himself before he could be convinced that he wasn't in a standard frame dwelling.

For methods may differ, but except for the stout steel underframe with which construction of a unit begins, little is used in a *Detroit* mobile home that won't be found in a conventional frame house. Differences are usually in quantity or degree, not in kind of material.

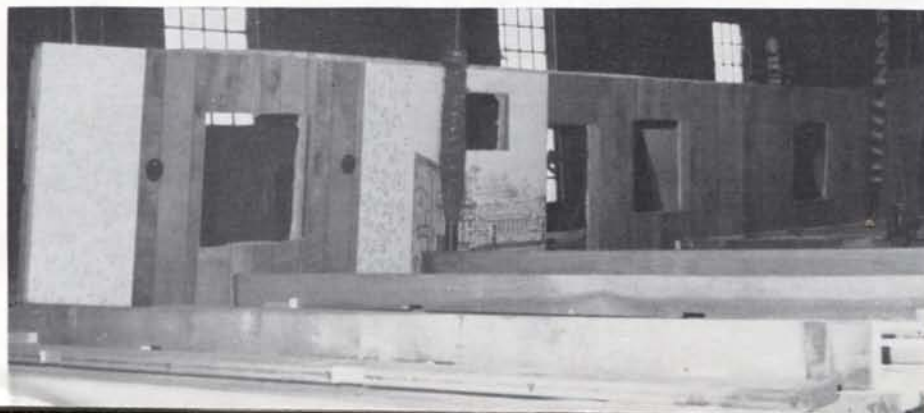
For example, joists and studding are common to both types of construction. However, while insulation in a stationary house is ordinarily confined to exterior walls and ceilings, the floors of mobile homes are completely insulated also. Furthermore, new *Detroiters* are sold fully equipped: custom-built wood cabinets, major appliances, furniture, draperies, lamps and wall-to-wall carpeting are standard equipment, all included in the purchase price, which can range from near \$3,000 to about \$12,000.

All-welded, steel-beam underframes are fabricated in a shop just across the road from *Detroit's* assembly plant. When one of them is completed it is rolled into the plant where it takes its place at the end of the straight-through-the-plant production line. If this happens early in the morning, chances are it will roll off the opposite end of the line as a finished mobile home before the day is out.

For the most part, this is made possible by the use of jigs and pre-cut dimensional lumber. At the outset, the floor is put together on a jig right beside the assembly line. After all the joists and plates have been joined, the unit is hoisted up and set down on the underframe. Then piping, ductwork, wiring and insulation are installed and the flooring is applied.



At right, floor joists, pipes and ductwork; below, wall is about to be added.





View of end wall showing thick fiberglass insulation and furring strips.

In the meantime, farther along the way, other production workers have built whole walls in jigs on both sides of the line. These have been finished right down to the interior paneling and quality wall fabrics. As the chassis is moved to the next position, all the wall sections are installed and electricians and insulation men swarm over it to progress their work.

Furnace and water heater are hooked up, and the roof is added, all in one piece. Kitchen cabinets and wardrobes, built on a separate assembly line, are moved in as complete units. Meanwhile, others are running flat, pre-finished, heavy-gauge sheet metal off rolls and into crimping machines prior to finish sheathing of the home's exterior. After the metal siding is applied, windows, lighting fixtures and floor coverings go in, then full-size appliances, furniture, draperies, pictures and lamps. The draperies, incidentally, are made by seamstresses right at the plant.

Finally, everything is tested to see that it operates properly, and

the completed mobile home is moved out to a storage lot to await shipment. At peak operation, this occurs six times each day.

When Detroitier bought out the Alma Trailer Co. of Michigan in 1961, the corporation acquired the Red Lake Falls plant as part of the deal. When production was started up early in 1962, there were 10 employees, including supervisory personnel, and daily production was limited to one unit.

"As we solved the problems inherited here," Woodard said, "we were able to add more people and double that production in 60 days. With things running more smoothly, we kept increasing staff and production until we reached maximum daily unit production of six in 1966."

Employment fluctuates between 125 and 175 according to the season now, with the peak coming during late spring, summer and early fall. The smallest unit turned out is a 10-wide, 40-footer, and sizes run from there on up to a 12-wide, 68-footer. This unit, containing 816 square feet of living space, easily equals the size of many a three-bedroom rambler dwelling. In all, the firm makes 22 different models.

