From the Editor

In the last issue I promised to poll the membership on the question of changing the name of *The Log Analyst*. The poll form can be found on page 434. Please register your opinion as soon as you can. Today, if possible.

In this spot in several recent issues, I have decried the lack of manuscript submissions in the past year. As I write these words I do not know whether the September-October 1999 issue of *TLA* will be the first one-paper edition of the journal. If it is not it will have been through the Herculean efforts of my associate editors and several authors. However, it has become abundantly clear to me that if we are to continue to have a six-issue-per-year journal then I am going to need to be proactive in finding manuscripts. Accordingly, I have invited the authors of several of the papers appearing in the Oslo symposium to submit their manuscripts for peer review, and all have accepted. These invitations were extended to all those included in the top 15 positions in the voting for best paper or best poster. In this way I avoid exercising my personal bias. I shall also be reaching out to the several chapters and associations of chapters that sponsor periodic mini-symposia as a source for inviting papers. I have also been receiving, gratis, issues of the Chinese counterpart to *TLA*, a Chinese language journal called Well Logging Technology. I have to admit that I have some trouble with the text of the articles, but the abstracts and titles are in English, and the equations and figures are also informative as to the content. So I will be inviting English language versions of selected articles from that journal. From these and a variety of other sources that colleagues have suggested, I hope the manuscript pipeline will be full again in two or three months. Of course *TLA* still wants *your* original contributions too.

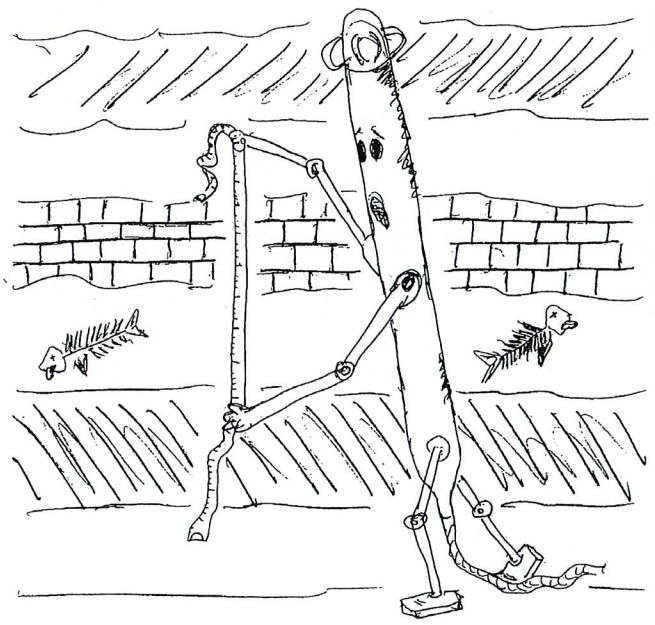
This issue will carry the first of a series of columns by Kenneth Mahrer reprinted from *The Leading Edge* magazine of the Society of Exploration Geophysicists. I solicited the column, entitled Writer's Block, because it will be helpful to new authors generally. It will also, after a time, allow me to vector authors to various suggestions for effective technical writing that will have been printed in our journal where hopefully they will reach many who are not members of SEG. I have found Mahrer's articles both entertaining and informative.

The purpose of the editor's column is to keep the membership informed regards activities impacting the journal. I have not used it in the past as a bully-pulpit, much as I like to preach, since it did not seem fair that I should have it while others did not. I have now decided that (to paraphrase George Bush's famous opinion regarding broccoli) "hey, I'm the editor. I can write an editorial if I want to." In the past several years I have perceived that those of us who like to study instrument responses are not doing a good job of communicating to our colleagues who like to evaluate formations. This has been brought home forcefully to me in the past two months as I have tried to explain to technologists and managers in my own organization and within one of the service providers why modeling is essential for formation evaluation in horizontal wells.

If after reading the following editorial you are moved to express a different opinion, then I will be pleased to offer you a forum here for your case. Actually, I think a lively debate on the topic would end up being an effective vehicle for educating the membership on this topic. Without further comment, here is my first . . .

Editorial

Sooner or later every practicing petrophysicist or log analyst will be shown two resistivity logs over the same interval, usually an induction log and a laterolog. A geologist or reservoir engineer, or even a manager, will ask: "Which one of these logs is correct?" By which he will mean, since in the interval he is pointing at the apparent resistivities have significantly different values, one of the apparent resistivity values must be "wrong," meaning not equal to R_t.



