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CALL ORIENTOR FOR

DRILL CORE ORIENTATION

GEMS

GEOTECHNICAL ENGINEERING
AND MINING SERVICES (U.S.A.) INC.
Suite 210, 7510 W. Mississippi Avenue
Lakewood, Colorado 80226
Telex 45-885 TAS DVR
USA (303) 922-5066

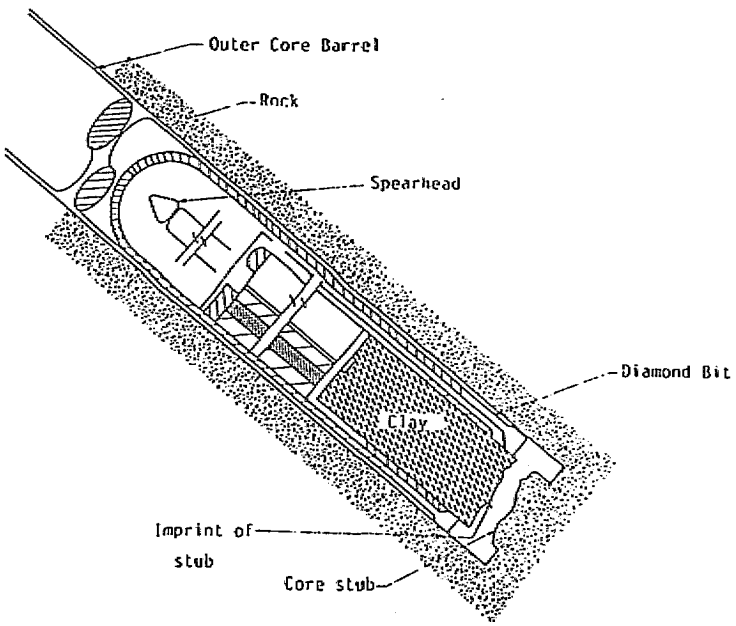
CALL ORIENTOR FOR

DRILL CORE ORIENTATION

Geotechnical and rock mechanics studies, associated with mine design, require an examination and analysis of rock fabric. Of particular importance is the orientation and distribution of the various fracture and discontinuity sets that occur with the rock mass. However, the area of interest is often at depth, and oriented core drilling is the only economic means of obtaining this knowledge.

GEMS provides an inexpensive downhole core orientating device developed by R. D. Call. This device operates by taking a clay imprint of the bottom of the hole. This imprint can be reliably matched to the top of the succeeding core run. A reference line indicating the drill hole can then be scribed in the core. Fracture attitudes are measured relative to the reference line and the core axis.

CALL ORIENTOR



The orientor has been designed to operate with conventional wire-line drilling equipment and has been successfully used with both side-discharge and face-discharge diamond bits and with single, double and triple tube set-ups. Due to the simplicity of the orientor, it is easy to operate and hence, results in the minimum of drill down-time.

The Call orientor is supplied by GEMS in a package which also includes:

- operating manual,
- a goniometer for the measurement of fracture orientation with respect to the drill axis, and
- a suite of calculator and computer programs for the rotation of the fracture data from the drill reference axis to a true north reference axis.

Have called them 10/5/84
& They will send brochure
et al. JOS

SUBJECT: Device for Orienting Core

Greetings from Greens Creek. I thought that I should tell you about a core orienting device that Noranda has at Greens Creek that might be of use to both of you.

It is a real simple device that is lowered down the hole on the wireline after the inner tube is pulled. At the end of the device is a plug of modeling clay that returns an impression of the core where it was broken off at the bottom of the hole. The device is eccentrically weighted so that it orients itself with the heavy portion on the lowest side of the hole and, hence, the impression in the modeling clay is oriented relative to vertical. The impression is mated with the last piece of core extracted from the hole and, in combination with a drill hole survey picture, allows you to determine the absolute orientation of structural features in the core.

I do not know if something like this would be of any interest to either of you, but it is a quick and relatively painless way of obtaining oriented core. The one real drawback is that the method will only work where the angle of the hole from the vertical at the site where the measurement is to be made is less than, I think, about -70°. Otherwise the eccentric weight may not properly orient itself.

A guy in Carson City does it.