Detroitier operates production and assembly plants in Albany, Ga.; Schuylkill Haven, Pa.; Alma, Mich., and Hutchinson, Kan., as well as at Red Lake Falls. Its products are distributed through an international network of franchised dealers, each of whom operates independently of Detroitier. The area served by the Red Lake Falls division encompasses Wisconsin, Minnesota, Iowa, North and South Dakota, Montana, Wyoming, the northern half of Idaho, Washington and Alaska, plus the Canadian provinces of Ontario, Manitoba, Saskatchewan, Alberta and British Columbia.

This plant has undergone drastic change, recently. A large area between the millwork and assembly shops has been enclosed; production flow has been reversed in the latter, a 50 x 475-foot-long structure; offices and sewing rooms were moved out of the production area into the new section, and a completely new forced air heating system was installed in the new mill room. This system involves an air exchange system in which wood cuttings are taken out to hoppers as



Woodard points out baseboard heating to A. O. Beilmann, NP general agent.



Detroitier kitchens feature full-sized stoves, vented hoods, wood cabinetry.



Standard furnishings include wall-to-wall carpeting, framed prints, drapes.

air is drawn out of the building.

Mobile homes are growing in popularity almost from day to day. Despite the tight money situation last year, Woodard said, the industry shipped more than 218,000 units. He said, too, that with the same economics prevailing this year, nationwide production is expected to increase only slightly, possibly to around 220,000 units.

"The potential in the instant

housing business is fabulous," he declared, "And when the Vietnam war ends, we will doubtless have a terrific boom in mobile home building."

Since the end of World War II, mobile home shipments have exceeded a total of 2.28 million units. Thus, by year's end, more than 2.5 million units will have been sold in just 21 years. Shipments in the last 12 years alone have averaged 139,000 annually. In 1965, the first year sales exceeded 200,000 units, one mobile home was manufactured for every five private, single-family (non-farm) conventional housing starts, according to Department of Commerce figures.

Where are all of these homes? Some 22,000 mobile home parks exist in this country, and they can provide a total of one million



Wrought iron room divider separates living room, fashionable dining area.

spaces. The average park has 75, but a few have as many as 4,000.

Since the future growth of the mobile home industry—there are about 220 firms producing them today—is largely dependent upon the development of new mobile home parks, Woodard believes the indus-

try itself may have to move in that direction in the near future.

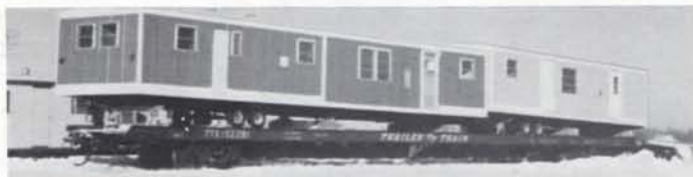
"About \$2,000 per space is required to build a park, and that's exclusive of land costs," he explained, "so financing the development is a major business venture. Land requirements for parks are increasing, too, because of the growing size of mobile home units. Thus, a minimum of 3,200 square feet is needed for each unit, which means that a 1,000-unit park requires more than 73 acres of land. At today's prices, this amounts to another sizeable sum."

Whatever the cost and whoever builds them, there can be no doubt that parks will be built and more mobile homes will be made. And one of the leading builders will doubtless be Detroit Mobile Homes, Inc. □



68-2/3FD-12 M-4 2 or 3 Bedroom, Front Kitchen, Center Dining

Detroit 68-foot, 12-wide floor plan shows bedroom options.



NP 85-foot flat car holds two homes ready for shipping.

Blackduck surges to fore in pulpwood production

There are no urgent cries of, "Tim-ber-r-r-r!" as the knit-capped young lumberjack moves alone through the heavy stand of tamarack, felling trees and methodically cutting them into the customary 100-inch logs for pulpwood. There is only the intermittent chortle of a gasoline power saw, punctuated now and then by the muted crash of a tree into snow-covered brush.

The temperature this late-January morning hovers at -13° F, despite a bright sun that swings slowly across a crisp blue sky in an arc that already has risen $8^{\circ}31'$ north of its winter solstice nadir. Yet the youthful sawyer works in shirtsleeves and plaid woolen vest in the windless forest, his exertion sufficient to dispel the cold.

There is little in this quiet woodland scene to suggest that the man

is part of a community-wide involvement in a fast-growing industry. The town is Blackduck, Minn., a thriving village of about 750 people. And the industry on which it thrives is the growing, harvesting, buying and selling of pulpwood, the basic raw material of paper.