LOGGING TOOL 'MEASURING' A FORMATION

Over other intervals the apparent resistivities are the same. Does one of the logging instruments have a subtle defect? The log analyst is forced to choose. However, the actual case may well be that both instruments are in fine fettle and that their apparent resistivity responses happen to be different at the spot where the questioner is pointing.

How can we engineer the thought processes of our colleagues and managers so that the question that they ask is "Since these instruments are responding differently, how can that information be used to infer a good estimate of R_t?" I think the process begins with reengineering our vocabularies.

It is true that you cannot think what you cannot say. A corollary is that you can think *only* what you *can* say. Whether we entered the profession as field engineers or by other avenues, each of us was exposed to a lexicon that includes the phrases:

This tool *reads* the resistivity in the virgin formation.

That tool *measures* the density in the formation close to the borehole.

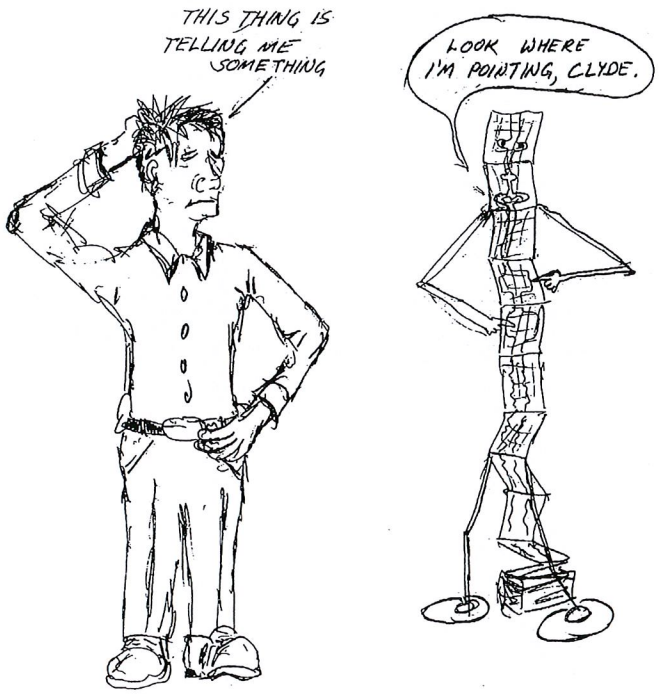
The log is *saying* that invasion has occurred.

or even

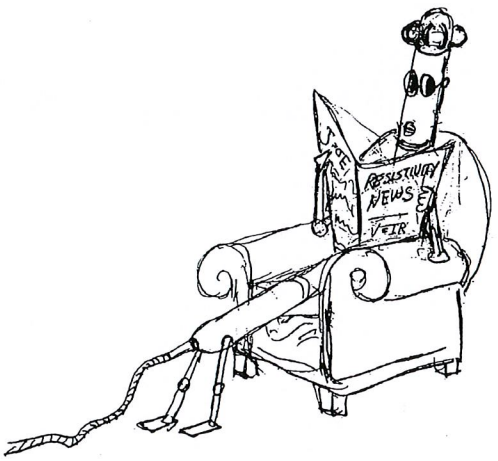
What are the rocks *telling* us?

I suggest that our thinking would be expanded if we replaced the word *tool* with "instrument" in almost every utterance. A crowbar is a tool, and I bet some of you have seen logging instruments used as crowbars. However, "instrument" is evocative of a tool used in an exacting environment, such as an operating room or physics lab. Still, instruments *are* tools, albeit special ones. However, there is no way that a logging instrument reads, or measures, or says *anything*. Logging instruments *respond* to their environments. The "raw" response taken at a transducer output is always either a voltage or a current. The responses are then calibrated by comparing them to responses in the simplest possible (and therefore unrealistic) media, typically infinite, homogeneous, and isotropic (although some may contain a model wellbore filled with a "typical" fluid). We then make the mistake of endowing the calibrated output of the instrument with a false air of reality by referring to it as a *measurement* or a *reading* of some formation property. However, if the assumptions of the calibration are unmet, the outputs in the calibrated units (say ohm-meters) are *meaningless* in terms of the formation parameter they purport to *measure*.

