ARKANSAS' BRINE PRODUCTION BUSINESS
HOW YOU MAKE SOMETHING FROM LESS THAN NOTHING

By Thomas A. Daily[1]

Introduction.

Salt water is a necessary evil in the oil and gas business. Most wells produce at least some of the stuff. Lots of wells produce lots of it. What a nuisance. First, the salt water must be separated from the produced oil and/or gas. Then it must be properly disposed of, usually by putting it in a "safe" spot underground.

Proper disposal requires more wells and lots of permits. It can also cause serious problems.[2] It is no wonder that in measuring the profitability of an oil and/or gas operation, salt water is assigned a sub-zero value.

There is an exception to the above rule in a small part of South Arkansas. There, about two miles underground, is what remains of a Juristic sea containing abnormally high concentrations of chemical salts. Because of its chemical value, that salt water is classified as a mineral in and of itself. We call it "brine."

This is a paper about brine law. Brine law is similar to oil and gas law, but not identical. We will discuss both the similarities and the differences.

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[1]Member, Daily & Woods, P.L.L.C., Fort Smith, Arkansas.

[2]I.e. spills, unintentionally washed-out reservoirs, even, occasionally, earthquakes.

The History of Arkansas Brine Development[3]

Arkansas' brine business was born from its oil industry. Wells drilled into the Smackover Limestone Formation, which straddles the Arkansas-Louisiana state line, gushed during the ArkLaTex's boom days. For a time, El Dorado, county seat of Union County, was home to a fellow named H. L. Hunt, who made and lost his first fortune there. Unfortunately the boom was short-lived. Much of the Smackover's oil was wasted through unregulated overproduction. Some Smackover wells do still produce, however.

In 1955 chemists, perhaps motivated mostly by curiosity, analyzed samples of saltwater from some South Arkansas Smackover oil wells. Good luck prevailed. That Smackover salt water turned out to be special. Its bromine concentrations far exceeded that known to exist anywhere else in the Western Hemisphere.[4]

Bromine is an essential ingredient in numerous common products. For example, plastic home appliances don't catch fire because they are formulated with flame retardants containing bromine. Bromine compounds purify swimming pool and hot tub water. We even swallow bromine in the form of the pain reliever, Aleve, to cure our aches, pains and hangovers.

Earth's highest known concentrations of dissolved bromine are in the Dead Sea,

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[3]A comprehensive history of Arkansas' brine industry was compiled by Mr. William J. Wynne, former counsel to the Arkansas Oil and Gas Commission, in the form a paper titled "Salt Water, Blight or Benefit" presented to the 1976 Arkansas Natural Resources Law Institute. Since that paper is apparently otherwise unpublished, it is attached here as Appendix "A." Subsequent references to Mr. Wynne's paper will reference "Wynne."

[4]Originally exceeding 4,000 parts per million.

dividing Israel and Jordan. However, there are both political and logistical issues with the Dead Sea source which make bromine from Arkansas a preferred alternative. The political issues are obvious. Near constant conflicts in that part of the world make relying upon the Middle East for much of anything risky. The logistical problem is that the Dead Sea is on the other side of the world. Bromine is not easily transported. It is both extremely heavy and dangerously caustic.

Following the 1955 Bromine discovery, two major chemical companies built brine-to-bromine infrastructure to tap Arkansas Smackover brine.[5] They drilled large-bore wells, equipped with down-hole electric pumps, which lift the produced brine at a rate of approximately 20,000 barrels per day each. Pipelines then carry the brine to nearby bromine plants where the elemental bromine is extracted from the brine's dissolved bromide salts. The dissolved bromine is reacted-out in a chemical process which involves infusing the brine with chlorine and steam. Not far away are other specialized chemical plants manufacturing bromine end-products. Their payrolls contribute mightily to the economy of the area.

After bromine has been removed, the now de-brominated brine ("tail brine") is carried by other pipelines to disposal wells where it is re-injected into the Smackover. That combination of production and disposal wells results in a recycling operation, similar to that employed in secondary recovery of oil. The injection wells maintain reservoir pressure and, beneficially, push additional bromine-rich brine toward the

[5]Ethyl Corporation, now Albemarle Corporation (Columbia County), and Michigan Chemical Corporation, which became Great Lakes Chemical Corporation and is now LANXESS Corporation (Union County).

production wells.

The resource is non-renewable, however. Eventually some of the injected tail brine migrates into the production wells, diluting the concentrations of bromine within their produced brine. When that happens, the bromine extraction plants process the same amount of brine for a decreasing amount of bromine, a death spiral for the project. In the short run, the wells which have become invaded with tail brine may be shut in and replaced with wells further away from disposal wells, but the commercial bromine concentrations are limited to a fairly narrow strip of territory, so the life of the project is not infinite.

Who Has the Right to Produce Brine?

Because brine is a mineral, it is not just out there for the taking. Its ownership is one of the sticks in the proverbial bundle of property rights. If chemical companies want the brine they must obtain production rights from brine owners. That is not always easy. Identifying the owners of any mineral is a bit complicated in Arkansas. Arkansas mineral law includes something called the "*Strohacker* doctrine," named for the Arkansas Supreme Court's landmark decision in *Missouri Pac. R. Co. v. Strohacker.*[6] That case involved 1892 and 1893 reservations of "all coal and mineral deposits" by a railroad to which the lands had been patented shortly after Arkansas became a state. The oil and gas potential of the patented lands was unknown when those reservations were made. The Supreme Court's opinion held that those reservations did not effectively reserve oil and gas because oil and gas were not generally regarded as

[6]202 Ark. 645, 152 S.W.2d 557 (1941).

minerals within legal and commercial usage, locally, at the time.

The *Strohacker* decision resolved a dispute over ownership of oil and gas, but it has subsequently been applied to other minerals as well,[7] including, almost certainly, brine. There is one unpublished decision, *D. M. Riche v. McGowan Working Interest Partners*,[8] in which the Arkansas Court of Appeals held that a 1938 deed reserving minerals and water failed, because of *Strohacker*, to reserve brine.

Strohacker thus complicates identifying brine owners. South Arkansas title history is filled with mineral reservations, many of which occurred early in the twentieth century before the commercial value of brine was even imagined. Because of *Strohacker*, it is common for a tract to have brine ownership which is different from ownership of its oil, while neither of such owners own the surface.

As a practical matter, the Arkansas brine industry has chosen to honor January 1, 1955, as brine's beginning *Strohacker* date, since brine's potential as a source of chemicals clearly was unknown before that date. Thus, the industry will credit only those severed mineral owners whose interests derive from generic mineral grants or reservations executed after January 1, 1955, with brine ownership.[9]

Understanding that brine was a mineral owned by such brine owners, the brine

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[7] *Carson v. Missouri Pac. R. Co.*, 212 Ark. 963, 209 S.W.2d 97 (1948) (Bauxite); *Dierks Lumber and Coal Co. v. Meyer*, 85 F. Supp. 15 (1949) (Novaculite); *Rosa Thomas, et al v. Markham and Brown, Inc. et al,* 353 F. Supp. 498 (1973) (Granite); *Mineral Corporation of Arkansas v. International Paper Co.*, 324 F. Supp. 705 (1979) (Cinnabar and Mercury).

[8] 2002 WL 31518861.

[9] See discussion within Wynne, supra, p.5-6.

industry secured brine leases covering the tracts surrounding their wells. Unfortunately, much less attention was given to nearby tracts not scheduled for surface operations. Some leases were taken from owners who wanted to lease, but those who refused were simply avoided.

By leasing mostly only their drill-site tracts, the industry relied upon the common law Rule of Capture. According to that common law doctrine, whatever comes up in my well is mine to keep, provided I stay on my lease and don't drill across the property line. It is immaterial where the brine originally came from.