If you are interested, the device can be leased from:

Geotechnical Engineering and Mining Services
7510 West Mississippi, #210
Lakewood, Colorado 80226
(303) 922-5066

P.S. The Coates driller) said they can make a similar tool (costs them ~$60) and it works great on core with breaks in it. They had one engineering/mining job where they oriented every 2' (40 times) and still got 100' a shift.!

GEOTECHNICAL ENGINEERING AND MINING SERVICES (U.S.A.) INC.
Suite 210, 7510 W. Mississippi Avenue
Lakewood, Colorado 80226, U.S.A.
Tel. (303) 922-5066
Telex 383559 SRK USA

October 8, 1984

Mr. James Sells
ASARCO
P.O. Box 5747
Tucson, Arizona 85703

RE: CALL ORIENTOR FOR DRILL CORE ORIENTATION

Dear Mr. Sells,

Thank you for your request for information on the above referenced product. I have enclosed our data sheet, as well as the first chapter of the manual.

We sell the Call Orientor for $1600.00 F.O.B. Denver. Please allow 4-6 weeks for delivery. We will need to know the type, manufacturer, and size of core barrel you will be using. Our price is based on the availability of a used core barrel like the one you use. We remanufacture the used barrel into the Call Orientor.

I hope this information is sufficient. If you have any questions, please do not hesitate to call.

Sincerely,

George L. Chedsey, P.E.
Manager

GLC/gg

Encls.

RECEIVED
OCT 10 1984
EXPLORATION DEPARTMENT

CLAY IMPRINT CORE ORIENTOR MANUAL

GEMS

Geotechnical Engineering and Mining Services Inc.

CLAY IMPRINT CORE ORIENTOR MANUAL

James P. Savely
Richard D. Call

March, 1981

Revised Edition

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THE CLAY IMPRINT CORE ORIENTOR

Abstract

An inexpensive clay imprint core orienting device, developed by R. D. Call, has a minimum of moving parts, is durable and easy to use, and adds only approximately 15 minutes to a core run. In order to use the orientor, an inclined hole is required, up to -70°? (horizontal?) and conventional wire-line drilling should be used. An imprint of the bottom of the hole is taken after each coring run. This imprint is matched to the top of the succeeding core run, the drill core is pieced together, and a reference line representing the drill hole is scribed on each core. Fracture attitudes are measured relative to the reference line and the core axis.

Construction of the orientor, imprinting procedures, measurement of fracture attitudes, and calculation of true orientations are described and illustrated in this manual.

1.0 GENERAL DISCUSSION OF CLAY IMPRINT CORE ORIENTING

1.1 Introduction

Geotechnical studies for mine design require a knowledge of not only the general geology but of the rock fabric as well. Adits or drill holes must be planned for subsurface investigation if sufficient information cannot be obtained by surface mapping. Even if surface mapping were possible, there is no assurance that fracturing at the surface (the sampled population) would correspond to that at depth (the target population).

Stability analysis for ultimate mine designs requires knowledge of the rock substance and rock fabric beyond the ore boundaries. Oriented drill core provides a means of obtaining this knowledge.

Until the development of the Craelius System (Atlas Copco ABEM AB; also see Roxtrom, 1961), core orienting was expensive because of the time required to orient the core, the expertise required to operate the orienting devices, and the equipment rental costs. The Craelius Orientor, a small device which fits inside the inner core barrel, is relatively inexpensive, but it is frustrating to use at a drill site because it contains intricate parts and a pin method for imprinting, which is difficult to match with the core.

1.2 Clay Imprint Core Orienting

An inexpensive core orienting device has been developed by R. D. Call. It has a minimum of moving parts, is durable and easy to use, adds only 15 minutes to each core run, and takes a reliable clay imprint of the bottom of the hole. Conventional wire-line drilling and a drill hole inclined 30° to 60° from the horizontal plane are used. The device

will not operate in a vertical hole.

The orientor is an eccentrically weighted, downhole device, which can be constructed in the mine shop by filling a 1 m length of an old inner core barrel half full of lead. Drilling fluid in the drill pipe surrounds the orientor during the operation and acts as a liquid bearing. In an inclined hole, the eccentricity produced by the weighted bottom of the orientor always causes it to rotate to the same position as it is dropped down the drill pipe. A line etched on the side of the orientor opposite the weighted side will be in the same direction as the drill hole.

