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**ENGINEERING
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FIELD NOTES • TECHNICAL REPORTS
DATA RETRIEVAL • MANAGEMENT
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VOLUME 12 NUMBERS 1 & 2

Field **Notes**

A MAN AND HIS MOUSETRAPS

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ENGINEERING FIELD NOTES

Volume 12 Numbers 1 & 2

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**FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Washington, D.C. 20013**

From the Editor--

PUBLISHING SCHEDULES

We have had many difficulties in publishing and distributing Engineering Field Notes during the past 6 months.

According to a report from San Dimas EDC, September's issue reached some offices as late as January 15. October was a disaster; articles came in late, and the printed copies were rejected twice because the GPO contractor's work was unacceptable. In November, the letter permitting us to reprint the "BIOMASS" energy article went astray in the mail, and the internal review and approval cycle was delayed.

By early December, the requirements of the Certification Examination Program were critical; and various projects prevented field inputs. As a result, we decided not to publish in December, and material was moved forward to this combined January-February issue.

We regret the necessity for our schedule changes, and hope we can publish more promptly during the remainder of the year. And we thank those in the field who called to express concern and their interest in Field Notes.

--Gordon L. Rome

February 1, 1980

A MAN AND HIS MOUSETRAPS*

OGDEN, Utah--The earth shifts. Mousetraps spring (see figure 1). A wire stretches tight, pulling open a series of clothespins attached to trees. A caliper's needle jerks up at an angle (see figure 2). Later, geologist Earl Olson ponders the evidence and finds it convincing.

"We've suspected land movement here for a long time," says Olson. "This gives us proof."

A Rube Goldberg contraption? Perhaps.

But the few dollars worth of hardware store paraphernalia has yielded Olson a wealth of scientific data.

After examining the evidence of land movement, Olson decides he needs more sophisticated monitoring equipment. With a few pieces of wood from his truck, he assembles a device that will provide precise answers to more of his questions.

The wooden contraption is one of Olson's many inventions to measure natural movement of the earth's surface. The device is based on principles employed by the Huggenberger extensometer, a tool used in laboratories to measure metal "creep." He has field-tested his simple device and knows it will provide reliable data.

Olson is an environmental geologist for the Forest Service, U.S. Department of Agriculture. He works in a region that includes 18 National Forests in Utah, Nevada, southern Idaho and western Wyoming.

Olson estimates that within those 31 million acres, about 30,000 landslides occur at any given time--more slides per acre than in any other part of the country.

"We use the same approach as the Chinese in gathering landslide data," says Olson. "Instead of spending thousands of dollars on electronic measuring equipment, we use simple inexpensive devices. You can find the parts in hardware stores."

*USDA News-Feature Service

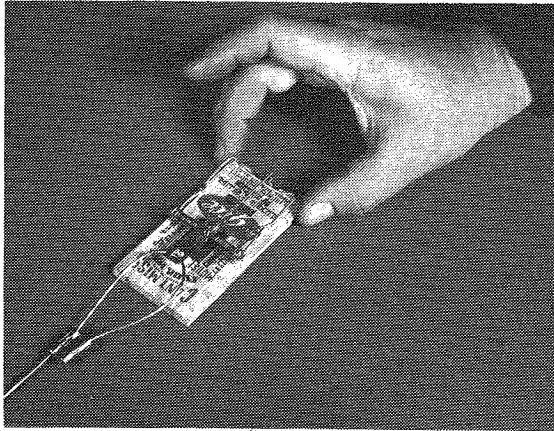
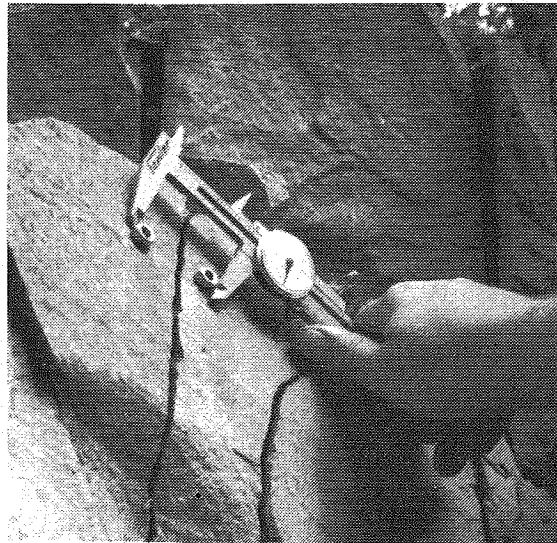


Figure 2.--Measuring the change in distance between two nuts glued to rock.

Figure 1.--Olson sets mousetrap that springs when shifting land pulls the wire.