The Rule of Capture is based upon flawed science. It assumes that mineral molecules somehow just move on their own in some unpredictable fashion. That is incorrect, as we have known for some time. Actually, fugacious mineral molecules move underground in response to pressure differences. They generally move from higher to lower pressure.[10] Thus, by manipulating those pressure differences, we have the ability to influence the molecules' movement. When we remove brine from the formation, we reduce the pressure at the bottom of the production well. When we then inject tail brine back into the formation we increase the pressure at the point of injection. Pressure wants to equalize so injected tail brine moves toward production wells, pushing the brine in between in that same direction. We are moving those molecules mechanically. Originally many in the bromine business did not realize that such manipulation of pressures may go beyond that which the Rule of Capture protects.

In the 1970s the Arkansas brine industry was plagued by litigation over the

[10]That is an over simplification. Other forces, such as gravity and friction are at work, as well, but it illustrates the point.

production/injection character of the way it produces brine. The first such case was *Budd v. Ethyl Corp.*[11] J. W. Budd had interests in two separate tracts close to brine producer Ethyl's brine wells. Budd was the fee owner of one such tract, which was unleased. He did not own a fee interest in the second tract, but he held an oil, gas and mineral lease on it. Budd sued Ethyl, claiming that its operations diminished the quality of the brine beneath his lands without compensation and thus constituted a trespass.

Ethyl's tail brine injection wells were laid out in a circle surrounding its production wells so that the injection wells effectively pushed brine inward toward the production wells. The court's opinion called that circle the "recycling area." Budd's fee-owned tract lay near, but outside, the recycling area. While some injected tail brine arguably pushed beneath Budd's fee-owned tract, that push was in the opposite direction from the production wells. The court said that any damage there, being outside the circle, was merely incidental and thus protected by the Rule of Capture since brine beneath that tract was not pushed toward the production wells.

The tract where Budd only held a lease was inside the recycling area but the court said that since Budd held only on a leasehold interest in that tract, he only had a license to drill and produce, which was not an interest which could be trespassed upon.

Apparently many in the brine industry gave *Budd* an overly simplistic reading and gained false confidence in the Rule of Capture. That bubble was burst by the next case, involving J. W. Young. Young was the fee owner of unleased land which, unlike Budd's tract, lay directly inside Ethyl's circular recycling area. Young sued Ethyl in federal court

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[11]251 Ark. 639, 474 S.W. 2d 411 (1971).

under diversity of citizenship jurisdiction. He lost at first when the district court dismissed his complaint, citing *Budd.*[12] However, that ruling was quickly reversed by the Eighth Circuit Court of Appeals.[13] Noting that Young's unleased tract was both fee-owned and located within Ethyl's circular "recycling area," the appeals court held that Ethyl's operations had indeed trespassed upon him.

Not long afterward, the Arkansas Supreme Court adopted the *Young* ruling in the case of *Jameson v. Ethyl Corporation*.[14] The resultant rule of law is this: If a tract is unleased, fee-owned and lies within a producer's recycling area, displacing minerals from beneath the tract constitutes an actionable trespass.

The Advent of Regulation, the Brine Conservation Act.

Awaking to a world of potential trespass liability must have been pretty frightening to the brine industry. At that time Arkansas had no statutory mechanism to unitize and force pool unleased tracts for brine production. The likelihood for multiple such trespass suits had potential to shut down the brine business altogether. Brine producers who had neglected to lease tracts outside their well sites were suddenly at the mercy of owners who preferred suing to leasing.

Fortunately for the brine industry, it was rescued in 1979 by the Arkansas Legislature's enaction of the Arkansas Brine Conservation Act.[15] That statute

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[12] *Young v. Ethyl Corporation*, 382 F. Supp. 769 (1975).

[13] *Young v. Ethyl Corp.*, 521 F. 771 (1975).

[14] 271 Ark. 621, 609 S.W.2d 346 (1980).

[15] Act No. 937 of 1979, now codified, as amended, as Ark. Code Ann. §15-76-301 et seq.

authorizes the formation of brine production units by order of the Oil and Gas Commission. It also delegates regulatory jurisdiction over brine operations to the Commission. The act provides that non-consenting owners of brine or brine leases within a unit may participate in the unit's operations, should they so elect. Failing such election, non-consenting owners will be paid for their interests in unit brine production. They receive both a bonus, set by the Commission, and an annual royalty per net acre. The amount of that annual payment is fixed by the statute. To date, the Commission has formed three such units.[16]

The per-acre royalty provision of the Brine Conservation Act is also common to brine leases taken by the industry. The act initially provided for a minimum statutory royalty of $25 per net brine acre, which was apparently the going rate in 1979. That minimum annual "royalty" was increased by a 1995 amendment[17] to $32 per acre and tied to a United States Government inflation index, the Producer Price Index for Processed Goods for Intermediate Demand, where it may increase but may never fall below the $32 per acre minimum.[18]

Virtually all current brine leases contain language deferring to that statutory royalty if the leased lands lie within units formed under the act or within close proximity

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[16]Great Lakes' Chemical Company's South, Central and West brine fields were unitized by Commission orders BU1-1995, BU2-1995 and BU3-1995, respectively.

[17]The amendment was Act No. 1287 of 1995.

[18]Ark. Code Ann. § 15-76-315. The government no longer publishes an index with that name. Accordingly, the brine industry has substituted the current Index for Processed Goods for Intermediate Demand as its successor.

to wells.[19] So, as a practical matter, the statutory royalty has become **the** royalty.

Appendix "B" to this paper is an example of a typical brine lease. You will note the similarity to the more common oil and gas lease, except for the royalty clause. Modern oil and gas leases provide for a fraction of production, or of its proceeds, to be delivered to the lessor as royalty. That is not so with the brine lease. From the beginning the brine industry has compensated its mineral owners by paying a "royalty" which is really more like rental ($____, per net brine acre, per year). The quantities of brine produced from that acre, its relative concentration of bromine, and the market for bromine and bromine-containing products are immaterial.

There is a historical explanation for the "per acre" royalty methodology. Early on, trying to devise a "proceeds" or "market value" royalty ran into a problem because there has never been a market where one may purchase a barrel of brine. Brine, regardless of its constituents, has negative value unless it is in the hands of a chemical company with the nearby facilities to extract those constituents. The post-production cost of that extraction process may well exceed the cost of the brine wells and associated pipelines. Further complicating is the fact that very little of the extracted bromine is sold as bromine. Rather, most goes straight into other products manufactured in nearby facilities owned by the same producer.

Royalty owners saw that companies were making valuable stuff out of bromine and wanted a piece of that action. However, basing a royalty upon the market value of

[19]See, e.g., Appendix "A."

bromine, or some product containing bromine,[20] is no more valid than basing oil royalty on the retail price of gasoline. On the other hand, "per-acre" royalty is simple and easy. Unfortunately, since "per-acre" royalty is unrelated to value, it is also disconnected from the fundamental purpose of royalty, which is to share that value.

Fractional royalty adjusts in amount with changes in the quantity of oil and/or gas produced on the lease as well as changes in the value of that production. Essentially, the oil and gas lessor is a passive partner in the venture who has an economic incentive tied to its success. Per-acre royalty, on the other hand, has no relationship to the quantity or quality of production. To the producer, per-acre royalty is a fixed cost. To the royalty owner, it is a fixed income stream. If concentrations of bromine in the brine or bromine value are high, the per-acre royalty may be perceived as unfairly low. However, the opposite is true, as well. As bromine concentrations decline due to dilution from tail brine, the fixed cost of royalty becomes an increasingly burdensome cost of doing business with the inevitable result that operations will be abandoned somewhat prematurely. Complicating this problem is that, under the Arkansas law, there is no way to shrink a producing unit. Once a unit has been formed it remains a unit, as to all acreage contained therein, as long as there is any unit production. Abandoning individual unit wells has no effect upon the unit's royalty burden.

The "Other Substances Rule."

The 1995 amendment to the Brine Conservation Act also added the following "additional substances" language:

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[20] I.e. Aleve.

> In addition to any other amounts due and owing by the producer or producers of any unit to the owners therein, the producer or producers shall account separately and on a fair and equitable basis to each owner in the unit for all substances which are found by the commission to be profitably extracted from brine by a producer and which were not extracted by a producer on January 1, 1979.[21]

Of course, only one substance, bromine, was being profitably extracted from brine on January 1, 1979. So whenever anything else is "profitably extracted" the Oil and Gas Commission must set a rate and method for its royalty.