Modeling clay is packed in the core lifter case that is screwed on the downhole end of the orientor. The clay packed lifter case is used for imprinting the bottom of the drill hole before each core run. Prior to imprinting, the drill string is raised about 6 in. (15 cm). The orientor is dropped inside the drill pipe and allowed to free-fall through a full mud column. When the orientor reaches the bit, the mud pump is engaged to hold the orientor in place at the bottom of the hole. In deep holes it may be necessary to engage the mud pump and to pump the orientor to the bottom of the hole. The drill string is lowered without rotation to take the imprint, and the overshot is then used to retrieve the orientor. The core lifter case containing the clay imprint of the bottom of the hole is unscrewed and then laid in the tray with the top of the core run next to the imprint. The imprint is matched to the top of the core run, the core pieces are fitted together, and a reference line, which represents the hole orientation is scribed on the core. This reference line is an extension of the etched line on the unweighted side of the orientor.

As the drill core is logged, angles are measured for each structural feature present. A drill-hole survey provides the

orientation of the drill hole and, thus, the orientation of the reference line on the core for various depth intervals. This survey is interpolated to specific depths in order to calculate the true orientations of each structural feature.

It is rare that the entire length of the drill core in intensely fractured zones can be oriented because it is impossible to piece the core together. However, if an attempt to imprint is made for every run, a good statistical sample of the fracturing can usually be obtained. In massive rock it may not be necessary to imprint every run if the core can be reliably pieced together from one run to the next.

1.3 Reproducibility of the Orientor

On a recent drilling project in quartz monzonite, two tests for imprint reproducibility were conducted. Test 1 was a 58° inclined hole, drilled to a depth of 97 ft. The orienting device was dropped six times. The first drop was considered the initial imprint, from which the variation in rotation of the five succeeding drops could be measured. Test 2 was a 52° inclined hole drilled to a depth of 513 ft. Table 1 summarizes the reproducibility of imprinting.

From the results of these two tests, the orientor averages about ±3° variation in location of the scribed reference line between imprints.

1.4 Comparison of Surface Mapping Data with Oriented Core Data

A recent study, in which both surface mapping and oriented core drilling were conducted, showed that the clay imprint core orientor could provide rock fabric data at depth that was consistent with rock fabric that had been mapped from surface exposures.

TABLE 1

Number of Drops	Test 1 Hole Depth = 97 ft Variation from First Dump	Test 2 Hole Depth = 513 ft Variation from First Dump
1	0.0°	0.0°
2	+3.0°	+1.1°
3	-2.2°	+2.1°
4	-1.1°	+5.3°
5	-2.2°	+1.1°
6	-4.3°	-4.8°

+ = clockwise rotation of orientor
- = counterclockwise rotation of orientor

Fracture set mapping and detail line mapping, both surface mapping techniques, described by Call, Savely, and Nicholas (1976), provided fracture orientation measurements. From the Schmidt plots (Figure 1-1), an orthogonal jointing system consisting of a dominant flat set and two vertical sets is evident. One trends northeast, and the other trends northwest. Some of the plots show another northeast-trending set with a dip near 60°.

The three core holes considered to be in the same structural domain as the surface data also show the same sets. Fractures parallel to the drill hole fall in a blind zone and are not intercepted. These blind-zone effects are obvious in the drill-hole Schmidt plots.

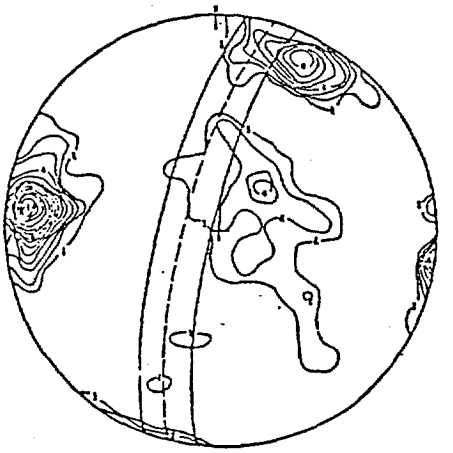
Similar studies have been completed where changes in fracture orientations occur with depth. Pit slope analysis and design were adjusted to include these changes.