At a recent luncheon at my local SPWLA chapter one of the Society's Distinguished Speakers made a presentation concerning the differences between LWD and wireline measurement. In the printed abstract appears the phrase "... the deepest reading wireline induction measurement matched the shallowest LWD resistivity measurement ...", but, as I remember, this came out verbally in the presentation as "The deep reading induction device reads R_{xo}, while the shallow reading LWD device reads R_t." This certainly expresses at least a verbal paradox, something like Zeno's paradox of Achilles and the tortoise. And the presentation was, after all, about reconciling such apparent differences. But, to my ear such statements are worse than paradoxes. They are linguistic monsters. However, if we are willing to



A LOG "TELLING" THE ANALYST WHERE THE OIL IS.



LOGGING TOOL 'READS' RESISTIVITY

recognize that a logging instrument response is *not*, for example, a resistivity value, but an output depending on the conductivity tensors of the heterogeneous conductivity distribution surrounding the instrument, and upon the orientation of the instrument with respect to these tensors, then we are not saddled with the mental image that apparent resistivity responses should equal a "true" resistivity, or that the responses of different instruments should be equal to each other. I have put "true" in the quotes because in an anisotropic medium the resistivity of the medium depends upon direction at each point in the medium. In such a case there i*s more than one resistivity value at each point* in the medium. Resistivity logging instruments respond to a combination of these tensor components that depends upon the relative orientation of the instrument and the tensor axes. So what, then, is the "true" resistivity?

I have been reminded by a recent letter to the editor from Ken Heslop, remarks in Alan Mitchell's letter appearing in this issue (page no. 308) and also several comments from the floor at the Oslo symposium, that some of our brethren whose primary job responsibilities and interests are formation evaluation are exasperated with, especially, the resistivity instrument designers and modelers. Their view must be that we are merely having fun with our computers. Apparently the message has not come clearly across that industry scientists are only now beginning to understand the complexity of the interpretation of resistivity instruments [see the last sentence in the conclusions section on page 342]. I have close colleagues who will go to any length to avoid using a resistivity-based method to estimate water saturation in a reservoir. This attitude develops from their having looked at many "resistivity" logs whose apparent resistivity readings, even after corrections were applied and state of the art modeling attempted, could be reconciled neither with core analysis nor formation tests nor production history. The time for all to acknowledge that the classical model for the near-borehole environment and the reservoir itself was too simple to accommodate many logging problems, both now and in the past, is here. Once this fact is starkly evident, perhaps their detractors will be more tolerant of the modelers [or "inversion addicts" as they are, no doubt affectionately, known to A. Mitchell, page 308].

Horizontal wells are now forcing a rethinking of the meaning of formation resistivity. In the days of vertical wells drilled through horizontal beds we could get by relatively consistently by referring to the horizontal component of resistivity as R_t. Sure, the instrument response was calibrated in apparent resistivity, R_a, but the paradigm held that if appropriate corrections were applied then R_t could be recovered from R_a. And never mind that the corrections are mutually incompatible (i.e., the thin-bed corrections leave out the borehole and invasion; the tornado charts for correcting invasion leave out shoulder beds). Tornado charts are inapplicable to most 'thin' beds (<10 meters), and the degree to which a step-invasion profile is ubiquitous is unknown. Once we realize that in addition to the complications of shoulder beds and drilling-induced radial conductivity variation and (so-called) polarization horns, we have to consider that at each point in the rock it takes up to *six* numbers to specify the conductivity (three to specify conductivity in three orthogonal directions, and three to specify these directions with respect to up-down, north-south, east-west), we then begin to appreciate the need to reengineer our vocabularies [see the last sentence in the first paragraph in the abstract on page 327].

In this issue one of the articles features the word "tool" in the title. Upon inviting one of the authors to consider changing that word to "instrument," his 'response' was that he would consider it if all the service companies also made the change. So, if it is leadership that is needed to start such a change, let *The Log Analyst* and the SPWLA membership set a new standard by encouraging all authors to choose their words thoughtfully. And with this thought in mind: The real world, especially as viewed from a horizontal borehole, has more complications than our customary logging vocabulary is able to express. We can judge our success in re-engineering our vocabulary when the geologists, engineers, and managers, having called us into their offices for an opinion, and pointing at an interval say "the laterolog and induction instruments are responding differently to this interval. What information does that give us about the fluid distribution in the rock?" Unless we all begin to recognize the need for a richer and more accurate vocabulary, we will continue to be forced to choose between the apparently different outputs of correctly functioning instruments.