The "additional substance" provision has been utilized only once, to date. In 2007, a chemical company made a deal with Great Lakes Chemical Company to build a salt plant adjacent to one of Great Lakes' bromine extraction facilities. The salt plant took a portion of the tail brine just processed in the bromine plant and removed three salts, calcium chloride, sodium chloride and magnesium hydroxide. It then returned the tail brine to the producer's tail brine disposal system.

Regulating pursuant to the "additional substance" language in the amended statute, the Commission established additional royalty to be paid to brine owners whose underlying brine was processed in the salt extraction plant based upon the volume of tail brine actually entering the salt plant.

In setting the additional royalty for extracted salts, the Commission devised a formula which reverse-calculated a value for brine from the dollar amount of the statutory royalty and calculated additional royalty based upon the concentration of salts, compared to bromine, within the brine and the relative market values of the salts vs. bromine. That order expressly provided that it was subject to revision as the formula's

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[21]Supra, specifically § 15-76-315 (c)(1).

variables changed, but before any revision occurred, the salt plant closed.

The Lithium Era is Dawning.

Apparently chemists have known for some time that Smackover brine contains dissolved lithium chloride, albeit in concentrations only approximately 1/10 of those of the bromine. Such sparse concentrations were previously believed to be non-commercial. That may have changed.

Lithium (Li) is a rare earth chemical element. It is highly conductive and thus has become valuable for its use in batteries. As the world moves away from hydrocarbon fuels, batteries to store electricity for on-demand use are getting appropriate attention. One important type of battery requires crystals of a lithium compound, lithium carbonate.

Most of today's lithium comes from South America and Australia, with only a small portion currently being produced within the United States. While some concentrations of lithium are present in most brines, including sea water, the traditional process of pumping the brine into shallow ponds, which are then evaporated by the heat of a hot sun requires, much higher concentrations than are generally common around here, as well as a hot arid climate. Even then, it is painfully slow and, thus, expensive.

A Canadian company, Standard Lithium, Ltd., recently announced that it has developed a process for extracting a highly concentrated lithium chloride solution from brine which is much faster and more efficient than pond evaporation, and then immediately converting that lithium chloride solution into battery grade lithium carbonate. According to Standard Lithium, Arkansas Smackover brine's lithium

concentrations of lithium are high enough to permit commercial application of its new processes in South Arkansas.

Almost simultaneously, Arkansas Lithium announced a joint venture with Great Lakes Chemical Corporation (now Lanxess Corporation) with plans to extract lithium chloride from tail brine, downstream from Lanxess' bromine extraction plants.[22]

Measured lithium concentrations in the brine vary, somewhat, across the field but the mix within the tail brine is well above Standard Lithium's minimum. Also, brine from bromine-depleted areas still contains original lithium concentrations because lithium was undisturbed by previous bromine extraction.

In compliance with the Brine Conservation Act's "additional substance" provision, Standard Lithium obtained Oil and Gas Commission permission to build and operate a small pilot plant downstream from one of Great Lakes' bromine plants. There it tests and refines its process of extracting lithium chloride, and plans to convert the lithium chloride thus extracted into battery grade crystalized lithium carbonate, which will be custom-designed to conform to the specifications of its potential customers, the various lithium battery manufacturers. Before the pilot plant was built, Great Lakes and Standard Lithium petitioned the Commission for an order confirming that the proposed testing would not constitute "profitable extraction," and thus would not trigger the royalty determination process.

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[22]Standard Lithium has also secured the rights to approximately 30,000 undeveloped acres in an adjoining county where analysis of salt water from oil wells shows commercial lithium concentrations. However, the Lanxess joint venture facilities will have the substantial advantage of having well and pipeline facilities already present. We can thus expect that project to be developed first.

The Commission did authorize the operation of the pilot plant. However, it deferred determination as to whether any part of the lithium chloride which the plant will produce is "profitably extracted" until completion of the pilot stage. Pursuant to the Commission's directive, Arkansas Lithium reports details of the pilot plant's operations and production, on a quarterly basis, to the Commission. The Commission has opened a "Lithium" portal on its web site where all such information is available to anyone interested in developments.

Arkansas Lithium obviously intends for its pilot operation to succeed and, if it does, to construct additional facilities to commercially manufacture battery grade lithium out of the lithium chloride extracted from the brine. If and when that occurs the Commission will set the method of determining additional brine royalty attributable to its lithium production.

It is not possible to predict exactly where that royalty discussion will lead, but all parties, including potential royalty recipients, intend for it to succeed. I believe the players will attempt to devise and agree upon a production-value based royalty, rather than the type of per-acre compensation paid for bromine. To do so, they must devise a way of determining the value of brine or, at least, the amount that brine's value is enhanced by the operation to extract lithium.

Remember, the mineral to be valued is brine, not lithium, and remember that we base oil royalty upon oil, not gasoline. Royalty owners are not entitled to a fraction of the proceeds paid for battery grade lithium carbonate crystals by Standard Lithium's customers. Still, they are entitled to additional compensation because lithium extraction has made their raw material, brine, more valuable. How much more valuable is the

issue.

There is a market for lithium chloride, which is the first lithium product which will be extracted. Lithium chloride is sold frequently enough to establish that value. Economists sometimes employ what they call the "net-back" approach to value a raw material, like brine, which is not regularly bought and sold. They take the established market value of a product of the raw material and work backwards, subtracting the costs of getting from raw material to product.

In the case of Smackover brine, you can start with lithium chloride, the first marketable lithium product, and subtract the costs of extracting it from brine, including a fair return on capital investment, to derive a net value upon which to base royalty. Of course, you must then agree what percentage of that net value should be paid as royalty.

The net-back method results in a formula rather than a fixed number. That formula recalculates periodically as variables[23] within the formula change, adjusting the result. In that way the royalty remains proportionate to the economics of the venture regardless of how much factors influencing those economics change.

None of this is guaranteed. Multiple stars must to align. The pilot program needs to prove that the new technology works on large scale. Lithium needs to continue to be enough in demand to justify the effort. Even if those things do work out well, serious work remains. Setting the right royalty won't be easy. It needs to be

[23]The market value of the first product, concentrations of lithium within the brine, actual costs of extraction up to the point of realization of the first product and, perhaps other factors can be expected to fluctuate.

based upon a formula that is fair now and also able to stay fair long-term. Ideally that will happen through agreement among producers and royalty owners. If so, the Oil and Gas Commission will almost certainly approve their agreement.

If the parties cannot reach agreement, the Commission will resolve the issue in a contested hearing. That is not where this needs to go. Some state agencies routinely decide utility rate cases involving issues of costs vs. profit.[24] Those agencies are staffed with economists and other experts on the subject. Unlike those agencies, the Arkansas Commission has no expertise in such matters, nor does its staff.

If the Commission must decide the issue, it certainly will do so, but the stake holders, behaving reasonably, will almost certainly do a better job. Hopefully, producers and royalty owners realize that the success of the project is more important to all than is winning the deal. If so, they will to find an appropriate middle ground and agree.

This is a developing story. Stay tuned.

[24]E.g. the Arkansas Public Service Commission.

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SALT WATER: BLIGHT OR BENEFIT

William J. Wynne

I was unaware when I was initially invited to appear upon this program and to address the subject matter which my remarks are entitled of the inordinate interest and activity that would soon ensue and is presently underway that has provided an economic bonanza for both landmen and lawyers in the aggressive leasing activities that have been and are presently underway and of the initiation of lawsuits in both State and Federal Courts that are presently pending. However, it is my intent that the scope of my paper and of my remarks will be limited to that which the program indicates as a presentation of the history of the production and economic value of salt water produced for the recovery of the bromide ions contained therein. Consistent therewith, perhaps it would be appropriate for me to first state that at the present time the current production of salt water for this purpose is essentially limited to the Counties of Union and Columbia.

