APPRAISING OIL & GAS PROPERTIES

A Newsletter for Appraisal Professionals

Richard J. Miller & Associates, Inc. Vol. 4 No. 4 August, 1999

First - A little News

Rita, Rita, Meter Maid - Here in Surf City, as Locals refer to Huntington Beach, we are into Typical June Weather: "Low fog burning off by noon. Air temperature 70-80'F, Water temp. 62', light winds, SW swells 4-6 ft. in triple sets," a condition which lasts from late April through mid-September. Things are good at the beach. Actually there was quite a flap in our fair city earlier this year. Our illustrious City Council decided that the city did not have enough revenue. After installing digital parking meters that charge 250 for 10 minutes up and down Pacific Coast Highway and on every possible space within walking distance of the beach, they made a deal with Coca-Cola™ by which Coke™ ponied up a few bucks and, in return, could slap its name all over the place - lifeguard stands, trash cans, top of City Hall, you get the idea. These was some concern that the police cars would have to be redesigned to look like Coke™ bottles - sort of like the Oscar Meyer™ Weiner Wagon. However, there was a sufficient stink raised, particularly after the national media got hold of it, that most of the plan got shelved. By the way, the hi-tech parking meters do not work - something about sand sensitive innards in a salt air environment - but that does not inhibit the local Meter Maid. Bummer, dude.

Tires, Bees and Expertise - I borrowed that phrase from Peter Huber (see Book Reviews). In the December, 1998 newsletter we discussed several court cases which related directly to expert opinion regarding appraisal issues. One of these was Kumho Tire Company vs. Carmichael which, at the time, had not yet been decided the U.S. Supreme Court. Well, the wait is over. See Legal Beat.

Opening Day - We had a mild winter up at the cabin which sort of balanced the 40-day deluge we had last year (see more on Noah below). The wild flowers are kind of sparse and the creek is dry. Because of the warmer weather, Opening Day came early. Someone said "House needs paint." The Time Had Come. After ritual chants and appropriate sacrifices to the Power Roller™ gods (with music by Wagner), the painting season was underway. The sounds of the breeze in the trees and scolding blue-jays were joined by the enthusiastic Pop! of paint can lids, scrapers on wood, the clatter and rasp of 30 ft. aluminum extension ladders headed for the heights, and the cheerful but inevitable, "You missed a spot." We (I) are determined to finish this summer, even though some observers have drawn a parallel between this job and painting the Golden Gate Bridge. I love the smell of oil-base primer in the morning.

Since the March newsletter we have been traveling a bit. First stop was the HEES in Dallas which had the usual collection of excellent papers which, while not exactly provoking controversy, at least sparked interest. The increasing influence of financial analytic methods on

the evaluation of oil and gas projects and properties is becoming more and more obvious. Futures pricing models, Cost-of-Capital, and Utility Theory discussions rubbed elbows with panel sessions on "How to (Not) Lose Your Butt in Uzbekistan" or wherever.

Then off to San Antonio for the AAPG extravaganza. I have always thought that Geology was the fun part of this business right after the making-money part - so I enjoy going to this meeting every few years just to see what is new. I always promise not to pick up any literature, books, core samples, T-shirts, etc. I failed, again. Geology has changed since I was in school when Dr. Christina Balk, who gave me a C+++ in Paleo, informed me that my prized fossil discovery was, in fact, Craptolite. What with 3-D Seismic and computer simulation some of modern geology is more like Star Wars than anything else. One has to keep a certain perspective on this stuff - computer simulations can be fun but not always accurate - as any computer gamer knows. Playing the Army of Northern Virginia, I have won Gettysburg three times and, if I get this editing done, today we could win the war. Now, what would Stonewall have done?

Finally, back to San Antonio for the Society of Petroleum Evaluation Engineers (SPEE) Annual Meeting which had a first-class program focused on economic evaluation parameters. SPEE has published an updated guide to oil and gas reserves definitions (See Book Reviews). SPEE has also completed the l999 Survey of Economic Parameters. This is an annual survey of the discount rates and other factors used by evaluators of oil and gas properties. Except for the HEES there is only limited publication regarding economic evaluation; SPEE is one of those few sources. They, are also looking for a Few Good Folks. Give them a call.

A Thought: The current arguing and posturing in DC over what to do with the so-called "Budget Surplus," actually overpaid taxes, is somewhat surreal, sort of like listening to two muggers argue over who gets your watch and who gets your wallet.