During the past six years, Olson has adapted about 100 common items to monitor landslides. Among his favorites are nuts, bolts, nails, tongue depressors, epoxy glue and measuring tapes (see figure 3).

He has invented at least six devices that perform competitively with expensive electronic equipment. It would be difficult to estimate the amount of money his inventions have saved taxpayers, his colleagues claim.

Forest managers need Olson's geologic information to determine stability of land for building roads, developing skiing and other resorts, making timber sales and protecting visitors. His counterparts collect similar data in many other National Forests.



Figure 3.--Olson hooks tape measure to nail in tree to measure changes in distance.

Some of Olson's most promising inventions include a scissors extensometer now in use and a "swing-arm" device he'll test in 1980. He makes the extensometer by bolting ordinary metal shelf brackets together in the shape of an "X." Olson drives two points into the ground and calculates land movement with a plumb bob hanging from the "X's" center.

Olson makes the swing arm device of wood or metal. It can amplify slope movement 100 times.

He also uses paraffin wax--another common substance--to detect land movement. He pours the melted wax into holes in the ground or encases it in plastic tubes before putting it in the ground. Cracks

in the hardened wax indicate land movement. His associates joke about his odd equipment and often refer to him as the "junk man."

"They laugh when they see what I'm using," says Olson, "but most people are impressed by the results. They are amazed, for example, that two tongue depressors glued to a clothespin can show that several tons of earth have shifted."

So far Olson has collected data on 7,000 landslides. One of the most spectacular is the Manti Slide on the Manti-LaSal National Forest in central Utah. In 1974, the side of a mountain started moving, creating a dangerous situation for the city of Manti.

Rocks and debris tumbled onto the Cottonwood Landslide, which had been moving a few inches annually for several thousand years. During one 24-hour period, the mass moved 7.8 feet per hour.

"We had visitors from all over the world," said Olson. "West Germany gave the slide special TV coverage. Scientists in Poland obtained aerial photographs of the area to study."

Electronic equipment was installed on the Manti Slide--at a cost of \$7,500 per unit. But Olson did much of the monitoring with his simple inexpensive devices and with aerial photography. He accurately predicted the slide's course for the immediate future. Today the Manti Slide is two miles long. Its upper part is still moving.

"With the number of landslides we have in our region, we're going to need many mousetraps and tongue depressors," says Olson. "But we're collecting sound data inexpensively. The data is being used in many parts of the world."

ABOUT THE AUTHOR

Bonnie Eldredge, the author, is a writer-editor for the Forest Service, U.S. Department of Agriculture, at its regional office at Ogden, Utah.

ENERGY MANAGEMENT

SOLAR BATHHOUSE AND TOILET FACILITIES

Thomas F. Smith
Staff Engineer
R-8

William A. Speer
Regional Architect
R-8

Visitors to Bankhead National Forest's Houston Recreation Area in Alabama will soon be able to shower in water heated only by the sun.

Several years ago, in response to energy conservation concerns, Region 8 adopted a policy of no longer providing warm water showers. The policy was recently modified to allow use of solar-heated water for this purpose, and a contract is underway for construction of a bathhouse, as well as a four-unit toilet with showers.

Both buildings will use solar collectors to provide warm water for showers, and the two solar systems are similar and very simple. Each system consists of solar collectors mounted on the roof; heated water storage tank(s) mounted overhead in the plumbing alley; and a variable-flow circulating pump. Each includes ordinary temperature and pressure relief valves; air vent-vacuum breakers; and a differential temperature controller for the pump operation.

Each system has a temperature control valve, which will automatically proportion 60°F (15.54°C) supply water from a well, with solar-heated water from the storage tank, to deliver 85°F (29.42°C) water to the showers (considered to be the minimum desirable shower water temperature). There are no provisions for auxiliary heat (in keeping with energy conservation concerns); should the storage tank temperature drop below 85°F (29.42°C), then 100 percent of the water will come from storage at whatever temperature storage will provide. However, the systems are capable of providing 85°F (29.42°C) water on all but the highest-use days.

Because the systems aren't operated during the winter, no freeze protection is provided; instead, the systems will be drained at the end of the recreation season.

(cut on this line)

The four-unit toilet has eight collectors (two different sizes for best use of the available roof area), with a total area of 246 square feet (674.4 square meters). The storage tank is 530 gallons (2006.05 liters).

(cut on this line)

The orientation of the bathhouse and placement of the solar collectors on the bathhouse roof are somewhat unusual. The Region utilized an existing design that met site needs, rather than a new design; however, for this design, site constraints dictated an east-west rather than a north-south roof orientation.

Additionally, more roof area was needed for solar collectors than was available on just one of the two roof slopes. An evaluation showed that placing collectors on both sides of east-west facing roof slopes would work. The relatively flat roof slopes (18.5°), coupled with the fact that most public use will occur during the period of the year when the sun is at a high angle, minimize the loss in collector efficiency.