This industry commenced with the formation of a joint venture arrangement between what was then known as Murphy Corporation and Michigan Chemical Corporation in 1955 when it was determined from a salt water analysis of water produced concurrently with crude oil from the Smackover Lime Formation underlying the Catesville oil field that the salt water produced as an incident of the production of petroleum hydrocarbons contained a concentration of bromide ions deemed to be commercial and that the production thereof in harmony with the remaining crude oil reserves would contribute towards extending the economic life of this field.

Let me interject at this juncture that this phenomenon has been found to exist only with respect to the Reynolds member of the Smackover Limestone Formation which was initially discovered in 1937 in the well drilled by Phillips Petroleum Company known as the No. 1 Rose in the Snow Hill Field. I might also interject that this particular member was named in honor of Commissioner J. David Reynolds' grandfather who was likewise involved in the oil and gas industry and like his father, also served as a member of the Arkansas Oil and Gas Commission By way of further identification, this particular formation is of Jurassic Age geologically or approximately 180,000,000 years old which was laid down with the recession of the seas from the surface of the lands. Generally speaking, it has an average thickness of approximately eighty feet (80') and is encountered at a depth of approximately 8,000 to 9,000 feet subsurface as the same underlies the Southern portion of the counties which I have earlier mentioned and extends generally from East to West in a shale-type buildup.

The question necessarily arises as to why this particular member uniquely possesses bromide ions with a concentration level under preproductive conditions generally in the range of 4,000 to 5,000 parts per million. It is recognized that the Smackover Formation ordinarily is a water drive reservoir and history has established it to be one of the more prolific zones for the production of petroleum hydrocarbons. The salt water to which I refer as you know is sea water which was entrapped and deposited within subsurface zones and the most logical explanation for this Reynolds member having this concentration or buildup of bromide ions is a result of the frequency of evaporations which over time occurred when other elements and chemicals would have been

dispersed by evaporation as bromide ions of all of the other elements is the most water soluble and because of its weight would remain in solution.

The economic analysis of producing this salt water commercially for the recovery of the bromide ion content resulted in the conversion of various oil wells and the installation of pumps and related equipment designed to achieve a much higher rate of production. Coincidental therewith, many other unique problems were encountered not the least of which was to overcome the universal recognition that salt water historically had been the scourge of the producer and the source in many instances of the ravages of the surface environmentally. The scars caused thereby are still evident in many areas upon the surface of the land because of the high sodium or salt content that still remains within the soil at levels so high as to either prohibit or inhibit the growth of grasses and coniferous vegetation.

It was necessary to adapt to new drilling and completion techniques unlike those ordinarily employed in the oil and gas industry. The diameter of the brine supply wells was required to be much larger to enable the wells to produce production levels in the range of 20,000 barrels per day and this required the utilization of multi-staged downhole submersible pumps utilizing impellers as a conventional beam pump has a maximum lifting capacity of 1,500 barrels per day. New concepts of pipeline transmission were required in order to maintain as closely as possible the temperature of the salt water at the wellhead as the recovery of the bromide ions requires the salt water to be elevated to 212 degrees Fahrenheit or that of steam in the column at which time it is subjected to a chlorine interface which

results within a chemical occurrence known as an oxidation reduction reaction wherein an electron is transferred or passes from the bromide ion to the chlorine and in the process the bromide ion becomes bromine and the chlorine in turn becomes chloride to be disposed of within the debrominated waste stream by reinjection into the Smackover Limestone Formation from which the same had been produced. This process required the drilling of large diameter disposal wells to permit the reinjection of the debrominated brine in order to maintain relatively stable reservoir pressures and to avoid pressure sumps and the creation of tilted water tables that would possibly be disruptive of the recovery of the residual petroleum hydrocarbons. This method of disposal is required by Federal regulation and disposal wells are likewise required to be cased and completed by both State and Federal regulatory authorities so as to assure the prevention of contamination of fresh water aquifers and the invasion of other shallower zones and formations productive of petroleum hydrocarbons. Bromine related wells are classified by the Environmental Protection Agency as Class V and the enforcement authority for environmental compliance is shared between the Arkansas Oil and Gas Commission and the Arkansas Department of Pollution Control and Ecology under the terms of a Memorandum of Understanding (MOU) executed by such respective State agencies and approved by the EPA.

Not only were the newly encountered problems limited to matters of drilling and production but all of you will likewise recognize the legal problems attendant therewith. For example, was "salt water" a mineral and if so, was it owned by the surface or mineral owners underlying the land. Each of you are familiar

with the decision of the Court in the case of *Missouri-Pacific Railroad Co., Thompson, Trustee v. Strohacker*, 202 Ark. 645, 152 S.W.2d 587 (1941) and its progeny enunciated most clearly in the later case of *Stegall v. Bugh*, 228 Ark. 632, 310 S.W.2d 251 (1958) which held that the meaning of the word "mineral" is governed not by what the grantor meant, but by the general legal or commercial usage of the word at the time and place of its usage. In other words, neither the subjective intention of the parties nor the doctrine of *ejusdem generis* is dispositive and this rule generally known as the *Strohacker Doctrine* has become a rule of law in this jurisdiction. Our venerable colleague, Gerald L. DeLung, wrote a splendid paper reviewing all of the cases involving this doctrine and rule which was published in the July, 1975, issue of the *Arkansas Lawyer* wherein he correctly pointed out that such rule has likewise been applied with respect not only to oil and gas but also when the question arose in instances involving "coal" *Brizzolara v. Powell, 214 Ark. 870, 218 S.W.2d 728 (1949)*; "novaculite" *Dierks Lumbers & Coal Co. v. Meyer, 85 F. Supp. 15 (1949)*; "cinnabar and mercury" *Mining Corporation of Arkansas v. International Paper Co., 324 F.Supp. 705 (1979)*; "granite" *Rosa Thomas, et al v. Markham & Brown, Inc., et al, 353 F.Supp. 498 (1973)*. While there are other cases involving other resources within which the Court has adhered to this rule of law in the determination of ownership, it seems unnecessary to make further reference thereto herein as those cases which have been cited are more than sufficient to evidence the legal question which arose with the commercial development of salt water for purposes of the recovery of the bromide ion content as to whether or not "salt water" constituted a mineral and if so, as to the

ownership thereof. I would, however, be remiss if I did not commend Mr. DeLung for his excellent paper and the sequel thereto which he later authored as an update. Let me interject at this point, however, that minerals are defined by statute which as amended specifically includes salt water whose naturally dissolved components or solutes are used as a source of raw material for bromine and other products derived therefrom in bromine production.[1]

Prior to the Legislative enactment of such amendment, the determination of salt water (brine) was made using the criteria otherwise observed based upon the point in time at which facts and circumstances were sufficiently well known as to make salt water of this type recognized as a mineral as a matter of general and commercial usage. Applying this standard, it appeared that January 1, 1955, would be the appropriate point in time within which to make such determination based upon the date upon which the first salt water (brine) leases were recorded. At that juncture, the lands proposed to be leased thereby frequently were then already the subject of valid conventional oil and gas leases and as a precautionary measure, salt water leases were likewise secured from the surface owners to avoid the calculated risk which would have otherwise had to be assumed. However, the consideration paid therefor and the benefits afforded the lessor thereunder were relatively minimal and therefore economically justified. A copy of one of such initial leases as was secured will be included within the Appendix of this paper to exemplify that of which I speak. As a consequence of the Murphy-Michigan Chemical Co. joint venture, others chose to enter the industry and

[1] Ark. Code Ann. (1987) Section 15-56-301(b)

they likewise formulated and utilized leases covering salt water (brine) with the resolution of this resource as a mineral. While these leases were patterned somewhat after oil and gas leases, certain changes and additions were required with respect to the length of the primary term, to accommodate the drilling and utilization of injection wells and in the calculation of the consideration to be paid to the lessor under the terms thereof. Even here, differences existed between the lease forms as utilized as some of these companies chose to characterize the annual payment as a "rental" as others rather referred thereto as "in lieu" royalty. This difference is substantive rather than semantical as "rents" would be payable to the mineral owners whereas "in lieu" royalties would be payable to the royalty owners and these recipients were not always the same. Another problem encountered from a legal standpoint was the formulation of a payment for a resource which had no established value. While the lessors sought to secure the maximum amount which could be obtained, the lessees sought to minimize the same justified by the differential between the method of calculating payments for the lessor's share of petroleum hydrocarbons which was then ordinarily based upon one-eighth of the posted price therefor whereas no price had been posted or was otherwise established for salt water which had been the scourge of the industry and therefore an economic blight rather than a benefit. Arms length negotiations between knowledgeable parties early on generally established a value based upon six cents per barrel justified by the high lifting and expense of drilling these large diameter high volume wells and of the costs of disposing of the debrominated brine following processing.

