From the Editorial Board

MARY NODINE

Drilling and sampling of soil and rock form the basis of most geotechnical site explorations, and this has been true for the century-long history of geotechnical engineering as we know it. Despite numerous technological advances over that time span — including the development of geophysics, automated laboratory testing equipment, and drone imagery, to name a few — the technology for geotechnical drilling and sampling has changed little. Data collected during drilling typically includes standard penetration test blow counts, and visual/manual observations of a sample extracted from the borehole. Apart from visual and auditory observations of the drilling process, no data are collected between sample locations.

Imagine if there were a way to objectively measure the response of the drill rig to soil or rock, and collect that data continuously during drilling. What a powerful tool that would be to determine layer boundaries, compare material response in boreholes across a site, and measure relative stiffness and strength! The good news is that unbeknown to many geoprofessionals, this technology, known as Measurement While Drilling, is available and used throughout the world. While it's familiar to many for its application as part of QA/QC for deep foundation drilling and grouting, the use of MWD for subsurface exploration is not yet widespread in North America, and especially in the U.S. In this issue of *GEOSTRATA*, we explore MWD from a variety of perspectives to educate readers on everything from basic concepts, to advanced interpretive methods, to case histories, to development of a standard, aiming to raise awareness about one of the industry's best-kept secrets in subsurface exploration.

What's Inside?

First, a note: You might notice that several articles in this issue include introductory material defining MWD and describing the instrumentation used and the data collected, because the technology is new to many readers. For this issue, we've elected to leave this content in the articles even though it's somewhat redundant within the issue, so that each article could have the necessary background information to stand alone. So skip over content that's obvious to you, and instead focus on the innovative perspectives provided in each article!

Frédéric Malinet kicks off the issue with a forward-looking commentary "What's the Current State-of-the-Art in MWD and the Latest Digital Technological Advances in the Field?" In it, Malinet explores the question of what it will take for MWD to achieve widespread acceptance and maximum utility — namely, measurements independent of the machine- and operator-related factors that can provide information about the formation itself. He explains why artificial intelligence and cloud-based processing will be essential to achieving this goal.

Jean Benoît has been performing research on MWD for decades, but he steps back in time to present an overview of the technology in his article "Measurement While Drilling: Listening to the Rig." Benoît and his colleague Bruma Souza describe the what, why, when, and how of MWD, and introduce practical aspects such as data processing basics and common applications and advantages. If

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MWD is new to you, this article is a great place to start.

MWD has been used by many public agencies to enhance their drilling operations, and two articles in this issue present case studies illustrating the practical aspects of this technology. Benjamin S. Rivers paints a nationwide picture in his article "MWD in the USA: Tales from Agencies Coast to Coast." From characterization of limestone in Texas and Florida, to correlations of hollow stem auger data with shear strength of intermediate geomaterials in Montana, state transportation departments are finding value in MWD. The U.S. Bureau of Reclamation has also made use of the technology, as documented in "Show Us the Data! From Installation to Operation — Implementing a MWD System," by Evan J. Lindenbach, Jack R. Foran, Dustin T. Morgan, Mike Procsal, and Jared Vauk. The authors describe some of the practical challenges and considerations involved in installing and using an MWD system, and explain how the data collected will fit into the bigger picture of the Bureau's site characterization efforts.

No test method can achieve successful widespread use without a standard to ensure consistency. In his article "Standardization of MWD through ISO 22476-15: A Step in the Right Direction," Philippe Reiffsteck describes the development of a Eurocode standard for MWD, and the type of information this standard includes. This standard will likely inform a future AASHTO standard here in the U.S., as alluded to by Rivers in his article.

The uptick in MWD use for site exploration is perfectly timed with developments in artificial intelligence and machine learning, which will greatly improve the value and utility of MWD data. This synergy is described in the article "Breaking Ground With Smart Drilling: How MWD Enhanced by Machine Learning Can Reshape Geotechnical Engineering." In the article, Tugce Baser, Anshu Abhinav, Michael Rodgers, Ann Sychterz, Scott Kassel, and Bradly Hessing describe some of the particular challenges of using ML with MWD datasets, and the power of ML to aid in functions such as determining strata breaks and developing correlations between measured parameters and geotechnical properties.

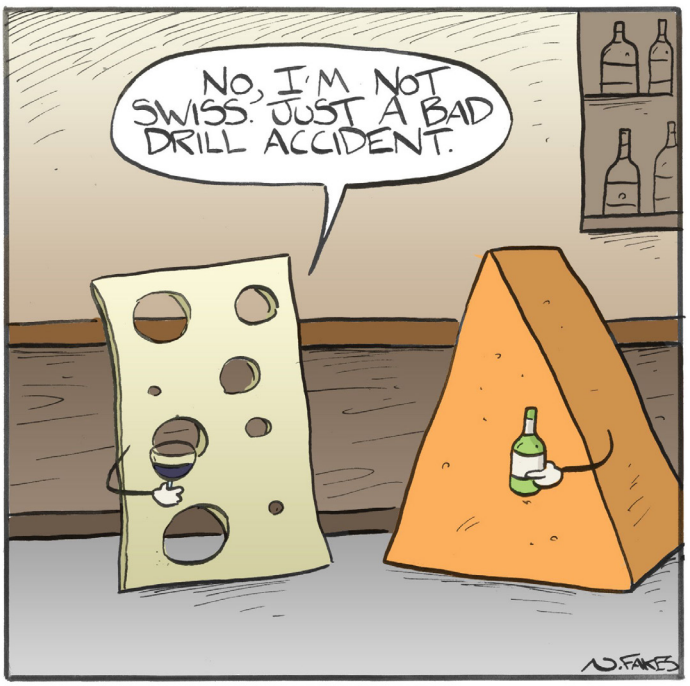
You'll find some MWD-free content in *GEOSTRATA's* regular features in this issue. Yi Zhong, Zi Yu, and Shivangi Jain interviewed this issue's GeoLegend, Les G. Bromwell. His career took him from soil research for lunar expeditions, to a reservoir in Venezuela, to sinkholes throughout the U.S., and his story about establishing Karl Terzaghi's library at the Norwegian Geotechnical Institute is particularly interesting. In the InGEOnius Innovations column, Ross Cutts and Travis A. Shoemaker write about Geosetta, a public repository of geotechnical data — descibed as "Google Earth" for the underground. Geosetta has the potential to revolutionize the way we perform site reconnaissance — and like MWD, harnessing the power of machine learning will make its data even more useful.

Finally, my pair of GeoPoems entitled "Bridging the Gaps" uses words to compare the level of detail MWD might provide with a typical subsurface exploration program of drilling and sampling. (*Editor's note*: Check out Mary's clever layout, which amplifies the level of detail differences between the two exploration modes poetically portrayed.)

Whether you've been leveraging MWD data for decades or the technology is brand new to you, we hope you find something enlightening as you "drill down" (*pun intended*) into this issue of *GEOSTRATA*. And if you have an ear to industry events, you'll likely hear more about MWD for site exploration — there will be a half-day, MWD-focused workshop at the upcoming IFCEE conference in Dallas in May 2024, and I hope you'll attend! As always, thank you for reading, and we look forward to hearing from you.

This message was prepared by **MARY NODINE, P.E., M.ASCE.** She can be reached at *mary.nodine@dot.gov*.

GeoCartoon



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