During 1966 all of Blackduck watched and counted almost daily as the carload shipments of pulpwood passed the old record, reached and passed 1,000 and closed out the year at 1,422. This was enough to make their town the "pulpwood capital of the Midwest" among Northern Pacific stations, a distinction formerly enjoyed by the neighboring community of Northome. In a sense, this achievement marks the town's return to an earlier glory.

Old-timers here can recall that Blackduck was founded in the hey-





District Ranger Beasley, left, with R. L. Graves, timber management staff officer who headquarters at Cass Lake.

day of logging in Minnesota's north woods. But those days turned to twilight and finally into night as the "unlimited" forests were reduced to stumps and swamp. Many people moved on with the loggers, but others stayed and established a new economy for the area. Cutover lands were cleared and drained; the bountiful land was tilled, and soon Blackduck was known as a farming community.

Not all of the land was arable; a large part of it was too boggy even to clear and drain. Here and elsewhere the timber began its long, slow comeback, and after several decades the process started to reverse itself: croplands and pasture were taken over by the trees, trees such as aspen (popularly known as popple), tamarack, balsam, birch, spruce and pine. Today, Blackduck is surrounded by forest; logging has gained the ascendancy again. But there are differences.

First of all, the day of the over-cutting logger is gone forever. Federal, State, County and private sustained yield management programs insure that not a single acre will ever again be completely stripped of trees, that timber may be cut year after year on a controlled basis. These practices also insure that Blackduck and similar towns will have an economy they can bank on throughout the future.

Other changes involve harvesting methods and equipment. Today, there are no horses, no axes or crosscut saws, no dinky engines or narrow-gauge logging railroads in the Blackduck area. Instead there are tracked or wheeled vehicles for

skidding logs out of the woods; a variety of power saws for felling, limbing and crosscutting trees, and trucks to carry the harvest over logging roads to the railhead.

The various timber management plans employed to control the harvest and perpetuate the forests near Blackduck are similar in their application, and every acre of forest is covered by one or another of them. Those administered by the U. S. Department of Agriculture's Forest Service and the Division of Forestry of the Minnesota Department of Conservation are typical.

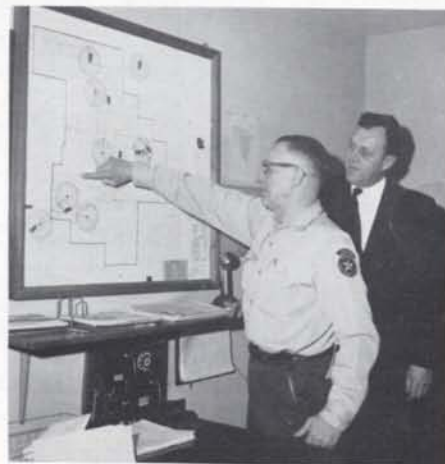
For the most part, the Chippewa National Forest lies south and east of Blackduck, the town itself lying outside its boundaries. But there is a Blackduck Ranger District within the Chippewa, and it contains gross acreage of 244,756, of which 99,382 acres are Government-owned. Timber activities on the latter are controlled by a Timber Management Plan that is in force for a 10-year period. The current plan has been in effect for five years now and will run for another five years. At the

Modern tractor and self-loading trailer are used to skid logs out of forest.



end of that time, another plan will be placed in operation for the succeeding 10 years.

Under this plan, the district ranger establishes an allowable cut on an annual basis by species. He also selects the areas where timber can be cut and advertises its availability. One such sale, advertised during the first three months of this year by District Ranger J. Lamar



Forester Lausche outlines State of Minnesota's Blackduck District for A. L. Gerner, local Northern Pacific Agent.

Beasley of the Blackduck District, lay near the southeastern tip of his area, about 17 miles from Blackduck. Spread over two sections, the sale covered more than 700 cords of wood, about 550 cords of which was pulpwood timber.

All the timber which is available for cutting under the plan is not always taken. Thus, while it is permissible to cut 11,707 cords of aspen in the Blackduck Working Circle each year of the plan, at this time there

remains an uncut balance of 26,241 cords still available. In other words, loggers could take as much as 37,948 cords this year alone. And if they do not, the remainder will be carried over to 1968.

Minnesota's Division of Forestry has divided the State's forest lands into 16 areas for administrative purposes. One of these, Area 9, is headed by Assistant Area Forester



Two views of the slasher used by the Loch brothers in State Forest north of town.

Louis Lausche and is designated as the Blackduck Area with headquarters in Blackduck. And within the Area there are a number of districts, one of which is headquartered at Blackduck also. Then, each district is broken down by Compartments, of which there are four in Blackduck District 1.