Income Approach to Value in Oil Property Appraisal: Revisited

The last two newsletters have examined the application of the Cost Approach and of the Comparative Sales Approach to the appraisal of oil and gas properties. It seems apparent that these two methods are most useful for the appraisal of commercial and residential properties where costs of replacement and/or duplication can be readily determined or where there are a sufficient number of timely sales of similar properties that Comparative analysis can be done correctly. It is equally apparent that they have no application to oil properties. Where the primary objective of owning a property is the income that can be derived from the property, *The Appraisal of Real Estate,* the standard real estate appraisal text, recommends the Income Approach. While other methods might (and in good practice, should if possible) be used to supplement the Income Approach, there is no question that significant weight is given to income analysis. In oil property appraisal there is only one method - the Income Approach.

Why the Income Approach?

In one of our early newsletters there was a generic discussion of the Income Approach that was concerned with construction and application. Herein we revisit the Income Approach and ask that most useful question; Why? Why is the Income Approach used for oil and gas appraisal virtually to the exclusion of all other valuation methods? Why is it that after appraisal theorists and practitioners have spent decades developing intricate Cost and Comparative Sales methods of estimating value, the oil industry and oil property appraisers rely solely on the Income Approach? We will also examine the components of the Income Approach to see how they are related. So, Why?

First, the purpose of owning a mineral interest is to produce and sell a commodity that has no intrinsic value with the objective of deriving income. This dependence on an income stream, combined with both the non-reproducibility of mineral properties and the lack of significant numbers of timely sales of oil properties, makes necessary the application of tile Income Approach to value mineral interests.

Second, the Income Approach is readily adapted to the evaluation of oil and gas producing properties. (Hereinafter, "oil" refers to both oil and gas). The greatest strength of the Income Approach is that it allows the appraiser to construct a complex production and economic projection for a property or group of properties over any time period and, using any time frequency that the appraiser deems to be reasonable, to then derive a value that reflects tile specific characteristics of *that* property and the economic and investment criteria selected by the appraiser at a specified point in time. It is this power to build a model which incorporates the anticipated size, shape and duration of the production and income stream that makes the Income Approach such an extremely valuable tool for oil property appraisers.

There is a third reason. As my granddaughter once said, "It's the way we always go." Petroleum engineers are not trained as appraisers but as evaluators of how best to invest our employers' $$. The only method taught, in school or after, is the Income Approach - although no one called it that. Unlike persons trained to be real estate appraisers, PE's (and their functional equivalents) are not burdened with Comparable Sales and Cost Approach thought processes.

History

The Income Approach has historically been the primary method of valuing oil properties both within the industry and in the financial markets that deal with the oil industry. The published literature reaches back to the late 1800's (Hoskold). The most common early form is the Payback or Payout method where the value of a property is estimated as a function of the income to be received from the property within an certain time period. The Payout method requires a projection of future income and can therefore accommodate expected changes in production, prices, and costs. While often used as an adjunct to more sophisticated analysis, Payout is an Income Approach and remains the most commonly used non-discounted cash flow

valuation approach, particularly for smaller projects.

The addition of the Present Value concept to the income projection used to calculate Payout results in the Discounted Cash Flow (DCF) method. The DCF approach has been the primary method of oil property valuation since at least the 1930's, particularly among larger companies and, in the last 20 years, with the wide-spread use of personal computers and affordable software, has supplanted all other methods of valuation. Running DCF on a modem PC allows the evaluator to incorporate significantly greater detail, depending on software, not to mention the ability to do multiple runs with essentially unlimited variations of data literally in seconds.

This is a significant improvement over The Auld Days. When I first started work for Texaco in Ventura, I was plunked down at a desk with one of those big Monroe mechanical calculators with the 2-foot wide carriage. These machines were the state-of-the-art in desk top computing in 1967. You had to punch in each data entry on a button array, then hit the function button, then punch in the second number, and then the next function key. Then write down the result. On a good day you could complete one spreadsheet. Anyway, when you hit = or ENTER that machine would take off calculating with spinning wheels, gnashing gears and the carriage moving across the top like on a typewriter. They were very dynamic and noisy. I was in a room with 4 other guys all with the same machines doing cash flows for use in bidding on California OCS parcels. I remember one afternoon, all of us hit GO at the same time; the machines got in phase and damn near shook the building down. CalTech recorded it as a seismic event. But, I digress.