The bathhouse has 10 collectors, with a total collector area of 644 square feet (59.83 square meters), and two 530-gallon (2006.05-liter) storage tanks. The toilet and bathhouse begin operation in the 1980 recreation season.

For more information, contact Tom Smith or Bill Speer at 404-257-3367.

SOLAR ATTIC DWELLING

Thomas F. Smith
Staff Engineer
R-8

William A. Speer
Regional Architect
R-8

Region 8 designed a 1300-square-foot "solar attic" dwelling that is currently under construction as a VST project at the Schenck Civilian Conservation Center near Brevard, North Carolina.

The "solar attic" dwelling employs a combination active/passive system that offers several advantages:

1. It is simple to build, using conventional materials that are familiar to the Conservation Center work force.
2. It needs no expensive solar collectors attached to the roof; the attic collects the sun's heat, providing up to 75 percent of the dwelling's space-heating requirements.
3. Its solar heating system can be reversed, thereby helping to cool the house in summer.
4. Solar water heating is easily incorporated into the system.
5. The solar system cost is low, amounting to about 15 percent of the total cost of the dwelling.

The solar attic design concept was developed by the Rural Housing Research Unit at Clemson University. Several prototype houses had been built in South Carolina and Georgia, and R-8 design personnel consulted with the Rural Housing Research Unit Staff before undertaking design of the Forest Service dwelling.

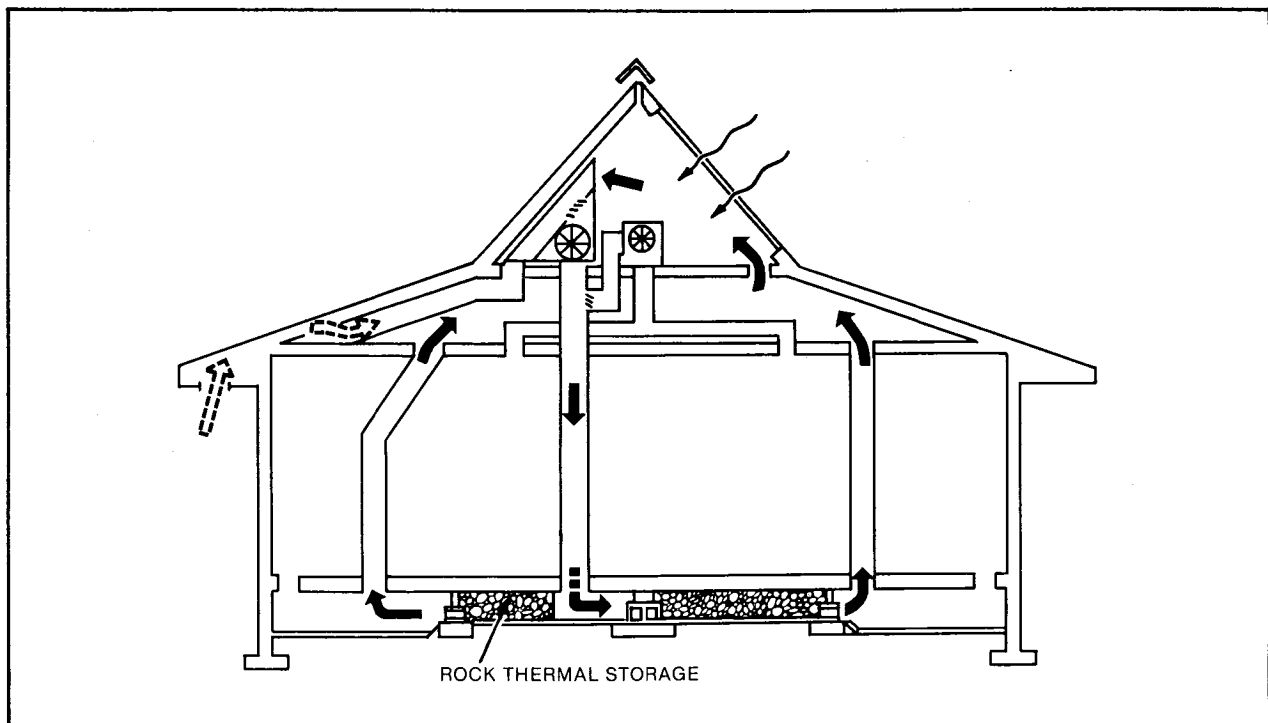
This solar dwelling design has an integrated split-attic for solar heat collection and distribution, and an underfloor rock thermal storage and distribution system.