As you would expect, litigation soon ensued and the first case which I would mention is *Parnell v. Giller*, 237 Ark. 267, 372 S.W.2d 627 (1963) wherein the question which arose was whether the lessee in calculating market value for royalty paying purposes was entitled to deduct its expenses in piping the salt water to the chemical company and in disposing of the spent brine. The Court in its Opinion construed the lease which was similar to that in *Clear Creek Oil and Gas Co. v. Bushmaier*, 165 Ark. 303, 264 S.W. 830 (1924) as entitling the lessee to deduct its transportation and distribution expense in determining market value as such services were essential and peculiar to the marketing of the product itself. This decision resulted within certain changes being demanded by the lessors of salt water (brine) leases subsequently executed but did not lay at rest the legal problems that continued to arise between the lessors and lessees. By this time, salt water was being commercially produced for the recovery of bromide ions in Columbia County and litigation there likewise resulted which initially concerned the application of the law of capture and for an accounting for the share of profits attributable to the bromide ions allegedly drained from under a 240-acre tract in which plaintiff owned an undivided 1/36th interest which was allegedly drained as a consequence of the recycling operations. The appellee held leases upon a compact block of about 16,000 acres of land and had drilled a number of input (disposal) wells near the outer edge and a number of output (supply) wells within the circle. The Court held that the law of capture applied and that the plaintiff was not entitled to an accounting as no trespass upon a vested existing property right had occurred. Having failed to volunteer to share the risk of the

project by participation failed to afford the plaintiff the right in equity to reap the profits. *Budd v. Ethyl Corporation*, 251 Ark. 639, 474 S.W.2d 411 (1971).

Another cause of action seeking somewhat similar relief was likewise the subject of a suit styled *Jameson v. Ethyl Corporation*, 271 Ark. 621, 609 S.W.2d 346 (1980) which limited the application of the rule of capture to initial production and not extended to apply without qualification to secondary recovery or so-called "sweeping" process without liability for damages. In this case the plaintiff owned a 95-acre tract within the same field referred to in the *Budd* case, supra, which was unleased for salt water. While the lower Court denied the relief requested by plaintiff based upon the decision in *Budd*, supra, the Supreme Court reversed stating that from a judicial prospective that the law as developed with respect to the rule of capture, trespass and nuisance fails to adequately provide a resolution of the issue with respect to bromine-enriched brine where secondary recovery methods are utilized, the results of which materially alter the natural drainage consequences of extracting from encircled properties lying within a common pool.

At the time of this decision, the Arkansas Oil and Gas Commission had not been extended jurisdiction nor authorized to establish brine production units. Irrespective of that fact, the Court nevertheless recognized that steps of secondary recovery from a common pool should not be subject to an arbitrary control of a limited number of landowners. Nor should the law permit those persons who are in an economically advantaged posture to be able to gain negotiating clout by being allowed to undertake, with impunity, processes that go beyond extracting transient minerals

or gases which have drained or flowed by natural process to their drilling sites. More significantly, the Court in its Opinion likewise stated:

> "While Arkansas' unitization laws are not, as previously noted, involved in this case, we do believe that the underlying rationale for the adoption of such laws, i.e., to avoid waste and provide for maximizing recovery of mineral resources, may be interpreted as expressing a public policy of this State which is pertinent to the rule of law of this case. Inherent in such laws is the realization that transient minerals such as oil, gas and brine will be wasted if a single landowner is able to thwart secondary recovery processes, while conversely acknowledging a need to protect each landowner's rights to some equitable portion of pools of such minerals. A determination that a trespass or nuisance occurs through secondary recovery processes within a recovery area would tend to promote waste of such natural resources and extend unwarranted bargaining power to minority landowners."

In recognition of the litigation both filed and threatened and consistent with the public policy of the State as expressed within the Opinion of the Court as appears verbatim above from the *Jameson* case, supra, the Director of the Department of Commerce at the direction of then Governor David Pryor established a Brine Study Committee in September, 1975. Eight members were appointed to the Committee, all of whom were knowledgeable in the brine operations connected with the bromine industry either from the view point of landowners, bromine industry representatives, engineers, geologists and chemists from State regulatory agencies. This Committee held its Organizational Meeting on September 30, 1975, to commence discussions of the charges as listed. Subsequent meetings were frequently held at which comments were received expressive of views of landowners, industry representatives, environmentalists, foresters, and experts within their respective professional fields. Matters of health and

taxation were likewise discussed. In an effort to assist the Committee in the formulation of its recommendation for the submission of a majority or minority report to the Governor, I wrote H.B. 404, 1977, entitled the Brine Conservation Act, wherein the Arkansas Oil and Gas Commission was expressly extended jurisdiction over the bromine industry and invested with the power to unitize areas on a field-wide basis upon the submission of the requisite information which such Bill required. The Bill was introduced into the House of Representatives and received a do-pass recommendation but failed to secure the approval by a majority of the Senate Committee to which such Bill was referred.

During the interval between the introduction of this Bill and the convening of the General Assembly in 1979, various changes were made within the proposed Act primarily by non-lawyers who addressed primarily the valuation of brine and the methodology for calculating royalty payments thereunder and the rights of owners of unleased interests to elect to participate in the operation of the unit and the production therefrom or to transfer such interest to the participating producers thereof upon such terms as were set forth. This amended Bill was again introduced in the Legislature and enacted as Acts 1979, No. 937[2] patterned in large part after the Oil and Gas Conservation Act. The Brine Conservation Act was recently amended by Acts 1995, No. 1287, for purposes of modifying the minimum compensation payable thereunder and changing the basis of adjustments therein based upon a Producer Price Index for Intermediate Materials, Supplies and Components published by the U.S. Department of Labor, Bureau of Labor Statistics, rather than upon the price of bromine as reported in the most recent edition

[2] Ark. Code Ann. (1987) Section 15-76-301, et seq.

of the Bureau of Mines Mineral Yearbook[3].

Some few of you may recall my oral presentation at the 1978 Annual Meeting of the Natural Resource Institute concerning a case styled *Young v. Ethyl Corporation* which was initially tried before Honorable Oren Harris in the U.S. District Court, W.D., El Dorado Division, cited as 382 F.Supp 769 (1974). In this case, the plaintiff sought to enjoin the operation of the plant of the defendant and for an accounting for the value of the brine which was displaced from the formation underlying plaintiff's lands and produced through wells located on adjacent property. This case like those in *Budd* and *Jameson*, supra, involved the same brine field and in this instance, the 169.1-acre area of plaintiff was entirely included within the 15,040-acre field which the Court found to be a common source of supply. The Trial Court under the facts before it dismissed the Complaint of plaintiff and rendered judgment for the defendant based upon the law of capture by holding that to do otherwise would be contrary to long and well-established rules to apply any rule of law other than the rule established by the Supreme Court of Arkansas citing in support thereof the *Budd* case, supra.