Discounted Cash Flow in Real Estate Appraisal

Despite a late start, real estate appraisal practice has grudgingly accepted DCF for appropriate uses. I just received my copy of the 11th Edition of The Appraisal of Real Estate over a period of time during which production, prices, costs, and ("ARE") which is, by the way, getting to be a very impressive tome. In this edition, the Income Capitalization approach starts in Chapter 20 and continues much as in previous editions until you get to Chapter 24, which used to be Yield Capitalization Advanced Applications. Guess what it is now? Discounted Cash Flow and Special Applications in Income Capitalization. All the old Ellwood stuff (J-factors, etc.) has been pitched out and is replaced with an expanded discussion that gives greater prominence to DCF than in previous editions. You no longer get the feeling that DCF was being hidden somewhere in hopes that no one would notice. Unfortunately, it is still burdened with a lot of old baggage, and the Appraisal Institute still does not seem to recognize minerals appraisal as distinct from houses or office buildings, which leaves the primary appraisal authority mute regarding a very large part of overall real estate value and appraisal practice.

As you might expect, the example in ARE is an office building where the income is usually estimated on the assumption of (relatively) fixed rents adjusted for vacancy minus costs of operation and replacement set-aside. The fixed. rent assumption allows the use of Direct Capitalization in which the first or average year expected net income is divided by a

Capitalization Rate to obtain value. In this case the "Cap" Rate is obtained from actual sales of similar properties by dividing the first year or average income by the purchase price. If DCF is used, the future income stream is reduced to present value by an appropriate present worth factor or Discount Rate to account for the time-value of money and for other concerns, such as risk. that may be deemed necessary. In either case, the present value anticipated from the future sale of the property, known as Reversion Value, and which provides the return-of-investment, is added to the Income Value to obtain a total value.

Oil property appraisal departs from real estate appraisal on two simple but vital points. First, oil and gas income streams are often highly variable due to predictable changes in production, product pricing and operating costs, the magnitude and direction of which are uncertain. Second, oil properties are wasting assets which, when produced to depletion or to economic limit, have no Reversion Value. The former eliminates Direct Capitalization as an appraisal method, while the latter requires that the income stream provide both *return-of* and *return-on* investment.

Discounted Cash Flow for Oil Properties

The overwhelming prevalence of and preference for the DCF as the method for evaluating oil properties results from several useful attributes of the method. First, the DCF is, by definition, a projection of future income. Second, when properly constructed, the method duplicates as closely as possible the form(s) of expected operation and exploitation of the property being appraised. Oil properties generate income over a period of time, during which production, prices, costs and other factors can be expected to change continually; a DCF appraisal can model those exceptions. The DCF has the ability to account for virtually every conceivable event and variable that might impact the income stream over the anticipated life of the property. If changes in production, prices, costs, etc. can be defined, they can be modeled in a DCF. Third, the DCF method is exceptionally flexible in allowing for multiple outcomes to be tested and weighed by simple alteration of expected conditions. Fourth, the introduction of the present value component reduces the future income stream to a common and comparable result. Fifth, the DCF construction can be broad and simple or detailed and complex, subject to the needs of the appraiser.

Taken together, these attributes make the DCF a powerful, dynamic and rather elegant method for estimating the future income and value of oil properties. When properly applied to a specific property, the method can result in a DCF that is not only unique to that property but is also unique to the effective date of the evaluation. Neither the Comparable Sales Method nor the Cost Approach have the ability to model future performance, and they provide none of the dexterity of the DCF.

Actually, if you are reading this, you already know all of the above, and I am preaching to the choir. We could drop the discussion here and go on to the other fun stuff. But, there are some interesting facets of the Income Approach that we do not often think about, so a further exploration may be helpful.

Discounted Cash Flow in Finance

Of course, the oil business did not invent DCF. We borrowed it. The DCF is the foundation of investment analysis in modern business. Most of us know this from working for or with large corporations, banks and consulting firms. Reference to any financial management text for journal will reveal that there are two primary methods (with variations) of selecting among various projects for capital budgeting: Net Present Value (NPV) and the Internal Rate-of-Return (IRR). In the NPV method, the expected cash flows from the various projects competing for capital investment are discounted at the same discount rate(s). The required capital is subtracted from the DCF to obtain the Net Present Value of the project. The projects are then ranked by the amount of NPV, and those with the highest NPV are selected until all available capital is budgeted. In the IRR method, the required capital investment is compared to the anticipated cash flow and an IRR is calculated as the discount rate necessary to reduce the cash flow to equal the required investment. Those projects which have the highest IRR are selected until all capital in budgeted. At least in theory. Whether in theory or in practice, when using either NPV or IRR (or one of their many variants) for capital investment selection, it is the **competing projected income streams** that are the basis for acceptance or rejection. That is a Very Important Point because it necessarily presumes that the income streams are comparable to each other. More on that later.

