EXPLORATION FOR NEW OIL IN OLD WELLS BY NUCLEAR LOGGING

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"When I was a third grade student at Moore School No. 5 some 40 odd years ago in Iowa, my teacher, Miss Schwartz, lectured her charges sternly on the imminent shortage of oil, saying there was but 25 years' supply remaining. I think Miss Schwartz supposed that she would go right on driving her 1928 Nash until the 25 years was up in 1953, whereupon gasoline would become extinct and she and every other auto driving citizen would en masse abandon their cars and shop around for another mode of transportation that hopefully would have become available, thanks at least in part, to her own timely warning.

"Of course, Miss Schwartz' estimate was a little pessimistic, but she couldn't have been expected to anticipate the discovery of vast reserves of oil in remote parts of the world, nor could she know that the proprietors of those lands would have so little need for their own oil that they would share it—up to a point—with the oil-poor nations of the world.

"Perhaps, in a subliminal way, it was Miss Schwartz' early admonitions that oil would become scarce that moved me to follow a professional career in well logging research, in which the greatest technical challenge and the most important single objective has been to develop instruments for finding oil that would otherwise go undiscovered in cased wells.

"Of course I admit that I was motivated more by the need for making a living than by altruistic concern for the ultimate well-being of the American automobile driver. Nonetheless, it was sometimes comforting to reflect on the certain prospect that eventually oil would be scarce; and that it would be important to conserve oil that would otherwise be lost; and that a career spent in pursuit of this goal could claim the virtue of high social purpose as well as the prospect of commercial value.

"I relate this background information to emphasize the fact that for 25 years I have sincerely believed that exploration in old wells to locate new oil was an objective which was technically feasible, commercially desirable, and socially significant. Today, although these phrases are in my opinion still appropriate, it appears timely to review the progress that has been made to see how far we may be short of our goal and try to judge the extent to which further research and development are justified. The facts are these:

1. Nuclear well logging has advanced to a point where oil can often be recognized in cased-off formations.
2. Further improvements in these techniques could still further increase the accuracy and reduce the ambiguity of nuclear logging methods to the end that an even greater proportion of cased-off oil could be discovered and assayed.
3. The Neutron Lifetime Log and the more recent carbon/oxygen ratio log, which are uniquely capable of finding oil, are run rarely as exploration tools except as a last resort: i.e. after divining rods, Ouija boards and mother-in-law's hunches have failed.
4. High social purpose is not sufficient justification for research and development of complex and expensive new logging concepts; nor does it even get wells logged after the equipment is developed.
5. Finding oil in old wells is a concept to which everyone pays lip service but for which no exploration money is budgeted.

"My company has supported research in nuclear

logging for over thirty years and I am sure they will continue to do so. But the extent of the research, and the pace of progress, are necessarily geared to the needs and demands of the industry (preferably to the needs—because demands are sometimes fickle). So for example, if we were to develop a new log today, we could not unilaterally force its adoption and use by the oil industry; and years might pass before it found significant commercial acceptance, if it were ever to do so. But if ten years were now to pass before a new development came into general use, it would have come, in fact, too late to help in meeting the energy crisis.

"Now as it happens we have "today" developed such a log. The carbon/oxygen ratio log is a logging measurement made with a sophisticated new nuclear instrument first described in October, 1973 at the Las Vegas SPE meeting. It can assay the carbon content of a cased-off formation with high precision and thus it comprises an oil-finding method, which—at least in sands—is not only accurate and reliable, but is in fact commercially available. For the more subtle problem of finding oil in carbonate reservoirs, more measurements than just carbon and oxygen are required to determine how much oil is associated with the assayed carbon and how much with the carbonates in the rock matrix. But happily those measurements too can be made by nuclear techniques involving gamma ray spectral analysis. These new logs supplement the Neutron Lifetime Log, which for ten years has been gaining in acceptance as a cased-hole oil finder wherever formation waters are relatively saline. The carbon/oxygen ratio log does not have this limitation, and will find oil even when it is associated with fresh water or with very shaly sands.

"So it is fair to say that logging methods are available which make it feasible to find oil behind casing with existing commercial equipment. But these developments have not taken the industry by storm. They have not even created a stir. These logging methods which seemed so desirable - so beneficial - so essential - in times past when we had not the faintest notion how to attain them from a technical standpoint: now they are attained and have been greeted with a yawn. It appears that nobody is interested. True enough, there have been lots of inquiries; and a few dozen logs have been run. But no line has formed of eager prospective users awaiting their turn. Could this mean that no one needs a log that will find oil? Is it not good enough to meet the demand; or was there in fact never a need? Or was there a need just as we supposed, but this new opportunity to exploit available logs has been so far overlooked or ignored? My thesis is that the last is true and a hypothetical example will show why this might be expected to happen.