The plaintiff timely perfected an appeal to the Eighth Circuit which held that the rule of capture did not apply and that the forceable removal of the brine beneath the plaintiff's land constituted an actionable trespass as a consequence of which the decision of the Trial Court was reversed and the case remanded. *Young v. Ethyl Corporation*, 521 F.2d 771 (1975). Upon hearing on remand, the District Court citing the findings of the Court of Appeals held that a good faith trespass had occurred and awarded

[3] Ark. Code Ann. (1987) Section 15-76-315

the plaintiff damages based upon the value as determined for the brine displaced from the lands of plaintiff based upon that of bromine and sulphur. Such damage award was calculated consistent with the Opinion in *National Lead Co. v. Magnet Cove Barium Corp.*, 231 F.Supp. 208 (1964). Consistent therewith, costs were deducted from the total income and an allocation of the profit determined thereby from the field operation was then calculated on a per-acre basis whereby the plaintiff was awarded judgment based upon 169.1/15,040ths or the relationship of the acreage within the tract of plaintiff over the total acreage within the field.

An appeal was again timely perfected in this instance by the defendant in *Young v. Ethyl Corporation*, 581 F.2d 715 (1978), and the Court of Appeals in considering the case a second time held that under Arkansas Law the Lower Court on remand applied an improper measure of damages under Arkansas law to the facts of the case which was again reversed and remanded as there was no support in the Arkansas cases or elsewhere for allowing the plaintiff under the facts of the case a share of the profits of end products produced from the brine in the proportion which plaintiff's land bears to the entire field. Citing with approval the decision of the Arkansas Supreme Court in *Parnell, Inc. v. Giller*, supra, the Court held that the royalty payable to the lessor is computed upon the market value of the salt water at the well which the Court determined to be two to five cents per barrel which reduced substantially the amount of damages which plaintiff had otherwise been awarded by the Lower Court on remand based upon the authority in Arkansas and elsewhere that the in-place value of the mineral, less the cost of bringing it to the wellhead or surface, is the appropriate measure of damages as the taking was in good faith and

rejected the contention of plaintiff that it was entitled to a proportionate share of the value of the ultimate products made from the salt water. After this remand, the District Court denied a Motion of plaintiff to vacate and this ruling was again appealed to the Eighth Circuit whereupon the same was dismissed for lack of a final judgment below. This protracted litigation in the *Young* case having initially been filed in 1974 remained active in litigation through the several appeals and remands until 1980 and the ultimate holding therein on the record before the Court remains the law as of the present date not having otherwise been overruled or modified.

Within this interval, the Brine Conservation Act has been adopted investing the Arkansas Oil and Gas Commission with jurisdiction and authority to regulate the industry and to create units for the production of salt water (brine) for the recovery of the bromide ion content thereof and for the unitization of unleased and non-participating interests within such units as so established.

As mentioned in my initial remarks, multiple cases are presently pending which challenge the constitutionality of the Brine Conservation Act and similarly seek an award of both compensatory and punitive damages for alleged intentional trespass and an accounting based upon the value of the beneficiated products derived from the volume of salt water (brine) produced.

The contraints of time have necessarily limited the extent of my remarks which will otherwise be contained within the program as printed should you wish to review the same. However, it has also precluded me from making extemporaneous remarks from the experience gained from the inception of this industry in 1955

until the current date. I would likewise express my appreciation for having again been invited to appear upon the program and the frequency within which I have done so in the past persuades me that this shall in all likelihood constitute the last occasion. In the language of Dorsey Ryan "the fat lady has now sung".

Appendix "B"

BRINE LEASE

THIS AGREEMENT, entered into effective as of _____, 20__ , between _____, herein called Lessor (whether one or more), whose address is: _____ and _____, _____ herein called Lessee,

WITNESSETH:

Article 1. Lessor, in consideration of Ten Dollars ($10.00) cash in hand paid, and other valuable consideration, the receipt of which is hereby acknowledged, of the rental and of the royalty herein provided and of the agreements of Lessee herein contained, hereby grants, leases, and lets exclusively to Lessee for the purpose of investigating, exploring, prospecting, drilling for and producing brine (as defined in Article 11); conducting exploration, geologic and geophysical tests and surveys; producing and removing brine by drainage, extraction, forced subterranean movement, pumping or other means; injecting gas, water, brine and other fluids and air into subsurface strata; laying pipelines, establishing and utilizing facilities for the disposition of brine; building roads, bridges, tanks, telephone lines, powerlines, power stations and other structures thereon and on, over, and across land owned or claimed by Lessor adjacent or contiguous thereto necessary or desirable to Lessee in operations to produce, save, store, take care of, measure, treat, transport and own said brine; for all appliances or structures, equipment, easements, and privileges which may be necessary, useful, or convenient to or used in connection with any such operations conducted by Lessee thereon or on land pooled or unitized therewith or on any contiguous or adjacent land, the following described land in _____ County, State of Arkansas; to-wit:

SEE EXHIBIT "A" ATTACHED HERETO AND MADE A PART HEREOF FOR LEGAL DESCRIPTIONS.

Lessor hereby acknowledges receipt of all rentals as cited in Article 3 of this lease for the first through the fourth anniversary dates, making this lease a five year paid-up lease as to rentals for the first five years.

This lease also covers and includes all land owned by Lessor adjacent, or contiguous to the land particularly described above. For the purpose of calculating rental and royalty payments hereunder, said land is estimated to contain ____**acres** whether it contains more or less.

Whether or not any reduction in rental and/or royalty payments shall have previously been made, this lease, without further evidence thereof, shall immediately attach to and affect any and all rights, title, and interests in the land and brine interest covered by this lease, including reversionary brine interests, hereafter acquired by or inuring to the Lessor and Lessor's successors and assigns. If any reduction in rentals or royalties shall have previously been made, such additional interest shall be considered in the computation of rentals or royalties starting with the rental or royalty payment date next ensuing more than forty-five (45) days after receipt by Lessee of written notice from Lessor of the acquisition and extent of such additional interest and the manner of such acquisition.

Article 2. This lease, subject to the right of Lessee to cancel and surrender it insofar as it covers all or any part of the above mentioned land as hereinafter provided, shall remain in full force and effect for a term of five years from the date hereinbefore first written and as long thereafter as any of the payments specified in Article 3 hereof continue to be made.

Article 3. As additional consideration for this lease, Lessee shall pay as rental to Lessor, on or before each anniversary date of this lease a sum to be ascertained by multiplying the number of acres set out in Article 1 above, as follows: (1) by One Dollar ($1.00) for each of the first through the fourth anniversary dates hereof, (2) by Ten Dollars ($10.00) for each of the fifth through the fourteenth anniversary dates hereof, and (3) by Twenty Five Dollars ($25.00) for each of the remaining anniversary dates hereof, provided, however, that, if more than sixty days prior to any such anniversary date hereof Lessee has engaged in the production of brine for the purpose of extracting minerals therefrom or injection of brine from or into any well located on the land covered hereby or on acreage pooled therewith (or any part thereof) or within one-half mile of the land covered by this lease, which brine is not produced incidental to the production of oil, gas or distillate or in the testing of the capacity of a well to produce brine, then, instead of payments as rental, each Lessor shall be paid thereafter a sum either in lieu of royalty or as shut-in royalty, such sum, in case of payments in lieu of royalty, being ascertained by multiplying the number of acres set out above in Article 1 hereof by Thirty-Two Dollars ($32.00) and such sum, in case of payments of shut-in royalty, being ascertained in accordance with the provisions of Article 5 hereof, and provided, further, that if Lessor owns less than the entire undivided interest in all or any portion of the land or mineral and royalty interest relating thereto (whether such interest is herein specified or not) then each payment to be made under this Article 3 may be reduced to the proportion which the interest, if any, herein covered by this lease bears to the entire undivided interest therein.

It is further agreed, that Lessee's right to make any annual payment as above set out shall terminate at the later in time of (i) the end of twenty-five years from the date of this lease or (ii) at the end of any annual period of this lease during which Lessee shall not have been in actual production or injection of brine either from or into land covered hereby or acreage pooled therewith (or some part thereof) or production from or injection into a well situated within one-half mile of land covered by this lease; and such right by Lessee to make such annual payments will then continue only so long thereafter as such production or injection shall be continued or so long as shut-in royalty is paid pursuant to Article 5 hereof.