Major Components

The Discounted Cash Flow form of the Income Approach has three directly related but distinct components: an Income Stream, a Discount Rate, and a Value. The Income Stream (Cash Flow) is the income that is anticipated to be derived from a property. The size, shape and duration of the Income Stream is directly dependent on (1) the physical and operational characteristics of the property, (2) the economic conditions which currently exist and which are expected to apply to the property in the future, and (3) events and requisite expenditures which might be expected to occur over time to take advantage of property characteristics and/or to respond to economic conditions. The Discount Rate is a *financial* function, the primary purpose of which is to convert the Income Stream to a (present) Value.

The Income Stream

The purpose of the Income Stream is to attempt to model the flow of income that may be anticipated from a given oil property (with specific geologic, reservoir, and production characteristics) under defined operating and economic conditions. The Income Stream is an intricate model which produces a unique result. In attempting to reach a conclusion of value, the appraiser must try to determine how the geologic characteristics of the property may affect the volume of oil in the reservoir(s), and how the characteristics of the reservoir(s) may affect the ability of the property to produce oil and/or gas, and at what rate(s). The appraiser must also define the operating system necessary to obtain the production as well as the costs of lifting, gathering and processing produced fluids. Such costs may include current and/or future capital investments and other expenditures to meet regulatory requirements. Finally, the appraiser must

determine the price(s) that may be expected for the oil and gas in the future. The construction of the income stream is a step-by-step function which forms an integrated whole. The end result is an estimate of monthly or annual income that is *unique to the property* and *Specific to the date of evaluation.* Every physical or economic factor is related to the others. A change in the input data or in an assumption used in one part of the income stream may affect some other component and require further change at another point in the model.

As users of the DCF method know, it is the ability of the DCF method to assimilate all these components that makes the method so useful in evaluating oil properties. If I have a very simple property with years of history, five wells on primary production with a steady 10% per year exponential decline, constant GOR, and no changes in sight, the production is projected as 10% less each year into the future; oil production times GOR equals gas production. If I assume flat oil and gas prices and so many dollars per month operating costs, then the revenue and expense projection is straightforward. Deduct royalties, etc. and I have a cash flow. Pretty easy. I can complicate my appraisal, and the DCF method responds nicely. Make the production trend hyperbolic and from different reservoirs; assume there is a modest gas cap so gas production has to be controlled and water-cut is increasing. Also, assume the operating costs are allocated to $/per well and $/per month. And throw in a sinking fund for cleanup. No problem.

How could the Comparable Sales Method deal with the anticipated production stream? First, a review. Assume I am trying to value Property X and I have some information on the sale of five other nearby properties in the last 6 months. I have the purchase price, name and description, and whatever publically available production and well data that may exist. (Note: If you are starting from the buyer's cash flow, you are (1) fudging and (2) proving the point of the exercise - go to Jail, do not pass GO.) In using the Comparable Sales method, I must adjust the sale price of each comparable based on "... the characteristics of properties and transactions that cause the prices paid to vary..." How is the anticipated future production stream of each comparable reflected in the value of that property? And how does the expected production compare to the production expected for Property X? Answer: You do not know because there is no production projection or income stream.

But now I decide to (1) drill 10 more wells, and (2) start gas pressure maintenance, and (3) assume that oil and gas prices will escalate at 1% per year less than operating costs which increase at the rate of inflation. What do we do? First, add production for ten new wells. Will they perform differently than the old wells? Next, how many injection wells? Do I have to buy make-up gas? I have to include capital investment for the wells, etc., and finally project my initial prices and costs to increase at the selected rates. Whatever the answers, I can construct an Income model which accounts for every component and its effect on the other components.

Obviously, we could go on and on making this example more complex. Enhanced recovery projects, segmented operating costs, variable product sales, periodic workover/remedial costs, sliding-scale royalties, capital investments, severance taxes, etc. Then there are Income Tax issues. The point is that if you can: (1) define it, and (2) quantify it, you can make it part of the production and economic projection using the Income Approach, BFIT

or AFIT, and you can do it monthly, or annually, or daily whatever your need requires. (Daily seems a bit extreme!) The Income Approach will pick up the change in production or investment in the month it is scheduled to occur. If you want oil price to go up 4% per year the DCF is your method. Change your mind and have it go flat after two years. DCF is the way to go.