The Chippewa National Forest overlaps 57 per cent of the District, and in this portion lie 70 per cent of the 58,930 acres of State owned lands in the District. The annual recommended cut of five pulpwood species within the District totals almost 11,000 cords. Last year's actual cut totaled 4,700 cords (spruce—2,285; balsam—950; aspen 785; jack pine—580, and tamarack—100). So there's a vast potential cut on State lands, too.

There are a dozen or so timber buyers active in the area, including Milo Gladen, one of the biggest, in terms of volume; Fred Benson, who is also a partner in B. & J. Timber Co., and V. R. Hufnagle. Their job, essentially, is to find and purchase pulpwood timber, usually for a number of principals.

Benson, for example, buys for

Truck hauls seven cords in one load to NP's 54-car yard at Blackduck, where one car will hold three truckloads.

such Minnesota firms as Hennepin Paper Co., Little Falls; Superwood Corp., Duluth; Northwest Paper Co., Cloquet, and Boise Cascade Corp. (formerly Mando) of International Falls, among others. Gladen buys chiefly for St. Regis Paper Co. at Sartell, but he has other clients, too.

Buyers do not ordinarily become involved in cutting. This activity falls, by and large, to what is far and away the largest group in the Blackduck area who are intimately connected with the industry. These include B & J Timber; Jerry and Lowell Joy; Isadore, Douglas and Loren Loch; Ray Kupcho; Mike Michalicek, and Earl Marty. Too, much of the timber is harvested by farmers who turn to logging during their off-season. Therefore, a large part of the rural population around Blackduck is engaged in cutting.

After a sale has been made, the buyer turns to an operator and orders the cut. Most often, the trees are felled, limbed and cut into pulpwood logs, and these are skidded out of the woods to a spot which is accessible to trucks. These trucks are equipped with pneumatic loading equipment. Thus the driver loads up and delivers his logs—seven cords, usually—to the NP

depot at Blackduck, where he concludes a run by transferring his load to a flat car.

The Loch brothers, on the other hand, are working with a completely new machine developed by a Duluth equipment firm. In this case, a high-wheeled Pettibone skidder drags whole tamarack trees out of the woods to the machine, which is called a slasher. Since pulpwood-grade tamarack bears slender, brittle branches, no separate limbing operation is necessary. Therefore, the operator simply picks up a tree and places the butt end of it between powered rollers



Stately pines bear witness to resurgence of forests, logging in Blackduck area.

which are studded with steel teeth. These rollers automatically feed the tree against a stop, then a great circular saw rolls forward and cuts off a piece the exact length of a pulpwood log. The saw drops back, the rollers tooth the tree up to the stop again, and the saw lops off another log. This machine helped the Lochs achieve their best year ever.

"It's been a good year for everybody," says E. J. Gorman, woodlands manager for St. Regis Paper Co. "Good rail service and good roads throughout the year helped

Nile Benson loads his truck with logs purchased from U. S. Forestry in Chippewa National Forest near Blackduck.



make it that way.

"What was accomplished here at Blackduck is a darned good example of free enterprise at work. What was good for all of us and our companies individually, turned out to be what was good for the entire area."

Gorman estimated that about \$400 was left in the community for each of the 1,422 carloads shipped from Blackduck. This means that more than \$565,000 was poured into the area economy during the 10-month logging season. (The other two months of the year are given over to the spring break-up and to permitting the logging roads to firm up again after the thaw.)

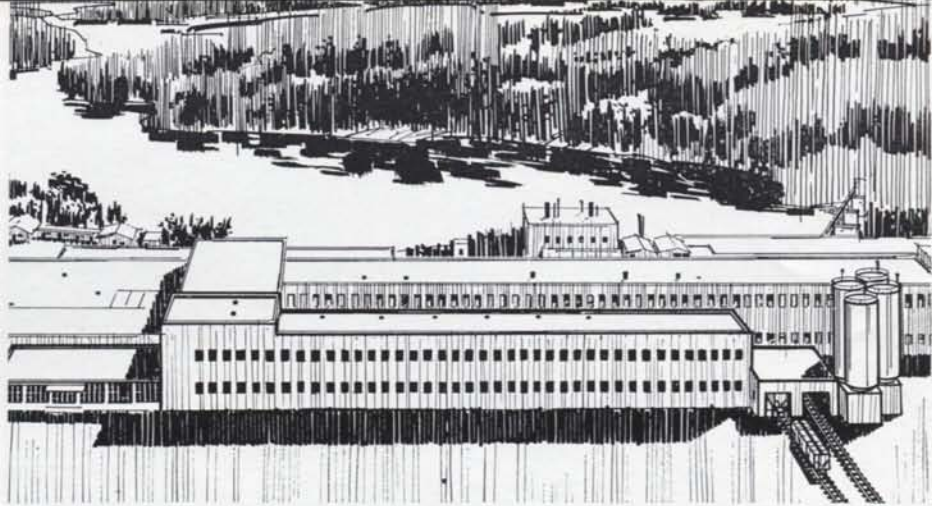
The future looks bright to all concerned. Gorman pointed out that there have been a lot of species changes in recent years as paper makers develop new technology in