1.5 Conclusions

Drill core can be reliably and inexpensively oriented using a clay imprint device. Tests have shown that fracture orientations can be accurately obtained from core drilled in an inclined drill hole using conventional wire-line coring procedures. The orientor is simple, with a minimum of moving parts; mechanical failure is, therefore, nearly eliminated. The clay imprint on the bottom of the hole produces an imprint that can be reliably matched to the extracted drill core. Since the drill core must be fitted together in the core tray, some drill runs in intensely fractured rock cannot be oriented. However, in most holes a sufficient number of fractures can be oriented to give a good statistical sample of the fracture population. Major structure, as well as rock fabric, can be oriented.

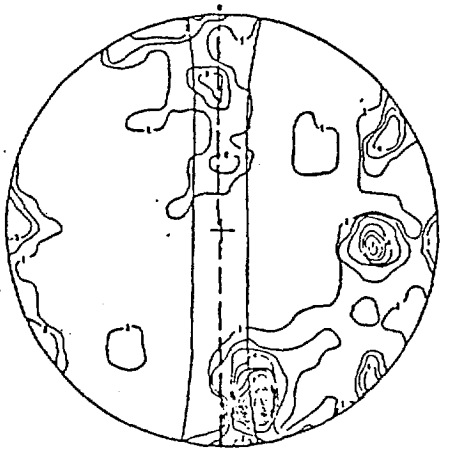
SET MAPPING
191 PTS.

CORE HOLE 1
297 PTS.



DETAIL LINE 1
152 PTS.

CORE HOLE 2
258 PTS.



DETAIL LINE 2
160 PTS.

CORE HOLE 3
512 PTS.

FIGURE 1-1: COMPARISON OF LOWER HEMISPHERE SCHMIDT PLOTS OF FRACTURES FROM SURFACE MAPPING WITH ORIENTED CORE DATA

This system has been used with both side-discharge and face-discharge diamond bits and with single, double, and triple tube set-ups.

SMALL CAMERA WITH BIG ADVANTAGES

2.75" DIA. CAMERA

Well Scan's small well inspection camera has a diameter of 2.75 inches, the smallest TV camera in the state. It is small enough to inspect 3-inch boreholes, NX core-holes, and comes in handy for fishing operations and other special applications.

The low-light Newvicon tube in this little camera produces 650 lines per inch of resolution, over twice the resolution of color cameras. Both Well Scan's standard wide-angle TV camera and this small-diameter camera have high-resolution Newvicon tubes and are coupled to an 850-lines-per-inch monochrome TV monitor. This means a sharp, clear, steady picture for the viewer. It also requires less light. This low-light feature gives better visibility, even in wells with suspended solids and murky conditions.

COMPASS SURVEYS

This small-diameter camera is equipped with a magnetic compass which indicates direction in uncased boreholes. The compass is mounted on the back of the lighthead and is illuminated so it can be seen live on the TV monitor. The borehole, the footage, and the compass can all be seen at the same time, so direction of fractures, etc., can be determined. This directional orientation in uncased boreholes is valuable for fracture studies, borehole analysis, and for geologic evaluation.

Well Scan offers a wide range of services for well and borehole needs: Sonar-Jet well cleaning, water sampling, and surveys including standard wide-angle TV survey, side scan survey, and temperature survey.

MORE REASONS TO CALL WELL SCAN — (602) 841-0219

WELL SCAN VIDEO SURVEYS, INC. (602) 841-0219 3713 W. CAVALIER DRIVE PHOENIX, AZ 85019

BEFORE WELL REHABILITATION, CALL
WELL SCAN
Your TV and Sonar-Jet Specialists

TV INSPECTIONS

Before rehabilitation work is begun on a well, a well scan will give you a solid evaluation of what needs to be done to restore the well. The downward-looking camera shows you live on the TV monitor the condition of the casing and perforations, identifies any structural damage, and verifies depth.

The side scan can be utilized to get a second perspective on any troublesome areas. The side-looking lens is particularly useful for studying breaks and the extent of the plugging of the perforations, especially horizontal perforations.

Featuring:

- improved lighting system for large diameter wells
- high-resolution camera and monitor
- videotaping all surveys for review and documentation
- professional service and equipment
- Polaroid pictures, if desired

SONAR-JET

Sonar-Jet well cleaning is a proven process for quickly and effectively removing incrustation from well casing and opening plugged perforations. Sonar-Jet utilizes mild frequency shock waves and pulsating gas pressure jets to clean the well. The shock breaks up and loosens incrustation; the pulsations wash the water back and forth through the perforations, removing particles of plugging material.