The attic is divided into an upper and a lower level. The upper level is basically an "A" frame, with a pitch that favors maximum solar heat collection from the sun's winter position of latitude

plus 15 degrees. With the south-facing slope serving as a double-glazed transparent cover,¹ almost the entire inside surface of the upper attic--which is painted flat black--becomes the solar absorber surface.

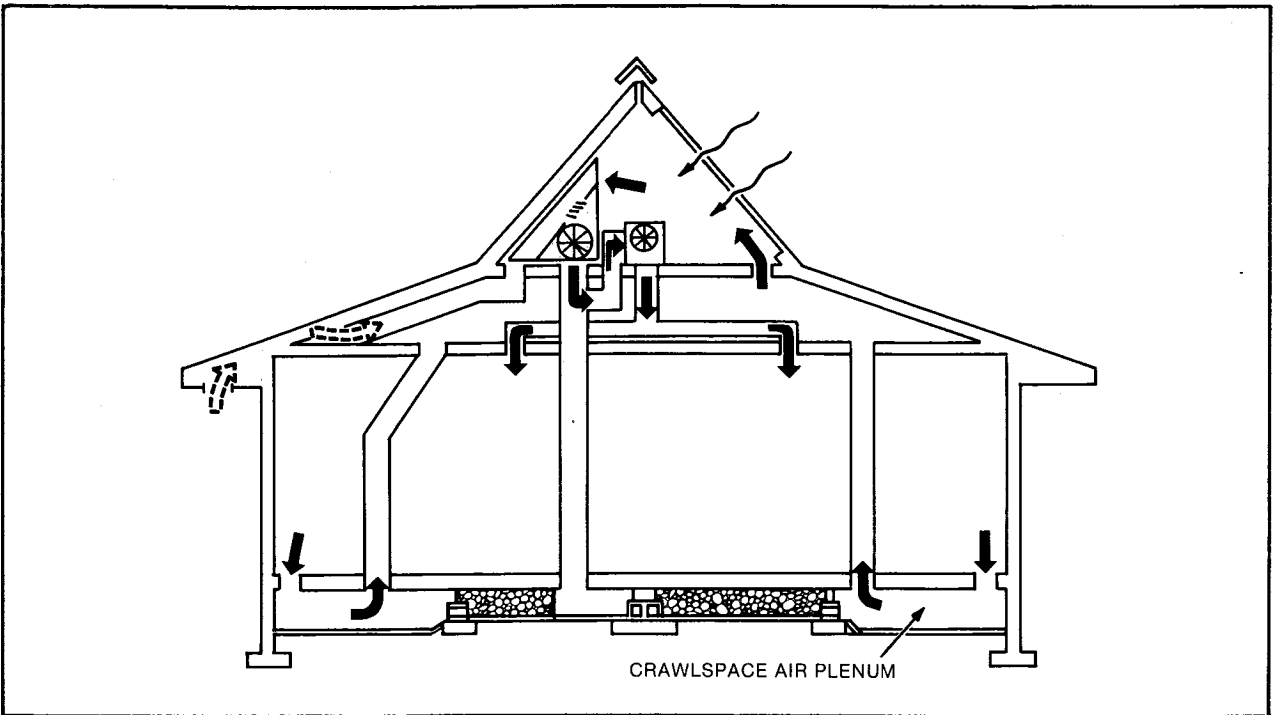
The solar attic has six operating modes; three for heating, and three for cooling (figs. 1 through 3). The system is controlled by differential thermostats that compare temperatures in the attic collector, in the dwelling, and in the rock storage beneath the dwelling.

During the heating season, the upper attic serves as the heat collector; it's sealed from the lower attic, which acts as a return-air plenum. A heat pump evaporator coil (that supplies heat when the solar system does not) is located in the upper attic; an air distribution blower is also located in the upper attic.

