Three Women, One Breakthrough: Unsung Heroines Who Transformed Oil Exploration*

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Introduction

What do you think was the first profound, wide-reaching, economically effectual technological breakthrough in petroleum geology?

Was it the anticlinal theory? No, though debated for over 40 years, it was not embraced until the 19-teens and ‘20s, and even then, it was still not universally applied or viable. Was it surface mapping? Recognized as important in the early 1900s, it was slow to be accepted and was of no use in complex stratigraphic and structural subsurface environments, such as the Gulf Coast.

First Major Technological Breakthrough

The first major breakthrough was foraminiferal micropaleontology – made by three young “girls” in 1921, which, within three years, created oil industry jobs for 300 micropaleontologists and gave rise to micropaleontology courses in 31 geology departments.

And, it profoundly affected the economics of drilling, as 75 percent of all wells drilled and completed in the United States came to rely on micropaleontology. But, fewer than 20 years after this breakthrough, when famous paleontologist Cary Croneis of the University of Chicago gave his presidential speech to the Society of Economic Paleontologists and Mineralogists (now the Society for Sedimentary Geology, but still abbreviated “SEPM”) on the history of micropaleontology in 1941, he downplayed their role and overemphasized the role of his male colleagues. By the time my mentor and hero, Edgar Owen, wrote the “Trek of the Oil Finders” in 1975, his discussion of foraminiferal discoveries ignored the women’s role entirely and he gave praise to the “men whose influence was most pervasive in its adoption – J. A. Udden, Edwin T. Dumble, Joseph A. Cushman, and Jesse J. Galloway.”

These four men had themselves failed to identify foraminifera as the clue to detailed biostratigraphy and were only convinced by scientific work done by the women. Yet, the men were given the credit. All four men were deceased by 1975, but I imagine at least some would have had the decency to roll over in their graves.

Charles Schuchert, a Yale paleontologist, did understand their role when in 1924 he wrote, “the ladies have it” a year before their seminal paper was published. He commented that they had not only identified the short ranges of foraminifera and more distinct species characteristics, but were identifying and applying important foraminiferal faunal assemblages that were critical for detailed biostratigraphy.

To really appreciate the monumental impact of their work, it is incumbent upon today’s exploration geologist to use his or her imagination and place himself or herself back into the pre-foraminifera days and try to delineate the stratigraphy of a complex salt dome area or the coastal down-warping and highly faulted Gulf Coast basin margin, or even the Mid-Continent mountain-front stratigraphy in Oklahoma – imagine working without the benefit of any well logs! And, continue to imagine exploring without the benefit of any seismic!

The only tools the subsurface exploration geologists had were lithologic data, and, at that time, this was poorly collected, erratically prepared, and under-utilized. More sophisticated stratigraphers sometimes combined the lithologic data with broken pieces of macrofossils found in well cuttings.

Will a Woman Do?

The story of these female paleontologists story begins with E.T. Dumble, former head of the Bureau of Economic Geology in Texas and, in the early 1900s, the vice president and general manager for Southern Pacific Company and its subsidiary Rio Bravo Oil Company. Their large task was to supply the Southern Pacific railroad with fuel oil, as they had recently converted from coal-fired engines. By 1915, Dumble had hired and trained the largest petroleum geology department in the world.

Much of his work was done from their San Francisco office, and the rest in their Houston office for the Texas and Louisiana Gulf Coast. When California privatized its oil lands, he turned his focus back to Gulf Coast exploration. He was convinced that the key to working out the chaotic Tertiary stratigraphy of the Gulf Coast was paleontology. But, it was macropaleontology that he had in mind. The conventional wisdom of the day among micropaleontologists was that single-celled animals, such as foraminifera, could not possibly have the short life span or the physiological complexities required for effective and detailed stratigraphic correlations.

Between 1918 and 1919, Dumble put together a consortium in Houston, consisting of his own Rio Bravo, The Texas Company, Humble Oil Company, and Gulf Oil Company, all of whom agreed to hire a paleontologist to work on macropaleontologic solutions to the troubling Gulf Coast stratigraphy. While in San Francisco he called the geology department at the University of California at Berkeley and asked Bruce L. Clark to recommend a man for the paleontology job. According to Esther’s autobiography, Clark said, “I don’t have a man, will a woman do?”

Dumble, to his credit, said, “I don’t see why a woman couldn’t do it better.” Dumble enlisted graduate student Esther English Richards (Figure 1, 2, 3, and 4) to come to Texas in the summer of 1919 to work for him, not letting her know that this was a “test” for her permanent hiring as the consortium’s paleontologist. She passed the test and returned with her master’s degree a year later to set up the paleontology lab at Rio Bravo, starting on Labor Day in 1920.

A month later, much to the amazement of both Dumble and Richards, Wallace Pratt hired Alva Ellisor (Figures 2, 3, 4, and 5) from the University of Texas at Austin to set up a lab for Humble Oil. However, Pratt assured Dumble that Humble would stay in the consortium and would encourage the women to work together – which worked out greatly, as the two soon found an apartment together in downtown Houston off Main Street.

Both women came to realize that macrofossils were just not going to work for detailed stratigraphy – the samples were broken and poorly preserved in cable tool wells, and were even more thoroughly destroyed with the new rotary drilling technology.

Applying new sample-washing techniques learned from J. A. Udden at the Bureau of Economic Geology, they began recording and comparing their observations on the microfossil assemblages. In the meantime, the Texas Company, under the management of Raymond Baker, hired another UT graduate, Hedwig Kniker (Figures 3 and 4), to set up a paleontology lab for them in Houston – but also agreed that the women would collaborate. Kniker moved into the downtown apartment with Richards and Ellisor. It was a collegial arrangement, and Richards later wrote that they often talked long into the night about their work. They sometimes went to Ellisor's mother's home in Galveston on weekends or entertained other geologists with dinner parties in their apartment.