Excellent for cleaning well screen and louvered casing which are difficult to clean by other means, Sonar-Jet is especially beneficial when time is critical. Usually Sonar-Jet cleaning can be done in a matter of hours.

Call Al Katz if we can be of assistance in your well rehabilitation work. We look forward to being of service to you.

WELL SCAN VIDEO SURVEYS, INC.
(602) 841-0219 3713 W. Cavalier Dr. Phoenix, AZ 85019

SEE IT OUR WAY -- SEE IT FOR YOURSELF

WELL REHABILITATION

Before rehabilitation work is started on an old well in poor condition, a well scan will give you a solid evaluation of what needs to be done to restore potential yield and performance of the well. Plugged perforations and well screens can reduce well efficiency and capacity --and increase pumping costs. You can see the perforations in clear detail, noting whether they are open or sealed over due to corrosive bacteria growths, mineral deposits, or other encrustation. The TV survey will help you determine what procedures are necessary, such as Sonar-Jet cleaning, acidizing, chemical treatment, or installing a casing liner. It will also show the condition of the well before going in to deepen the well.

UNKNOWN CONDITIONS

Where records of a well are lost or unavailable, a well scan will show the static water level, perforated areas, type of perforations, liners or reductions in the well, and current depth. The camera is a useful tool in assessing if an abandoned well is salvageable. Of course, it will also reveal any obstructions and casing damage.

FISHING OPERATIONS

When dropped pumps, tools, or other debris are in a well, a good close look with the camera at the shape, depth, and position of the object makes it easier to recover. A well scan saves time and aids in the design or selection of the appropriate fishing tool.

STRUCTURAL DAMAGE

This is a problem, especially in older wells and areas of subsidence. Most casing damage, such as ruptured, telescoped, and collapsed casing, separated joints, and holes, is repairable. A video inspection can pinpoint the trouble, so that appropriate repair tools or procedures can be selected.

GENERAL INSPECTIONS

Routine inspections when the pump is pulled for repairs can reveal unsuspected damage and potential problems. This routine inspection may show the reason for excessive pump wear. Detecting and correcting problems in the early stages minimizes damage, cost, and downtime.

NEW WELLS AND BOREHOLES

The videotape of a well gives you a permanent record of that well for future reference. This videotaped documentation of a new well can be the basis for a program of preventative maintenance. In borehole inspections, you can see fractures, cavities, and formation type.

WELL SCAN VIDEO SURVEYS, INC.

(602) 841-0219 3713 W. Cavalier Dr. Phoenix, AZ 85019

CORPORATE OFFICE

JOY MANUFACTURING COMPANY
ONE OXFORD CENTRE
301 GRANT STREET
PITTSBURGH, PENNSYLVANIA 15219
Phone: (412) 562-4500

Joy Contract Core Drill Division is celebrating its 100th anniversary this year. We have enclosed a reprint of an advertisement that commemorates this milestone.

We are extremely proud of our solid record of achievement over the past century. The entire Joy Contract Core Drill Division family looks forward to providing customers with many more years of reliable service.