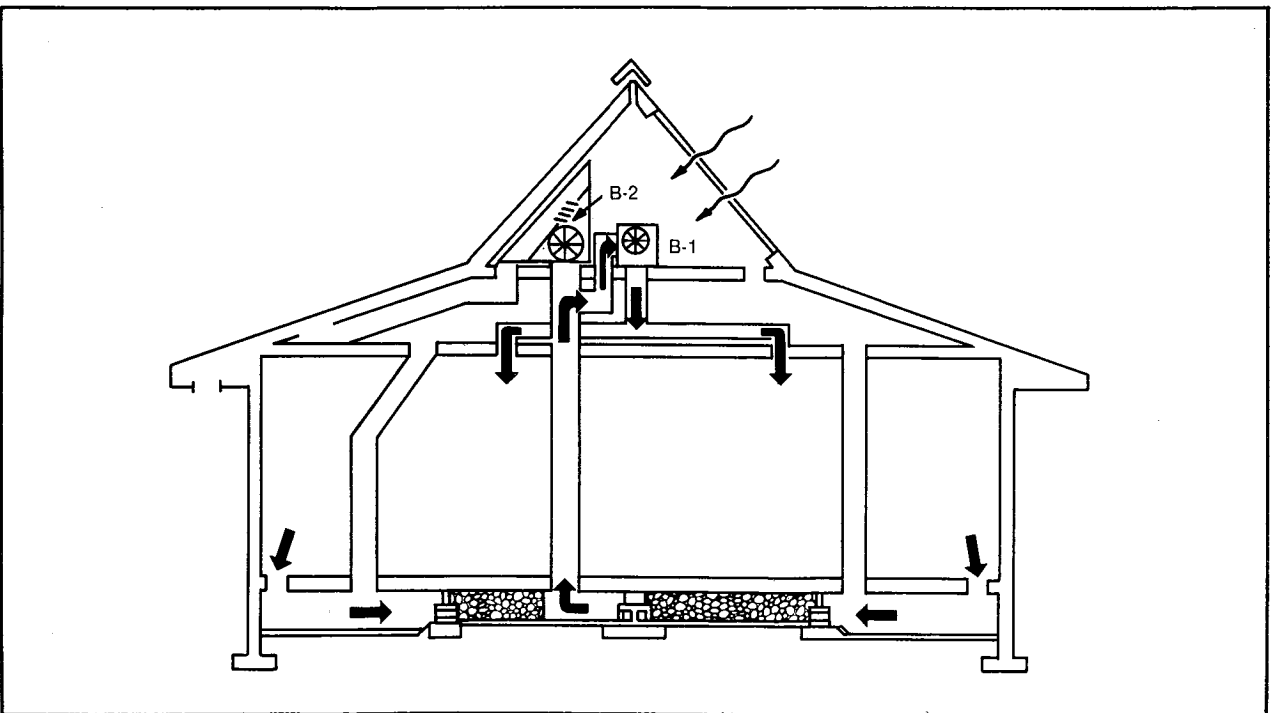


*Figure 1.--Heating--attic to storage
Cooling--outside to storage*

¹ Glazing consists of 1-inch (2.54-centimeter) tempered glass on the outside of the rafters, and polyester film on the inside of the rafters.



*Figure 2.--Heating--attic to house
Cooling--outside to house*



*Figure 3.--Heating--storage to house and auxiliary to house
Cooling--storage to house and auxiliary to house*

When the sun has warmed the air in the upper attic, a differential thermostat starts the air distribution blower, thereby circulating the air through the rock storage; if the house requires heat, a differential thermostat starts the heat pump blower. The air is moved by the distribution blower through the upper attic from the lower attic through openings in the floor of the upper attic. A gravity-operated polyester flap, attached to the top of each opening, prevents reverse circulation of cold air at night from the upper to the lower attic.

Solar-heated air is ducted directly to the house and/or to the rock storage under the house (airflow arrows in figs. 1, 2, 3). When no solar heat is available during night hours or cloudy weather, stored heat is ducted from the rock storage to the dwelling's living space by the heat-pump blower, but in the reverse direction from which it is stored. This is because:

(out on this line)

Heated air enters the rock bin from the upper attic chamber in the heat-storage mode at, say, 110°F (43.3°C), that is about the peak attic temperature anticipated. The first rock it reaches rises to this temperature. As the air travels horizontally through the rock bin, it gradually raises the temperature of the rocks in the direction of air movement, until it exits via ducts for its return trip to the attic at, say, 68°F (20.0°C).

To remove heat from storage, the air flow is reversed. Then air enters storage at about 68°F (20.0°C), and exits at 110°F (43.3°C) (or whatever temperature the rock has attained), since it reaches the hottest rock last. If storage is exhausted, the heat pump supplies the heat.²

In the cooling season, the ridge and eave vents are opened, thereby allowing cool air from the eaves to flow into the lower attic and, by convection, to pass up through the upper attic, and exit through the continuous ridge vent.

During the cooling season, the lower attic from the eaves to the upper attic serves as a cool-air plenum. An important function of the lower attic is serving as a thoroughly-insulated cavity that separates the living space from the upper attic to reduce the heat gain in the cooling season and heat loss in the heating season. Monitoring done by the Rural Housing Research Unit on a prototype

² Tests by the Rural Housing Research Unit on the already-constructed prototype houses indicate that storage is sufficient for three sunless days.

house shows that, during the summer, the lower attic stays 30°F (16.65°C) cooler than the temperatures in most conventional attics.

During the summer cooling season, an air-intake vent to the outside of the dwelling is opened to draw in cool, nighttime air. The cool air does not enter either the upper or lower attic; it is ducted directly to the air distribution blower (now isolated from the upper attic chamber). This blower circulates cool air directly through the house, with help from the heat-pump blower motor, and/or cools the rock storage.