White-barked aspen, or popple, gains favor among nation's paper mills.

that industry. His company is now taking an active interest in aspen, a fact which augurs well for Blackduck and its timber industry.

At its Sartell plant alone, St. Regis consumes 37,500 cords of pulpwood annually. That's more than was shipped out of the Blackduck area last year by almost 8,000 cords. What with a surplus of pulpwood there, and many more companies than St. Regis to deal with, it appears that the town can almost reach for the moon. At any rate, it's a cinch they won't be resting on their laurels, nor their aspens, either. □



Artist's sketch of Northwest's new coating plant shows dry chemical silos at right.

Northwest diversifies with coated paper line

Back around 4000 B. C., the Sumerians of Mesopotamia (part of modern Iraq) introduced the art of writing on clay tablets. Nowadays that ancient practice is referred to as cuneiform writing.

Oddly enough, although cuneiform writing died out during the third century B. C., man is once more writing on clay. What's produced in this instance, however, is simply called printing. This printed page, as a matter of fact, might be called a perfect example of modern "clay writing."

Some 12 tons of paper go into the printing of *The Northwest* each year. Almost three tons of this weight is contributed by a coating comprised of various pigments and an adhesive. One of these pigments—it makes up nearly 4,000 pounds of the coating material—is kaolin, or china clay. Why clay?

According to Frank Kaulakis, manager of coating at Northwest Paper company's Brainerd, Minn., mill, the idea is to cover the fiber surface of paper with "an extremely fine mineral surface." What this does is invest the paper with a much improved printing surface: its visual appearance is vastly improved, of course; illustrations and type are more faithfully reproduced, containing far more detail than when they're impressed on uncoated stock, and four-color printing enjoys sharper images in clearer, brighter and truer colors.

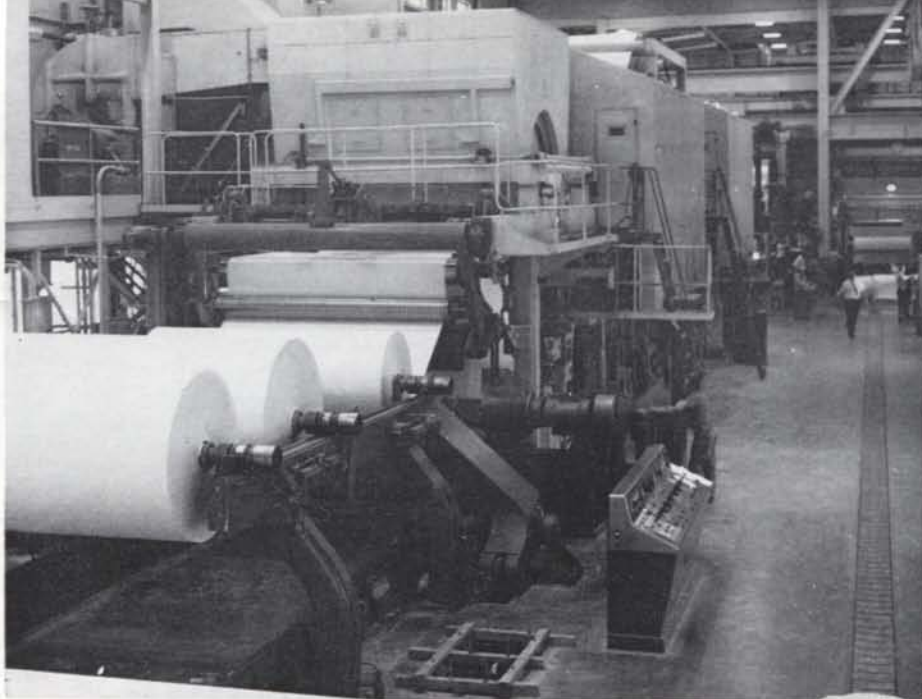
Paper is made from wood fibers of microscopic dimensions. Even so the helter-skelter matting of these



Mill Manager Warren Johnson with one of original paintings that have become a Northwest Paper Company trademark.

fibers leaves pits and voids, so to speak, which inhibit fine printing. Pigment particles in the coatings are in a size range from .20 to 5 microns in diameter. The fibers are roughly 10 times as wide and 500 times as long as the average pigment particle, so their relatively rough and porous surface must be leveled off by adding millions of pigment particles in a suitable adhesive medium.