If the mineral or royalty interest of any person named as Lessor under the land covered by this lease has heretofore been reduced by the conveyance of a nonparticipating mineral interest or nonparticipating royalty interest by him, or by his predecessor in title, each payment to be made under the provisions of this Article 3 to that particular person named as Lessor may be reduced proportionately.

Each owner of such nonparticipating mineral interest, or nonparticipating royalty interest, executing this agreement, or a counterpart thereof, agrees to accept such payment in lieu of royalty on brine produced or removed from the land covered by this lease and in satisfaction of damages, if any, which he may sustain by drainage or removal of brine from the land covered by this lease.

In lieu of making any payment to Lessor under the provisions of this Article 3, Lessee may pay or tender for deposit to the credit of Lessor in _____ , the sum so payable, which shall, for all purposes of this lease, be considered to be a payment to Lessor. If at the time of such deposit any person hereinbefore named as Lessor is dead or is an incompetent, such deposit in the name of the deceased or the incompetent shall, for all purposes, be binding upon the heirs, devisees, executor or administrator of the deceased or upon such incompetent or the guardian of the person or of the estate of the incompetent. Should the bank named, or any depository subsequently named by Lessor, fail or liquidate, or if it should for any reason fail or refuse to accept the check or draft of Lessee tendered in payment of any sum payable under the provisions of this Article 3, the attempted payment in the manner hereinbefore provided shall not thereby be rendered ineffective, nor shall Lessee be in default for failure to pay the sum involved until thirty days after such Lessor shall have furnished to Lessee a recordable instrument naming a new depository. The failure to pay any such sum so due shall not give Lessor the right to cancel this lease as to any land covered by this lease, but shall only entitle t,he Lessor to recover from Lessee the sum so due.

Lessee, or any assignee or sublessee, may at any time, and from time to time, execute and file for record in said county, a release of this lease insofar as it affects all or any part or parts of the land covered by this lease, and thereby be relieved, as to the land with respect to which this lease has been released, of any and all obligations of this lease not then accrued. Without impairment of Lessee's right to release said land or any part thereof and be thereby relieved of any liability therefor, it is agreed that Lessee shall nevertheless be required to continue to make the annual payments in lieu of royalty or as shut-in royalty above set out for any and all acreage covered hereby and situated within one-half mile of any of Lessee's wells from which brine is being produced or into which brine is being injected so long as such production or injection by Lessee shall be continued. Upon the filing of any such release, each payment shall be reduced in the same proportion as Lessor's interest in the number of acres of land as to which this lease has been released bears to Lessor's interest in the total number of acres stated in the foregoing Article 1.

Article 4. Lessee shall have the right to use, free of cost, fresh water produced from the leased premises, excepting water produced from a well of Lessor, for any of the operations of Lessee on the leased premises.

Article 5. No royalty or payment, other than the payment provided in Article 3, shall be payable by Lessee to Lessor with respect to brine produced or removed from the leased premises or with respect to any product, products, or minerals extracted from such brine by Lessee, or with respect to brine produced from the leased premises, nor shall Lessee in any event be liable to Lessor for failure to protect the leased premises from drainage or removal of brine and its contents. The sums payable to Lessor under the provisions of the foregoing Article 3 are to be made by Lessee in lieu of any royalty with respect to brine produced or removed from the leased premises and any product or products extracted from the brine and in complete compensation for any drainage or removal of brine from the land hereinbefore mentioned. The parties hereto agree that the annual in lieu of royalty specified in Article 3 hereof shall be adjusted annually effective June 1, 1996, in the same manner as is provided by Act 1287 of the 1995 General Assembly of the State of Arkansas which amended Ark. Stat. Ann. § 15-76-315. Notwithstanding any other provision hereof relating to rental, royalty, or payments in lieu of royalty, if Lessee at any time or times suspends all production or injection of brine (including its component parts) from or into the land covered hereby or acreage pooled therewith (or any part thereof) or from or into wells located within one-half mile of the land covered hereby, for any period of twelve consecutive months prior to sixty days prior to any anniversary date of this lease, then, provided Lessee pays to Lessor (in the manner specified above in Article 3) on or before such anniversary date as shut-in royalty a sum to be ascertained by multiplying the number of acres set out in Article 1 hereof by Ten Dollars, this lease shall continue and remain in full force and effect without the obligation by Lessee to make any other payment under the aforesaid Article 3 hereof, provided, however, that in no event may Lessee make such shut-in royalty payments continuously for a period in excess of three consecutive years.

Article 6. Lessee shall have the right to drill, complete, recomplete, deepen, and operate a well or wells for the production of brine from any horizon under the land covered by this lease, or for the injection of brine produced by Lessee from land covered by this lease or from any other land into any horizon which lies below the depth of 4,000 feet subsurface under the land covered by this lease.

Article 7. Lessee, at its option, is hereby given the right and power without any further approval from Lessor, at any time and from time to time, to pool or unitize the land or interests therein covered by this lease or any portion thereof with other land, lease, leases or interests therein in the vicinity thereof when in Lessee's judgment it is necessary or advisable to do so in order to properly explore or develop or operate said leased premises or to comply with the orders, rules and regulations of any Regulatory Body of the State of Arkansas or the United States having jurisdiction. The term "Regulatory Body" shall include any governmental officer, tribunal, or group (civil or military) issuing orders governing the drilling of wells or the production of minerals. Such pooling shall be of tracts which will form a reasonably compact (but not necessarily contiguous) body of land for each unit, and the unit or units so created shall not exceed substantially _____(_____) acres for each well for brine exploration, production or injection, plus a tolerance of ten percent (10%) thereof in each instance, unless a larger spacing pattern or larger drilling or production units (including a field or pool unit) shall have been fixed and established by an order of a Regulatory Body of the State of Arkansas or of the United States, in which event the unit or units shall be the same as fixed by said order. Lessee shall execute and file for record in the appropriate Records of the County in which the land and/or mineral interest herein leased is situated a declaration describing the pooled acreage, and, upon such filing, the unit or units shall thereby become effective; except that when a unit is created by order of a Regulatory Body the pooling shall be effective as of the effective date of such order, and no declaration shall be required in connection therewith.

With regard to the payments in lieu of royalty as provided in Article 3 hereof, payments shall continue to be made upon an acreage basis and specifically not based upon the proportionate part of production from any pooled unit. Any unit formed by Lessee hereunder may be created either prior to or during or after the drilling of the well which is then or thereafter becomes the unit well. Separate units may be created for separate stratum or strata of brine even though the areas thereof overlap; and the creation of a unit as to one strata or stratum shall not exhaust the right of Lessee (even as to the same well) to create different or additional units for other strata or stratum of the same or other minerals. A unit established hereunder shall be valid and effective for all purposes of this lease even though there may be land or mineral, royalty, and/or leasehold interests in land within the unit which are not pooled or unitized, or even though there may be a failure of the leasehold title (in whole or in part) to any tract or interest therein included in a pooled unit. Any unit created by Lessee hereunder may also be revised so as to conform with an order of a Regulatory Body issued after said unit was originally established; such revision shall be effective as of the effective date of such order. Also, any pooled unit designated by Lessee in accordance with the terms hereof may be dissolved by Lessee by instrument filed for record in the appropriate Records of the County in which the land or interests therein are situated at any time prior to the commencement of drilling or after the completion of a dry hole or the cessation of production on said unit. It is specifically understood and agreed that Lessor does hereby grant to Lessee the right and authority to consent to or otherwise comply with any order, rule or regulation of any Regulatory Body of the State of Arkansas or of the United States having jurisdiction with regard to the creation of any pool, unit or district for the production and injection of brine which shall be binding upon Lessor without Lessor's further consent, provided only that Lessee shall never decrease

the amount of the annual payments herein specified to be paid in lieu of brine royalty which would otherwise have been required to have been paid in the absence of such pool, unit or district.