Which raises another point regarding DCF - it is very flexible. Any element of a DCF can be changed - drilling schedule, production rates, royalties, taxes, escalation rates and the method will provide another answer that can be compared to the first answer. What if I wait a year to drill half the 10 wells? What if oil price drops by 10% next year? This is called "What If-ing", a term-of-art which describes a highly useful form of engineering and financial analysis to which the DCF is extremely well adapted. Particularly on a PC - not so much fun on a Monroe. This flexibility has value because - as we know - not all our projections for the future are 100% dead on accurate and it is very useful to be able to examine alternatives and perhaps even assign probabilities and - well, that's a whole other topic.

There is one thing about DCF that is often overlooked if only because it is so obvious. If an appraiser values a property using DCF, and does it correctly, the income projection is a model specific to that property. This is a Very Important Point. The production rate is a function of the geology of the reservoir(s) that can be produced on that property not a property in another field or state. It is also a function of the physical factors, fluid characteristics, reservoir mechanism, and operating system on that property, not the lease next door. The same is true of product prices (we do not use WTI to value Kern River 13/ API) and operating costs and all the other factors that go into a detailed DCF evaluation.

The result of all the above is a *stream of income;* not oil, not gas, just a stream of income. If you are reasonably correct in the assumptions and inputs to your DCF model, then, in the future you can reasonably expect a stream of income approximating that which you projected. This is, after all, the whole purpose. Who wants oil? It is dirty, nasty stuff - Bucks are Better. Dollars are fungible and ignorant of their source. This is another Very Important Point.

The Comparability of Cash Flows

If an appraisal is done for each of 10 properties using the Income Approach., as described above, the appraisal of each property would capture all the physical and economic characteristics that define that property and would convert those characteristics into a stream of income. The outcome would be 10 streams of dollars each with a (possibly) different size, shape, and duration. Only the Income Approach can accomplish this feat. All of the erstwhile differences between the 10 properties are boiled down to 10 streams of future income. For value purposes, the source of that income is irrelevant, almost.

It was noted above that DCF is the foundation of capital investment analysis. One reason, of course, is the ability of the DCF to evaluate complex properties. But the <u>real</u> reason is that the method produces estimates of future income which are directly comparable to each other

and can therefore be evaluated using NPV and/or IRR (or variants) as a budgeting/investment criteria. Think about that for a moment. If the cash flows were not comparable then it would be meaningless to select A over B simply because A has a higher NPV or because B has a lower IRR. The only area where cash flows can be said to differ is in the *RISK* of not receiving the expected income stream. This is recognized and accounted for by applying a risk adjustment to one or more portions of the cash flow to make that cash flow compatible with the relative risk of the other cash flows before subjecting all the cash flows from all the projects to NPV and/or IRR analysis.

The Discount Rate

Which brings us to the second primary component of DCF; the Discount Rate. The primary purpose of the Discount Rate is to reduce the expected Income Stream to a (present) Value. All discount rates are present value factors. Some discount rates, if derived and selected correctly, can be used to estimate specific results, such as Market Value. The discount rate is not a function of the property being appraised; it is unrelated to production rates, oil gravity, location, well count, oil price, or any other characteristic of the property. All that is in the income stream. The discount rate for an oil property is a *financial* factor which is directly related to and is a function of the financial return that is required by an investor in an oil property which is, in turn, a direct function of the tolerance for risk of that investor relative to the other investors in the marketplace. If we make the reasonable assumption that the marketplace is made up of knowledgeable, experienced and successful investors, the *range* of relative risk tolerance and, therefore, required returns should be definable and identifiable. Further, the range is bracketed and controlled by the *range of returns,* which can be obtained from alternative investments in marketable items such as equities, bonds, or real estate.

It remains only to fully address the *risk* issue. Oil property appraisals are estimates of future events - some estimates are better than others. Each element in the projected cash flow carries some degree of risk or chance that it will not occur as expected. Some of these risks can be included in the cash flow by adjusting production projections or cash flows while others are accommodated by running multiple cases at, for instance, different prices. To the extent that risk is not reflected in the cash flow, it is included in the discount rate. Such a risk inclusive discount rate would necessarily be higher than a discount rate that was applied to a risk adjusted cash flow.