During the day, cool air from rock storage is circulated through the house by the heat-pump blower. Air flow through storage is reversed for the same reason as in heating, except that, in cooling cycle, the air reaches the coldest rock last. During the cooling season, the heat pump is turned on for short periods of time, as needed, to control humidity, and/or to provide supplementary cooling.

The solar water heating system includes an air-to-water heat exchanger, differential thermostat, circulating pump, and solar electric water tank. The heat exchanger consists of copper tubing with aluminum fins painted flat black; this is attached to the underside of the solar glazed rafters in the upper attic. The plumbing is arranged for a direct circulation loop, where the domestic water supply is circulated through the water tank. Freeze protection for the heat exchanger is provided by a drain-down, solenoid-operated valve that opens when the upper attic temperature drops below 35°F (1.67°C).

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The living spaces are completely conventional and appear to have a conventional forced-air heating/cooling system. The underfloor space in the home is basically a crawl-space design; the central half contains the rock thermal storage, and the remaining equally-divided areas, running with the length of the house, serve as return-air plenums.

NATIONAL FOREST BOUNDARIES

DESCRIBING WILDERNESS BOUNDARIES

Some Comments on Methods in General Use

One Land Surveyor's Viewpoint

*C. C. Doak, PLS, Regional Land Surveyor
R-3*

NATURAL or CULTURAL FEATURES

Natural or manmade features that are readily identifiable on-the-ground are the most satisfactory boundaries to survey, post, administer, and maintain. This type of boundary can be seen on-the-ground, posted without survey, and portrayed on maps; it is recognizable on aerial photos, and offers very little, if any, question as to its exact position in the eyes of a court or any other concerned party. Examples of such features are ridge tops, rim rocks, travelways, drainages, railroad grades, logging spurs, and fence lines, etc. Of course, these features are not always available, and other methods must be used partially or entirely. Features such as contours or "toe of slope" may be rather vague, difficult to find through expensive survey, and subject to challenge.

EXISTING PUBLIC LAND SURVEY NETWORK

Recent GLO or BLM Surveys

Describing wilderness boundaries along lines previously surveyed by the GLO or BLM is satisfactory because these lines can be retraced and located on-the-ground. The monuments of GLO or BLM surveys are generally permanent-type monuments and recoverable. We are not really concerned about the accuracy of the published bearing or distance between these monuments if these monuments are on-the-ground.

It is also satisfactory to describe a boundary through the center of the section from one-quarter corner to another; it is an expensive survey procedure, however, to break a section down into aliquot

parts, and this would be necessary if the boundary makes a break (or turn) within the section.

Old GLO Contract Surveys

Land net surveys made before 1912 were performed by private practitioners under contract. The survey methods were somewhat crude in most instances; allowable inaccuracies were great; monuments were often not readily identifiable, and, in some instances, were never set. As in the areas we are designating as wilderness boundaries, the excessively erroneous and/or fraudulent surveys increased as the terrain and conditions in general became more difficult. Locating these lines on a map is no problem, as some cartographers have previously "estimated" their position on paper. To find the true position on-the-ground is another matter. To describe a boundary along these uncertain, unfound lines creates an expensive and often unsuccessful operation; and, if the corners cannot be found, you have created a real monster--a line that you cannot find and cannot resurvey. The legal survey authority vested in the private surveyor by any one of the public domain States only authorizes the survey or resurvey necessary for the determination of the limits of patented land. The only other survey authority to reestablish the location or relocation of a lost corner on the public survey system is the Department of the Interior, cadastral survey division of the BLM. Further, the BLM program, at present and for the past few years, is dealing with the limits of public domain land--not administrative boundaries or township subdivisions, for the purposes of identification or disposal of public and private land. Original or resurveys wholly within public domain lands are virtually things of the past. Consequently, I do not advise that you use an old survey for a tool unless you can live with it in its present condition or unless the limit(s) of ownership is involved.

Unsurveyed Section Lines

Unsurveyed section lines portrayed on maps cannot be found on-the-ground legally or otherwise by anyone except the BLM. Their program has previously been discussed. The unsurveyed land net on our maps is based on a projected plan of the BLM to show the approximate location of the continuing survey of public lands. The intent was to project only the approximate locations and numbering schemes of range lines, township lines, guide medians, standard parallels, and subdivision breakdown, all subject to change. Remember: the BLM has sole jurisdiction at this time to make an original survey on the rectangular system. Consequently, my view is that this is the last way I would describe anything that must be found and posted on-the-ground in a fashion that I could support.