If this page were magnified 12,500 times before coating, it would look something like a yard-high stack of peeled logs 2.17 miles long by 1.63 miles wide. It would be made up of about 100 million logs averaging 10 inches in diameter and almost 42 feet in length. Then, if 165 billion sticky ping-pong balls were spread over it, half on each side, the effect would be about the same as coating this paper with 2-micron particles of clay and calcium



Overall view of coater shows rolls of new paper lined up to maintain steady flow.

carbonate in an adhesive made from corn starch, casein, or soybean protein blended with synthetic latex.

Although it has been in the papermaking business since 1898, with mills at Cloquet, Minn., and Brainerd, the Northwest Paper Co. is one of the country's newest manufacturers of coated stock. Its entry into this field three years ago was more of a move toward diversification than one of expansion. Over the years, Northwest (now a subsidiary of Potlatch Forests, Inc.) has developed a reputation in the industry as a major supplier of quality uncoated printing papers.

"However, there has been a big swing to coated papers in recent years," Kaulakis said, "so to keep pace with the printer's changing needs and to provide greater growth opportunity, we cut out marginal grades of paper and upgraded our line of printing papers by moving into coating."

Construction was begun in 1963 on what the trade calls an off-machine trailing blade coater. The new unit went into production on a one-shift basis in March, 1964. It advanced to two shifts five months later, then to around-the-clock operation in February, 1965.

Housed with the coater in a new 20,600-square foot building are two new supercalenders and a winder, plus coating preparation and roll storage facilities. Adjacent to one end of the structure, just outside a coating preparation room, is a bulk chemical unloading and stor-

age area where the clay and other coating ingredients are handled.

Roll stock to feed the coater is made on both paper machines at Brainerd. However, the pulp used is produced at the Cloquet plant, where daily production runs to about 125 tons of bleached sulphite pulp, 180 tons of Kraft softwood pulp and 115 tons of Kraft hardwood pulp. The base sheet for coating is comprised of various blends of these pulps.

The coater is designed to produce a full array of double-clay-coated papers ranging in basis weights from 50 to 146 lbs. (This page is printed on paper with a basis weight of 70 lbs.; this is actually the weight of 500 sheets measuring 25 by 38 inches.) Grades produced include C2S (coated-two-sides) sheet-fed and web-fed offset and letterpress papers; C1S paper for labels; semi-dull or velvet finish papers, and a line of dull or matte-finish papers. All of these are required to meet customer demand for different end uses, varying from textbooks and catalogs to advertising pieces.

The base sheet is prime-coated with 3 to 6 lbs. per side per ream (3,300 surface square feet) right on the paper machine. So the coater actually applies a finish coat running from 6 to 10 lbs. per side. A prime coat serves virtually the same purpose here as it does in house painting: it seals the surface and holds up the top coat.

Rolls of paper weighing up to



Coatings are mixed in this machine.



Employee controls flying paster operation.

12,000 lbs. each and wound on 8-inch cores to 60 inches in diameter, are delivered from the paper machines to the coater via an in-the-floor system of belt and roller conveyors and switching turntables. They can be channeled directly to the coater or to the storage area beyond it.

The rolls are dressed with a pneumatically expandable shaft which provides the horizontal support necessary to unwind the paper and run it through the coater at web speeds of 2000-2500 feet per minute. As a roll of paper expires, a new roll is started without stopping or slowing down the coater. The transfer is made from the expiring roll to the new roll of paper by means of the "flying paster".

First the lead edge of the paper web on the new roll is cut with a W-shaped design and brushed with a pink-colored, non-drying, rubber-based adhesive. The lead points of paper are held down with easy snap-off tabs which prevent the web from unraveling as the new roll of paper revolves before the transfer is made. The spherical peripheral or

surface speed of the new roll of paper must be matched to within 0.05 per cent of the web speed of the expiring roll in order to make a successful transfer.

The transfer is then made, in automatic sequence, triggered by a button pressed by the operator. First a soft rubber covered roll firmly pushes the expiring web against the revolving new roll of paper. When the glue line contacts the expiring web a firm bond is made. The hold-down tabs are broken and paper from the new roll starts unwinding. At this point a guillotine cuts the web from the expiring roll so that there is less than 2 feet of tail after the glue line.