Exciting News

Ellisor is credited with the first breakthrough, in 1921, though Richards says she was working on the same samples and ideas when it was announced. Anyway, the story is that Ellisor showed Wallace Pratt what she could do using Tertiary foraminifera for well-to-well correlations. He was so excited, he at first told her not to share this information with anyone! He thought they could use this to Humble's advantage. However, by the time Ellisor got back to the apartment that very night, Richards and Kniker greeted her with congratulations: "Wow … we hear Pratt loves the use of forams for stratigraphy and we all have the go-ahead to pursue it!" they said. Apparently, Pratt was so excited, he couldn't keep the news to himself, plus, collaboration was probably obligatory under the consortium's agreement.

"Dr. Dumble wanted to spread the news that (simple, unicellular forms … were supposed to live on, unchanged, through many geologic time periods) and that these simple organisms did change as rapidly in time as their more organically complicated macrofossil relatives," said Richards.

He immediately wrote a paper, "Recent Geological Work in the Gulf Coast Oil- Fields" in December 1921, and, interestingly, he listed himself as the only author, but sent Richards, accompanied by Ellisor, to Amherst, Massachusetts. to present the material at the Geological Society of America, where he knew many micropaleontologists would be in attendance. Richards delivered the talk: five pages, double-spaced and never published, but Richards' granddaughter, Patty Kellogg of Gloucester, Virginia., has preserved a copy of it.

When the very nervous young Richards finished delivering the presentation, Jesse J. Galloway, a professor at Columbia University stood and said, "Gentlemen, here is this chit of a girl right out of college, telling us that we can use foraminifera to determine the age of formation. Gentlemen, you know it can't be done."

Undaunted by this criticism, Richards and Ellisor, with Rio Bravo's and Humble's encouragement, lingered through the Christmas holiday on the East Coast to meet and talk with other leading paleontologists, including J.A. Cushman at Columbia and William H. Dall of the U.S. Geological Survey. And, significantly, they also met with Julia Gardner, the queen of Tertiary coastal biostratigraphy, and stayed at her Washington, D.C. home for several days. They forged lifelong friendships and working relationships.

When Richards and Ellisor returned to Houston, invigorated and motivated, they – along with Kniker – began, in earnest, their work sorting out the coastal stratigraphy. All three felt strongly that their subsurface work had to be closely tied to surface "ground truth" and initiated many field trips into central Texas. Richards took yet another trip around the north and northeast Gulf Coast collecting samples. She also conducted frequent meetings with drillers – constantly instructing them on sample-catching techniques as well as their washing and preparation for the laboratories. Dumble also took an interest in Richards' personal life and sent her out into the field often with his bachelor field geologist, Paul Applin. The matchmaking was successful and they were married by 1923.

In 1925, the three women published their epic work and landmark AAPG paper which, according to retired Shell Oil micropaleontologist Ed Picou, established the basic framework of benthic zonation in the Gulf Coast: "Subsurface Stratigraphy of the Coastal Plain of Texas and Louisiana."

A Transformed Industry

Very quickly, micropaleontology was a necessity for every oil company and drilling venture. Initial skeptic J.J. Galloway, in 1928, noted, as stated earlier, that more than 300 micropaleontologists were using this tool to work out stratigraphy and structure. Galloway had himself capitalized on their discovery and, within a year of their Amherst paper, was consulting for oil companies using foraminifera.

Not until the 1930s did electric logs start making a presence in Gulf Coast wells. Micropaleontology kept its dominance in exploration, while being combined with electrical logs and eventually seismic, for decades.

Ellisor's career with Humble (ExxonMobil) exemplifies the impact and scope of these early lab managers – she started the Humble lab with herself and one sample washer. By 1946, Humble Oil reported in their company magazine, *The Humble Way*, that they had:

- 12 micropaleontologists
- two paleontologists
- 20 sample washers
- several clerks
- 220,000 samples washed annually.

It is past time to give credit where credit is due and honor these three female scientists who changed the course of stratigraphy and the economics of petroleum exploration forever.

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Robbie Gries (Figure 6) is a member of the AAPG History of Petroleum Geology Committee and recently published "Anomalies – Pioneering Women in Petroleum Geology: 1917-2017." She is a past AAPG president and recipient of Michel Halbouty Award for Outstanding Leadership, AAPG Honorary Member, and is president-elect of the Geological Society of America.

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Figure 1. Esther Richards in the field in 1923 near Meridian, Miss. She is wearing her “puffy panties” and high leather boots, a novelty for females in the deep South. Photo by Patty Kellogg, Esther’s granddaughter.

Figure 2. Esther Richards and Alva Ellisor organized many field trips to collect samples, believing surface work was necessary to understand the subsurface. From left: Esther Richards, John Suman, James L. Ballard, Alva Ellisor, and colleagues (likely William A. Baker and W. F. Bowman) at Hidalgo Bluff near the Brazos River bottom. Photo by Patty Kellogg, Esther’s granddaughter.

Figure 3. Hedwig Kniker, Esther Richards, and Alva Ellisor in 1927.

Figure 4. Typical laboratory attire for the pre-air-conditioned laboratory in the 1920s (per Shell Oil retiree, Ed Picou). From left: Kniker, Richards, and Ellisor.

Figure 5. Alva Ellisor preparing foraminifera for her microscopic work and identification, 1946, the year before she retired. Photo by F.W. Rolshausen and R.D. Woods of The Dolph Briscoe Center for American History at the University of Texas at Austin.

Figure 6. Robbie Gries.