METES AND BOUNDS

The metes and bounds system of describing land is the system of selected directions and distances to meet a particular need that is not fulfilled by the rectangular system for one or more of the reasons previously discussed. The metes and bounds system can be tailored to enclose any parcel of land not described by the rectangular system. My view is that the metes and bounds system be used whenever you do not have an adequate existing survey with on-the-ground monuments surrounding your exact area of concern. Legal authority is not required for these metes and bounds surveys as patented land is not involved and the rectangular system of surveys is not altered, extended, or resurveyed. Anyone who can measure bearing and distances can legally perform this survey and post the boundaries.

SUMMARY

Posting wilderness boundaries requires finding the boundary on-the-ground. When recognizable natural or cultural features are not followed, a survey is required; a survey must follow a description; the manner in which the description is written may make the task routine or involved and expensive; and may require legal authority and the use of the BLM, which is not available under their present program, funding, and manpower. Existing surveys should be used, or course, if they meet your needs. If the survey cannot be recovered on-the-ground, it cannot meet your needs, as is the case of nonexistent rectangular system survey.

With new survey technology and equipment (such as the laser range pole, electronic distance measuring, combination transit/distance measurer, and programable computer [total station], together with airborne control [ABC system], satellite surveyor, digitizers, gyro-scope theodolites, and photogrammetric capabilities, etc.), it may be advisable to make a new metes and bound survey, rather than try to live with the rectangular system (existing or proposed). Once the description is written, we will live with it as well as the best we can. However, my last view is that you should coordinate with surveyors (RO or Forest) if you are preparing a land description.

CORNER SEARCH IN NEBRASKA SANDHILLS

*Rollin C. Curd
Registered Land Surveyor
Nebraska National Forest*

The Samuel R. McKelvie National Forest is located 40 miles (64.4 kilometers) southwest of Valentine, Nebraska, with the north boundary situated south of the Niobrara River. The terrain is rolling-to-rough sandhills, with occasional ponderosa and broad leaf trees in the canyons; the grass cover is native sandhill varieties. The soil texture is very fine sands with isolated pockets of clay and loess-type material. The land has never been plowed or cultivated.

Under contract with the General Land Office, in September, 1877, Frank M. Crowell surveyed the 8th Standard Parallel, between Twp's. 32, 33 Rgs. 30, 31, 32, 33, 34. He set 3-inch by 3-inch by 4-foot (0.08-meter by 0.08-meter by 1.22-meter) charred, red cedar posts with pits and mounds at half mile intervals; his notes indicated the use of bearing trees when available.

There are no records to indicate any resurveys of the 8th Standard Parallel until 1979, except that--beginning in the 1920's--Forest Service personnel had found several corners by ground search and posted these corners.

In 1979, a Forest Service survey crew searched for corners on the south boundary of T-33-N, R-33-W (8th Std. Parallel). Using a combination of electronic measuring equipment, 200-foot (60.96-meter) tape, T-2 theodolite, and transit with compass and shovels, the crew recovered the corners shown in the photograph.

The corners were found by using transit with compass for direction and HP-3800 for distance, to run random line. Beginning with one known corner, a search was made at 1/2-mile (0.80-kilometer) intervals; setting a temporary wood stake, the surrounding area was searched by shovel; the shovel was used in a near horizontal position to remove the grass cover and the top 3 inches (0.08 meter) of soil.

Aluminum monuments and steel posts were set alongside cedar posts. Survey distances varied from the record from (as much as) 1 to 2 feet (0.3 to 0.6 meter) per 1/2 mile (0.80 kilometer). Blowouts,