Finally, it must be remembered that the discount rate is a financial and economic parameter whose primary purpose is to guide investment decisions, The appropriate discount rate exceeds the cost-of-capital because of the desire of all investors to earn a return on investment and not simply to swap dollars. It exceeds the returns on stocks and bonds (in general) because of the additional risk of a long-term, non-liquid investment which has no residual value. It follows then that discount rates must have broad application among properties in widely differing locations and circumstances so that an investment in one can be compared to an investment in another.

Value

After all the work of constructing a reliable income stream and selecting a discount rate, the appraiser puts the two together, discounts the cash flow, and arrives at Nirvana - the Estimate of Value - be it for purchase, sale, tax, eminent domain, damages or abject curiosity. An appraisal which estimates Market Value is unique to that property at the effective date and is a function of the Income Stream and the Discount Rate. Assuming that the appraiser (investor) has (a) put everything he knows of the property and his expectations for future economic conditions into the Income Stream and (b) has incorporated his tolerance for risk and required rate-of-return into the Discount Rate, then the Value estimate obtained should be maximum he would be willing to pay. There may be other considerations but those may not be "market" considerations. If the Income Stream and/or Discount Rate is changed then the Value will be changed.

The Relationship of the Components

A strong appreciation for the relation and function of each of the three components is essential to an understanding of the purpose and use of the Income Approach. The overriding purpose is to provide a knowledgeable and informed investor with a rate-of-return commensurate with the perceived risk; the Discount Rate is the measure of that required return. The Value is a by-product. Appraisers sometimes find this difficult to grasp, but it is vital to a proper application. Assume for example an Income Stream where Operating costs are projected as $3/Bbl and, using Discount Rate X, an Investor calculates a Value, Y. If he then finds out that costs are actually $6/Bbl, which is likely to change - Discount Rate or Value? Would he pay the same price and accept a lower return (½ X) or require the same return and offer a lower price (½ Y)? Time's up! The answer is: Lower the price to get the same return. None of this can even be considered in Comparable Sales let alone the Cost Approach.

Legal Beat

Kumho Tire Co., Ltd. v. Carmichael, U.S. Supreme Court No. 97-1709, 1999 Daily Journal D.A.R. 2645.

We discussed Kumho Tire several months ago in the context of petroleum engineering, oil property appraisal, and science. This was the 11th Circuit Court of Appeals case made noteworthy by the reference to beekeepers and bumble bees neither of which had anything to do with the case - but which helped that Court decide that the Daubert criteria for expert witness testimony applied only to "scientific" evidence not to "skill - or experience - based observations." (For the latter, read engineer or any other person who is not a "scientist.") Kumho Tire, decided on March 23, 1999, unanimously reversed the appeals court and went to considerable length to explain Why (there's that word again). The Kumho case addresses the propriety of a Federal district court excluding testimony by plaintiffs witness, an expert in tire failure, as based on unreliable methodology. The Supreme Court opinion is well written and does a good job of explaining for judges and others how to apply or consider the "flexible"

Daubert/Kumho "factors" to cases involving scientific, technical, or other specialized knowledge..." (see Federal Rules of Evidence 702). The importance of the issues decided in this case is shown by the fact that over 20 amicus briefs were filed in support of Kumho. This opinion generated as much if not more newsprint and legal commentary as the original Daubert decision probably because Daubert has had such wide impact. Several of these commentaries are excerpted or referenced below.

The opinion, written by Justice Breyer, states: *"In Daubert v. Merrell Dow Pharmaceuticals, Inc.,* 509 U.S. 579 (1993), this Court focused upon the admissibility of scientific expert testimony. It pointed out that such testimony is admissible only if it is both relevant and reliable. And it held that the Federal Rules of Evidence 'assign to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand.' *Id*., at 597. The Court also discusses certain more specific factors , such as testing, peer review, error rates, and "acceptability" in the relevant scientific community, some or all of which might prove helpful in determining the reliability of a particular scientific "theory or technique." *Id*., at 593-594.