Sincerely,

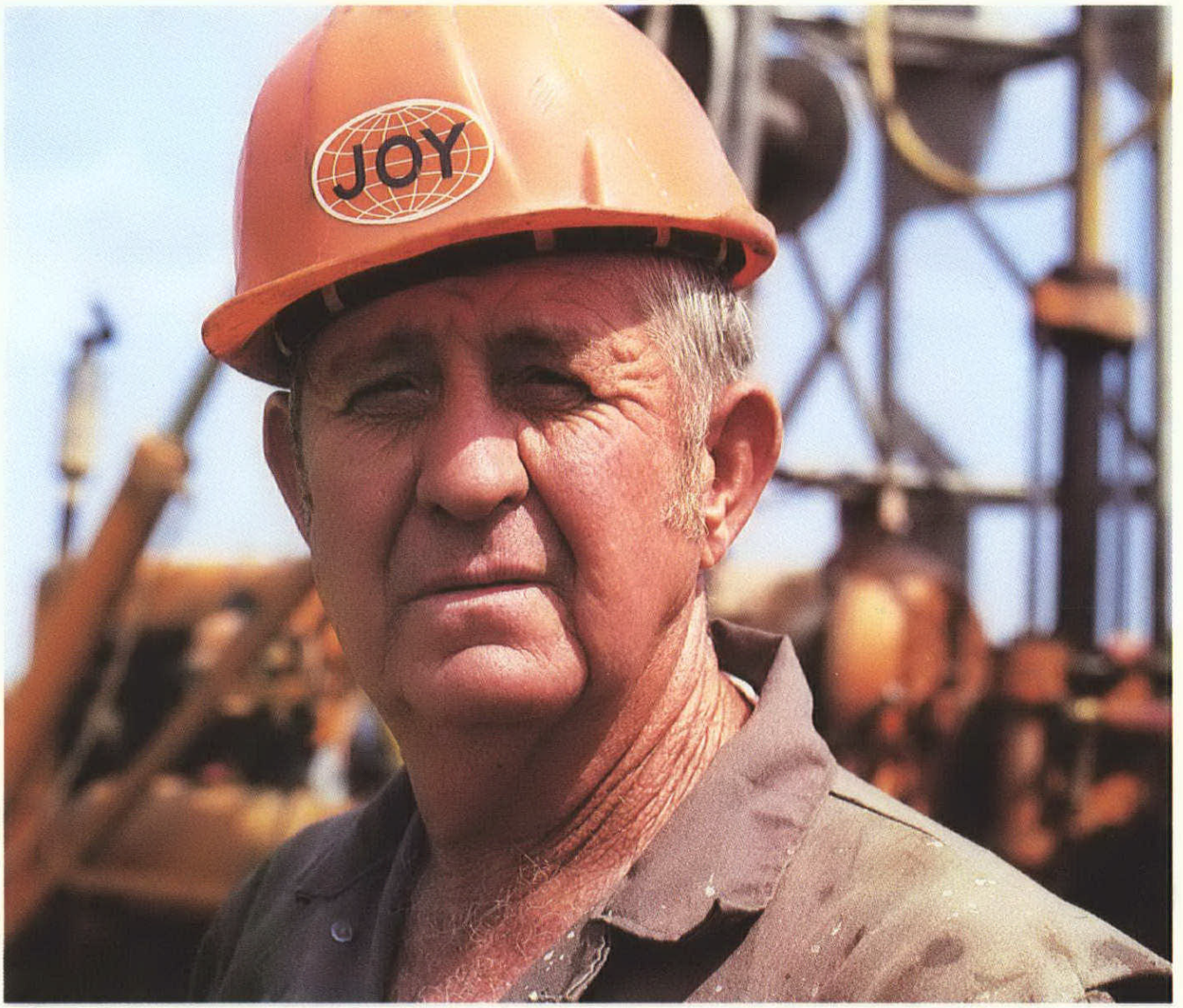
Jim Koontz
General Manager
LaPorte, IN 219/362-2191

ASARCO Incorporated

DEC 26 1984

SW Exploration

Experience.



It can't be taught.

When Leland Machen joined Joy Contract Core Drill Division in 1953, his father already had been working for us for almost 20 years.

Leland is typical of the Joy employees working on our drilling teams. They're a special breed. Tough. Sophisticated in the use of the latest drilling techniques and technology. But with a certain kind of horse sense that just can't be taught.

Call it experience.

The members of our drilling teams bring an average of over 15 years of experience to the job site. Like Leland, they know the importance of maintaining the absolute confidentiality of core samples. And they work to fulfill Joy's commitment to its customers of guaranteed satisfactory core recovery on every job.

Since 1884, we have been providing exploratory and developmental contract core drilling services for metallic and nonmetallic minerals for investigation of dam sites and underground gas formations, and for foundation testing. So when you deal with Joy, you're dealing with people who have learned many lessons that just can't be taught.

Joy Contract Core Drill Division celebrates its 100th Anniversary this year.

For information on our services, call or write:

Joy Manufacturing Company

Contract Core Drill Division, Marketing Services
301 Grant Street, Pittsburgh, PA 15219
(800) 458-1115—Outside Pennsylvania
(800) 458-1116—Within Pennsylvania