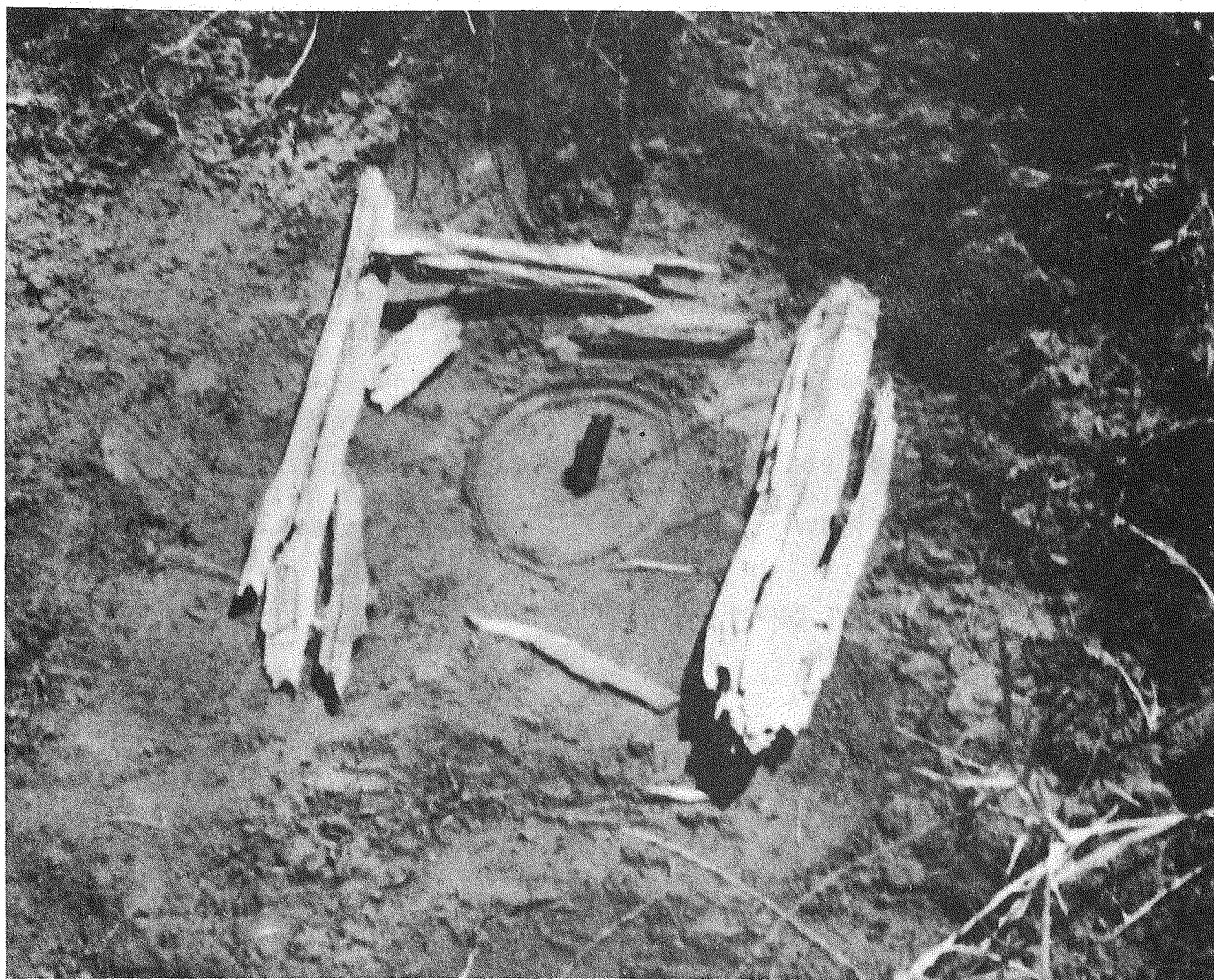
LOCATION	EVIDENCE
South 1/4 Section 34	Found pieces of splintered cedar and original hole (light-colored sand).
South 1/4 Section 31	Found 2-inch (0.05-meter) diameter by 20-inch (0.51-meter) long, red cedar stake.
South 1/4 Section 32	Found a rotted 3-inch (0.08-meter) diameter by 18-inch (0.46-meter) cedar post; set 14 inches (0.36 meter) into ground and charred at the base.
1/4 Corner between Sections 1 and 6; South of 8th/Std. parallel	On west line of T-32-N, R-33-W, found a 3-inch (0.08-meter) diameter by 3-1/2-foot (1.07-meter) long red cedar post. This post was located on a slight northwest facing slope; 108 feet (32.92 meters) west of fence; 10 inches (0.25 meters) of the post was above ground.

shifting sands, and cattle have obliterated and destroyed some of the corners. Because cedar retains its color and scent, the evidence of the original corners was apparent; corners found above ground have a light, exterior color and are smooth surfaced. The well-drained sands of the area probably contributed to the longevity of the posts.

Stones were set for closing corners on the original survey in the township to the south; three of these corners were searched for, but none was found.

In summary, I believe a three-man survey party with two sharp shovels and a desire to find old corners will find some cedar posts. It should be noted that the Forest Service boundary fence varied from several feet to over 100 feet (30.48 meters) from the true line.

We are running out of time; 102 years elapsed from Frank Crowell's survey to Rollin Curd's search. Can we afford to wait another 100 years? At what point do we say, "Take the time, and monument our boundaries now."?



*Remains of original cedar stake set in 1877
on the Samuel R. McKelvie National Forest.*

INVITATION TO READERS OF *FIELD NOTES*

Every reader is a potential author of an article for *Field Notes*. If you have a news item or short article you would like to share with Service engineers, we invite you to send it for publication in *Field Notes*.

Material submitted to the Washington Office for publication should be reviewed by the respective Regional Office to see that the information is current, timely, technically accurate, informative, and of interest to Forest Service Engineers (FSM 7113). The length of material submitted may vary from several short sentences to several typewritten pages; however, short articles or news items are preferred. All material submitted to the Washington Office should be typed double-spaced, and, ideally, all illustrations should be original drawings, glossy prints, or negatives.

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