This case requires us to decide how *Daubert* applies to the testimony of engineers and other experts who are not scientists. We conclude that ***Daubert's*** **general holding...** applies not only to testimony based on "scientific" knowledge, but also to testimony based on "technical" and "other specialized" knowledge... We also conclude that a trial court *may* consider one or more of the more specific factors that *Daubert* mentioned when doing so will help determine that testimony's reliability." (Emphasis added)

Further, "...it would prove difficult, if not impossible, for judges to administer evidentiary miles under which a gatekeeping obligation depended upon a distinction between "scientific" knowledge and "technical" or "other specialized" knowledge. There is no clear line that divides the one from the others. Disciplines such as engineering rest upon scientific knowledge. Pure scientific theory itself may depend for its development upon observation and properly engineered machinery. Conceptual efforts to distinguish the two are unlikely to produce clear legal lines capable of application in particular cases. And, "... some of Daubert's questions can help to evaluate the reliability even of experience-based testimony. In certain cases, it will be appropriate for the trial judge to ask, for example, how often an engineering expert's experience-based methodology has produced erroneous results, or whether such a method is generally accepted in the relevant engineering community."

I singled out a few parts that refer to engineers but it is clear that anyone holding himself out to the court as an expert in any field can have his testimony subject to the Daubert/Kumho factors. At least at the Federal level, the shield of "my years of experience" to cover subjective conclusions, such as those made by the tire expert or by beekeepers or appraisers, is gone.

As noted by Peter Huber, (WSJ, 4/l/99, Op Ed pg.) "Explaining why such testimony was properly excluded, Justice Breyer's opinion provides a short primer on tire "separation," "overdeflection," "bead groove," tread wear and sidewall deterioration. You will find in his opinion helpful citations to the technical literature on rim flange abrasion and bead contact

pressure measurements. Such papers, you will discover, are published under the auspices of the Society of Automotive Engineering and the Rubber Division of the American Chemical Society. You will also find something almost never seen before in a Supreme Court opinion on any subject: an illustration. It depicts the multi-layered innards of the modern pneumatic tire... The details may seem whimsical, but they make a larger point, one surely obvious to most people outside the legal profession. Major industries in our modern economy, are built on a vast, fast-growing infrastructure of systematized knowledge. A hundred million drivers aren't cruising the American highway on the wheels of subjective impression. Whatever your business - engineering, immunology,, lithography, software, failure analysis, and no doubt beekeeping too - the intellectual underpinnings of your livelihood are solidifying day by day. New science, newer technology, vast databases, statistical analyses and computer simulations have overtaken old wing-and-a-prayer ways of doing business."

Justice Breyer's opinion is short, only six pages. and well worth reading and understanding. But leave it to Justice Scalia, with Justices O'Connor and Thomas joining. to sum up the whole thing is a short paragraph, to wit: "I join the opinion of the Court, which makes clear that the discretion it endorses... is [the] discretion to choose among *reasonable* means of excluding expertise that is *fausse* and science that is junky..." (Emphasis in original.)

At least three Federal cases have been decided since Kumho that appeared to get the message. See: Black v. Food Lion Inc. 1999 WL 173001(5th Cir. Mar. 30, 1999); Tanner v. Westbrook, 1999 WL 246712(5th Cir. April 27, 1999); and Jaurequi v. Carter Mfg. Co. Inc., 1999 WL 185046 (8th Cir. April 6, 1999). It remains to be seen how quickly Kumho Tire filters down to the state courts such as California which cling to the old Frey concept of "general acceptance." As noted in previous discussions, Daubert merely innumerates the conditions precedent to "general acceptance" and Kumho would seem to complete the replacement of Frey through incorporation.

"In a post-Kumho Tire world, proponents of experts with cutting-edge theories or questionable logic should be prepared for a more searching inquiry by the district court, regardless of whether the expert is a traditional scientist or some other type of expert." Brown, Michael K. and Baird, Lisa M. in Los Angeles Daily Journal, 5/7/99, pg. 7.

Book Reviews

"Judging Science: Scientific Knowledge and the Federal Courts," Foster, Kenneth R, and Huber, Peter W., The MIT Press, Cambridge, MA, 1999.

Virtually coincident with the Kumho Tire decision is the publication of this excellent book by Huber and Foster; their second collaboration in the legal-scientific arena. "Judging Science" is a tour-de-force of the effect of the Daubert decision (I 993) on the perception and treatment of "scientific" testimony in Federal and state courts. Rather than a simple recitation of the outcome of subsequent cases, Messers Huber and Foster have examined all the components of the Daubert decision in terms of the meaning of the words and the relation of the decision to the fo and function of the work of the scientific community and of expert testimony. The Huber/Foster work is valuable in its own right but it is almost a shame that it could not have

waited until Kumho Tire was decided - one way or the other - so that the implications of that decision for engineers, appraisers, and other experts could have been examined along with the Daubert analysis. As Justice Breyer's opinion states, Kumho Tire is a direct result of Daubert. Perhaps a sequel is in order.