"Let us for a moment assume that in fact the available techniques were accurate and infallible under every reasonable circumstance. How many wells do you think need to be surveyed to find some by-passed or overlooked oil? Not many, you may be sure. But probably more than one, and maybe several. How many wells need be logged to find a significant untapped oil stringer or lens? Quite a few, perhaps, but hardly thousands, we can be sure. Indeed, it seems most unlikely that 1000 wells—any 1000 wells anywhere in the world—could be logged without finding a significant unknown pay zone. And the total cost of such a venture would be like that of one new well. Where, in the oil business, are there better prospects for success? But what are the chances of its being done? The chance is of course negligible, for a clear and simple reason. The log only finds oil—it doesn't put oil in the well. And if the odds are 1000 to 1—or 100 to 1—or even 10 to 1 against a significant return from a log on a particular well then hardly any production engineer is going to run it on that particular well. An exploration man would likely leap at the chance. But a production engineer is paid to budget expenditures and plan production; not to gamble on logs that might increase reserves. Indeed, he likely would be censured for running it. And worse yet, the log is not infallible, so the odds are poorer that ever: not likely twice as bad as the hypothetical, whatever that may be, but certainly poorer.

"So one sees that despite having attained some of our loftiest objectives, we have for our pains a new service which can find oil only where oil is to be found. This, it now seems clear, is not what the industry wanted. What was wanted was a logging method that would find oil where none existed.

"The problem of selling a new idea like prospecting with a carbon/oxygen ratio log is magnified by the coy reluctance throughout the industry to accept at face value the claims of the vendor, who is suspected of hucksterism, chicanery and misrepresentation; additionally, the customer is bombarded by counter-claims by competing service company representatives; and

to boot, the customer himself may find it difficult to judge the technical merits of the service or its applicability. The result of this understandable recalcitrance on the part of the oil companies is that continued research and development are inhibited by justifiable doubts on the part of the service companies as to the marketability of the service. This self-enforced deprivation by the industry discourages development methods that would, if exploited, increase oil reserves and production rates.

"A case in point relates to the Neutron Lifetime Log and its use in locating gas-bearing formations. The Neutron Lifetime Log is, as many of you know, the most sensitive method available for detection of gas in cased wells. It is uniquely effective in shallow sands where evaluation is difficult by other logging methods even in open holes. It has been used for this purpose in hundreds of wells with outstanding success. Consider, then, the amount of untapped gas which could be found by logging, say, 1000 wells. And again, the cost of logging these wells would be less than many an individual new well; less than the cost of a single nuclear stimulation project.

"But I see no chance that such a project of gas exploration by logging could be financed. There is plenty of precedent for spending millions of dollars in search for gas by both the government and the oil companies, but there is no mechanism for financing the use of cased-hole logs for exploration. The cost is too high, it is said; or the risk is too great. But the cost is not too high; nor is the risk as great as other exploratory methods. It is simply not a viable exploration method because it has never been made a significant part of the industry's oil exploration program.

"I have chosen to make these remarks for a reason that seems a compelling one to me. My company has invested millions of dollars and I have invested my personal lifetime career in the development of nuclear logging techniques which were intended and expected to play an important role at that crucial moment in history when oil would be scarce but when adequate substitutes would not yet be available. That time is now. In a few years the importance of liquid hydrocarbons will begin to decline, and with it the urgency that might reasonably motivate us to spend $10 a barrel for quickly recoverable oil. If the Neutron Lifetime Log, the carbon/oxygen ratio log, and related nuclear logging techniques are, as I believe, capable of making a significant contribution, their evaluation must proceed faster and a greater commitment to construction of new instruments must be made.

"This can only be done if the industry confirms their own commitment to the use of such services by participating in field tests with less parsimony and by supporting existing cased-hole services like the Neutron Lifetime Log from which we derive the impetus to pursue further research and development. The question to be answered by workers in the industry is whether or not they can economically use an oil-finding log to find oil. If the log costs too much; or if the attendant and associated plumbing costs are too high; or if it is simply an unattractive way to use the company's money and manpower; then our quest for new methods to find cased-off oil is a fool's errand which should be abandoned or deemphasized in favor of other technological goals that might be more ardently embraced by the industry when they are made commercially available.

"Possibly people have been unaware of this dilemma which faces us. Possibly it has been presumed that advances in well logging are free for the asking—or inevitable. But the fact is that advancements in this field come only at great pains and at the price of reduced effort in other lines of endeavor. And unless there is a real prospect that exploration of old wells will become a major program within the next decade it appears to me that research and development presently in progress are doomed to economic failure.

"I wonder if my view is justified, and if so, whether some plausible means might be discovered to alter the situation. It seems to me that there must be a way to speed the development and hasten the commercial application of the new nuclear logs which can find cased-off oil. These logs are capable of increasing the known hydrocarbon reserves of the nation without drilling a single well. A systematic program for increasing the use of such logs would automatically guarantee an increased rate of development of further improvements by the service companies as well as accelerated improvements in interpretation and application techniques. Who will take a stand against such laudable objectives? And who will strike a blow toward their attainment?"

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