Article 8. Lessee shall have the right to construct, erect, maintain, replace and use on the land mentioned in the foregoing Article 1 all storage tanks, separators, pipelines, buildings, pumps, shafts, hoists, machinery, boilers, engines, electric lines, telephone and telegraph lines, roads, bridges, and other equipment reasonably necessary for conducting, on the land covered by this lease, operations hereunder of any nature whatsoever. Lessee shall have the right to remove all equipment, materials, and supplies placed upon the leased premises at any time while this lease is in effect as to the land on which such material, equipment and supplies are located, or within a period of two years after this lease has terminated for any reason with respect to the land on which such materials, equipment and supplies is or are located. Lessor grants to Lessee the right to lay, maintain, repair and replace, from time to time, upon the land covered by this lease, a pipeline or pipelines for the purpose of transporting brine and associated gas onto and across the land covered by this lease.

When requested by Lessor in writing, Lessee shall bury any pipe below plow depth. Lessee agrees to pay all damages to timber and growing crops on the leased premises caused by its operations. Lessee further agrees to pay to surface owner annually $50.00 for each surface acre hereof which Lessee has used during the previous year in such manner that surface owner was thereby prevented from having the normal use thereof; provided, however, Lessee's failure to make payment of such surface rental shall not be cause for termination of Lessee's rights hereunder but shall entitle owner to recover from Lessee any such rental so due. Further, it is specifically agreed that if Lessee shall have constructed or placed roads, pipelines or powerlines upon land covered by this lease and Lessee has ceased to make any of the payments required to be made in Article 3 or Article 5 hereof, then Lessee may, nevertheless, execute a partial release of this lease as provided under the terms of Article 3 hereof which partial release shall retain to Lessee the right to continue to hold for such surface use purposes only the land then being so used for such road, pipeline or powerline purposes by continuing to make such above specified annual surface rental payments to Lessor which payments shall be continued only as long as said surface is so used by Lessee. Notwithstanding arty other provision of this Article 8, Lessee shall not drill any well or construct any structure, other than a pipeline, within 200 feet of any dwelling house now upon land affected by this lease.

Article 9. If the estate of either party hereto is assigned or sublet, and the privilege of assigning or subletting in whole or in part is expressly allowed, the covenants hereof shall extend to the sublessees, successors and assigns of the parties; and in the event of an assignment or subletting by Lessee, Lessee shall be relieved and discharged as to the leasehold rights so assigned or sublet from any liability to Lessor thereafter accruing under any of the covenants or conditions of this lease. No change in the ownership of the land or mineral interests covered by this lease or in the ownership of any royalty, however accomplished, shall operate to enlarge the obligations or diminish the rights of Lessee or require separate measuring or installation of separate measuring tanks by Lessee. Notwithstanding any actual or constructive knowledge of or notice to Lessee, no change in the ownership of land, or of any mineral interest, covered by this lease, or of the right to receive any payment to be made under the foregoing Article 3, or of any interest therein, by reason of death, or conveyance, or in any other manner, shall be binding on Lessee until ninety days after Lessee has been furnished written notice thereof, together with the original or certified copies of all documents and affidavits necessary to establish the change in ownership involved.

Lessor hereby warrants and agrees to defend the title to the land covered by this lease, but if the interest of Lessor covered by this lease is expressly stated to be less than the entire fee simple mineral estate, Lessor's warranty shall be limited to the interest so stated. Lessee may purchase or lease the rights of any person claiming any interest in the land covered by this lease and exercise such rights as may be obtained thereby and Lessee shall not suffer any forfeiture nor incur any liability to Lessor by reason thereof Lessee, shall have the right at any time to pay for Lessor, taxes or any indebtedness secured by a mortgage or other lien on said land, in the event of default of payment by Lessor, and be subrogated to the rights of the holder thereof. Any such payments made by Lessee for Lessor may be deducted from any amounts of money which may become due Lessor under this lease.

Article 10. So long as each payment which Lessee is obligated to make in accordance with Article 3 or Article 5 hereof is made. Lessee shall not be obligated, whether or not there has previously been production from or injection into land covered hereby or on acreage pooled therewith (or any part thereof) or from or into any well located within one-half mile of the land covered hereby, either expressly or impliedly, to drill or operate on land covered by this lease any well for the production of brine or for the injection of brine into said land.

Article 11. The term "brine" as used in this lease shall mean subterranean salt water and all other chemical substances produced with or extracted therefrom, except brine produced incidentally to the production of oil or gas, unless such brine is saved or sold for the purpose of extracting the chemical substances therein.

Article 12. In the event the Lessor at any time considers that Lessee is not fulfilling its express or implied obligations (including the payment of royalties due hereunder), Lessor shall notify Lessee in writing of the facts relied upon as constituting a breach of said obligations; and Lessee shall have sixty (60) days after receipt of such notice in which to take such action as is then legally necessary to comply with the requirements hereof The service of said notice and the lapse of sixty (60) days without Lessee meeting or commencing to meet the alleged breaches shall be a condition precedent to any action by Lessor for any cause hereunder. It is provided, however, that, after production of brine has been obtained from the land covered hereby or land pooled therewith (or any part thereof), this lease shall not be subject to forfeiture or loss, either in whole or in part, for failure to comply with the express or implied obligations of this contract, except after final judicial ascertainment of such failure and after Lessee has been given a period of sixty (60) days after such final judicial ascertainment to prevent such loss or forfeiture by complying with and discharging the obligations as to which Lessee has been judicially determined to be in default.

Article 13. The requirements hereof shall be subject to any State and/or Federal law or order regulating operations on or under the land. It is further agreed that, should Lessee be prevented from complying with any express or implied covenants of this lease, from conducting drilling or reworking operations thereon, or from producing brine therefrom by reason of scarcity or inability after effort made in good faith to obtain equipment or material or authority to use same, or by failure of carriers to transport or furnish facilities for transportation, or by operation of force majeure, any Federal or State law, or any order, rule or regulation of governmental authority, or by any other cause beyond Lessee's control, then while so prevented, Lessee's obligation to comply with such covenants shall be suspended; and Lessee shall not be liable for damages for failure to comply therewith; and this lease shall be extended while and so long as Lessee is prevented by any such cause from conducting drilling or reworking operations on or from producing brine from the leased premises; and the time while Lessee is so prevented shall not be counted against Lessee; provided, however that if such suspension occurs, Lessee shall pay or tender the appropriate annual sum in payment of rental or in lieu of royalty as provided in Articles 3 or 5 thereof.

Article 14. Lessee shall also have the right to produce, remove, and appropriate such oil, gas and other minerals as may be necessarily produced incidentally with the production of salt water (brine); provided, however, that three-sixteenths (3/16ths) of the value of all such oil, gas, and other minerals produced, saved, and marketed by Lessee shall be paid as royalty thereon to those persons entitled thereto based upon the spacing pattern therefor as established by the Arkansas Oil and Gas Commission or alternatively upon the basis of the regular governmental quarter section upon which such well is located if no spacing pattern has otherwise has been established.

Article 15. This lease and all provisions thereof shall be applicable to and binding upon the parties and their respective heirs, successors and assigns. If any one or more of the persons named as Lessor does or do not execute this lease, it shall nevertheless be binding upon each of the persons executing it.

Article 16. And for the consideration aforesaid, each of the undersigned persons does hereby join in this instrument for all purposes and does hereby release and relinquish unto the Lessee herein all of his and/or her rights of cutesy and/or dower and homestead in and to the above described property to the extent necessary to effectuate the purposes of this instrument.

IN WITNESS WHEREOF, this instrument is executed as of the date hereinbefore first mentioned, which date shall be the basis for ascertaining the first and each succeeding anniversary date of the execution of this lease.

_____

By: _____

Title: _____

ACKNOWLEDGEMENT

STATE OF _____

COUNTY OF _____

BE IT REMEMBERED, that on this day came and appeared in person before me, the undersigned, a Notary Public in and for the County and State aforesaid, duly commissioned and acting, _____, _____ _____, to me well known as the Lessor (whether one or more) whose name is subscribed to the foregoing instrument of writing, and stated that said Lessor had executed the same for the consideration and purposes therein mentioned and set forth.

WITNESS MY HAND AND SEAL AS SUCH Notary Public on this the _____ day of _____, 20_____.

_____

Notary Public,