There are two coating units in the machine, each equipped with a 16-inch applicator roll, a 30-inch backing roll, a blade holder set at an angle of 50 to 55 degrees, and a 3-inch-wide, 15-mil-thick blade that extends 0.75 of an inch from the holder. The applicator roll is located directly below the backing roll (or in a 6 o'clock position). The applicator roll, revolving in a reservoir of coating, applies an excess of coating to one side of the paper web as it passes through the nip formed by the backing and applicator rolls. The blade contacts the web after it passes through this nip. The backing roll acts as a support for the web when the blade (9 o'clock position) is applied against the web. The pressure of the blade removes the excess of coating, while leaving a precisely measured, smooth film of coating on the surface of the web.

From this point the paper is led over an 84-inch backing roll which is situated beneath a Gardner high-velocity hood. The latter expels air that has been steam-heated to a maximum temperature of 380 F. under 200 psi pressure. Then the paper rolls around seven 60-inch can dryers. With the first coat dry, the other side of the paper is coated and dried exactly as the first. As it emerges from the second dryer section, it is wound up once more into rolls.

The coater is equipped, additionally, with two Beta-ray gauges to measure coating weight, an Atrometer to test moisture content, and six temperature recorders for each dryer section. As the finished

paper comes off the machine it must have the correct weight of coating and about 6 per cent total moisture. Paper with less than this amount would be brittle and would curl and break on printing presses. To maintain the proper level of moisture in the paper after coating and during further processing, plant humidity is rigidly controlled.

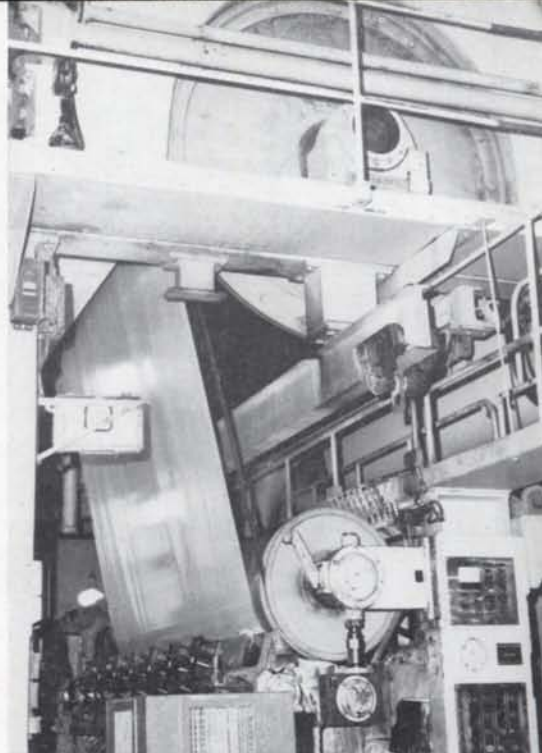
From the coating machine the paper goes to either of two supercalenders. Each of these consists of a stack of nine rollers laid horizontally and made up alternately of chilled iron and paper filled rolls. The latter are made by compressing paper under extreme pressure to make a very firm roll, yet one which has enough resilience to deform slightly under high pressure. Only the bottom or king roll is power-driven, and the others revolve in opposite directions to each other as a result of pressures up to 1900 lbs. per linear inch which is exerted against them by the driven roll, much in the manner of wringer-type washing machine rollers.

As the paper is rolled through the supercalenders the resilience of the paper filled rolls causes slippage, and this slippage burnishes the coated surface to a high luster. The total pressure applied through the top (or queen) roll determines the amount of slippage and the resulting degree of gloss.

Now the paper is sent to a re-winder where it can be cut to various sizes during rewind. Rolls are then ready for wrapping and sale, as is, or for transfer to another room for cutting into sheets in sizes up to 56 by 72 inches.

Northwest's coatings are based on an adhesive of casein, protein, starch and/or latex, in combination with clay or calcium carbonate and titanium dioxide. Separate blending systems are used to prepare coatings for both the paper machines and the Rice-Barton off-machine coater. Synthetic latex is the primary adhesive. (It's similar to those used in interior and exterior water-based paints manufactured for the home.) It is blended with one of the natural adhesives and cooked in water. In turn, this adhesive blend is mixed with pigments, the particles of which are dispersed in water.

The basic pigments are clay



Wet with coating, paper leaves blade to run over backing roll beneath dryer.