The Daubert decision was an outgrowth of the testimony and evidence offered in the case in the lower courts which lead the Supreme Court to decide that clarification of expert testimony requirements were necessary. The book first discusses the Daubert case in some detail including the testimony given by experts on both sides. The authors then explore the primary criteria set out by the court and how these criteria relate to the divergent requirements and practices of scientists and lawyers. Particular attention is given to the concepts of Reliability and Validity in the scientific and legal contexts.

This is a very good book but it is not for the timid. It is 330 pages of small print, heavily footnoted, with three substantive Appendices and with excerpts from depositions, briefs, and other sources. I found I had to read the text first, then the excerpts. It definitely should not be confused with "Daubert for Dummies." It is intended to give scientists and engineers, people like you and me, a thorough understanding of what Daubert really means and how it (and now Kumho Tire) affect us. From that vantage point it is worth the effort.

See also: **"Phantom Risk: Scientific Knowledge and the Law."** Foster, Kenneth R., Bernstein, David E., and Huber, Peter W., The MIT Press, Cambridge, MA 1993.

Guidelines for Application of Petroleum Reserves Definitions: Monograph 1, Second Edition; Ausburn, Brian E. et al; Society of petroleum Evaluation Engineers, October, 1998.

This revision of the SPEE Monograph 1 provides for reserves estimators and users of reserves estimates a timely exposition of the currently accepted oil and gas reserves definitions and estimations procedures and establishes guidance for the application of the "Petroleum Reserves Definitions" approved by the Society of Petroleum Engineers (SPE) in March, 1997. The), are intended to enhance, supplement, elaborate, and illustrate applications of those definitions.

All oil property appraisers should have this book. You may not agree with all of it but it is the most comprehensive and authoritative discourse on the subject that is available.

Order from: SPE, Dallas, TX. (800) 456-6863

Noah's Flood: The New Scientific Discoveries About the Event that changed History; Ryan, William and Pitman, Walter, Simon & Schuster, (NY) 1998.

This is not the National Enquirer story of "Ark discovered on Hollywood mountain." Messers Ryan and Pitman are senior scientists at the Lamont Doherty Earth Observatory of Columbia University. Pitman is a fellow of the American Geophysical Union, and both authors have received the Shepard Medal for exemplary research in marine geology. So when they

present considerable evidence that "Noah's Flood" is the cultural memory of the flooding of the Black Sea basin by the rising Mediterranean, they should be taken seriously. If you, as I do, like your geology, archeology, and anthropology mixed together, this is a very interesting book. Not everyone is convinced of the author's analysis or interpretation, but questioning, debating, and testing of new theories and ideas is the essence of good science(or appraisal for that matter) and only further work will confirm, deny, or more likely modify this story. But there is a certain compelling logic to the Black Sea filling and Biblical flood theory. Accept or not it is good reading.

Interview with Al Gore (Friend of Bill and Hill)

Our friend Rocky was in DC earlier this year trying to get the Clinton regime to help oil producers the way they do farmers, China, etc. to which Bill provided a single digit response. Rocky did have a chance to interview Vice President Al Gore on his (Al's) concern for the "small producer." The following. is an excerpt: "So Al, how are things at the White House, picking out new china?" "No, not yet, but as part of my crusade to eliminate tobacco, I am gonna get rid of those d... cigars." "Is that OK with Bill?" "Bill? Bill who?" "Well, now Mr. VP, oil prices have gotten so low that many small operators cannot stay in business. Can the Clinton administration help out?" "Don't know, I'll have to talk to Hillary. But I am very concerned about small producers, such as Iraq, and, of course, we have to keep gas prices down so all you folks can afford to drive to work, and use the Internet. Did you know I invented the Internet?" "I heard that, I'll bet that's your proudest achievement." "No, Fire is." "You invented Fire!" "Yes, but keep it quiet - Fire bad, burn trees, create CO, - Bad, bad, bad." "Oookay! Now Mr. VP, about the oil business." "Not to worry Rocky, I have a plan to help." "You do!" "Yes, I plan to launch a system of satellites that will be of great benefit." "How so?" "Well, I have heard about this Continental Drift that keeps moving things around. Well, the satellites will monitor where all your oil is going so you can find it every day just by checking the Internet." "Is that all?" "No, when I find out who is causing CD I will pass a law to stop it - or tax it." "Thank you Mr. Gore." "Don't mention it."

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