Steel reel is moved into place at wind-up end of coater to start new roll.

(kaolin), calcium carbonate and titanium dioxide. Varying proportions of clay and calcium carbonate may be blended with a variable small part of titanium dioxide, depending on the amount of brightness desired: calcium carbonate is brighter than clay, while titanium dioxide is used to attain a particular degree of opacity.

Our word kaolin is made up of two, one-syllable Chinese words, *koa* (high) and *lin* (hill), descriptive of the site in China where such clay was first mined. In the United States, the best deposit of kaolin lies in a belt running between Columbus, Ga., and Aiken, S. C. This belt actually marks the shoreline of the Atlantic ocean during the

Eocene epoch of the Cenozoic era, 50 million years ago. The bed of clay represents a centuries-long deposition of material from the mother rock along the ancient coastline.

Calcium carbonate, a chalky substance known also as calcite, is procured by reacting calcium chloride and sodium carbonate. It is the same mineral that is precipitated in a teakettle when hard water is boiled.

Titanium dioxide is the most important compound of the metallic element titanium. It is used extensively in the pigments industry because of its exceedingly good opacity or hiding property, which derives from its pure whiteness and high reflectivity. Thus, it is an ideal constituent of house paints, inks and cosmetics, as well as paper coatings.

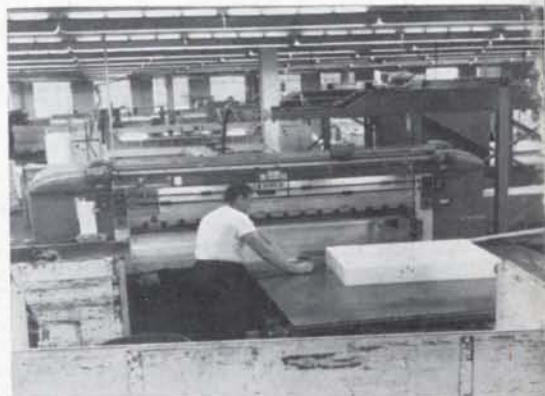
When a coating is ready for the machine it has the consistency of, say, ordinary corn syrup, about 58 to 65 per cent solids. It is supplied to the coater at the rate of 100 gallons per minute at each coating unit. The ratio of coating circulating to coating applied is about 16 to 1. This large overflow returns by gravity through four screens to a storage tank below each unit.

So efficient is the coating opera-

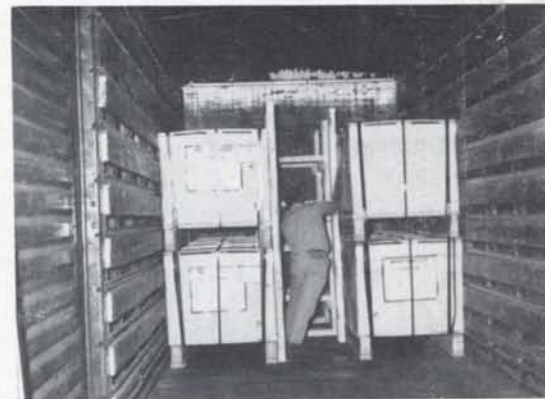
tion, so fast is paper coated on two sides and dried, that it is easily possible to finish close to 500 miles of 114-inch-wide paper each day, even at relatively slow speeds. The machine is designed to operate at 3,000 feet per minute, but its current range is being held between 2,000 and 2,400 fpm. In terms of weight, daily production averages 250 tons. This would supply enough paper to print nearly 3.25 million copies of this issue of The Northwest, or to print the magazine at its present circulation for more than 20 years.

The stream of raw materials that go into the Brainerd plant is almost as endless as the finished product coming out. Countless cars of pulp are delivered during the year, of course. But even the tonnage in the cars of minerals and chemicals for coatings is quite impressive. In 1966 this amounted to 19,895 tons of dry ingredients, plus 548,710 gallons of liquid latex, all of which arrived in the equivalent of 382 freight cars.

Largest single dry item was the clay—11,503 tons, or about 165 carloads. With that amount of clay, those ancient Sumerians probably could have struck off some 2 million cuneiform tablets. But even at that they couldn't have come close to



Coated paper is cut, above, and wrapped for loading in NP 'Damage-Free' car.



the astronomical number of words that could be printed today on the year's supply of paper that was coated with that clay. □

THE NORTHWEST
Room 116

THE NORTHERN PACIFIC RAILWAY
ST. PAUL, MINNESOTA 55101