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GLEN FRANCIS BROWN

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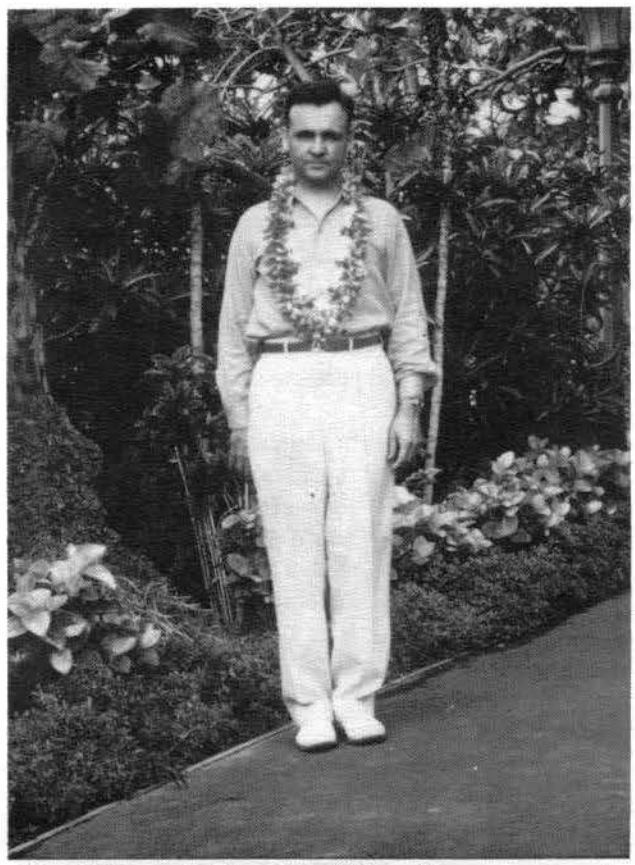
"...every scientist starts from a base established by his (or her) predecessors..."
(Ian Tattersall, The Fossil Trail, Oxford University Press, 1995)

The base for modern hydrogeology in Mississippi was established in September 1938 when Glen Francis Brown reported to Dr. William Clifford Morse at the Mississippi Geological Survey's headquarters at the University of Mississippi. Dr. Morse was Director of the Survey and Chairman of the University's Department of Geology. Glen Brown, a new employee of the U. S. Geological Survey (USGS), was a young geologist with several years experience, mostly foreign.

Glen Francis Brown was born December 14, 1911, in Sullivan County, Indiana. He received a Bachelor of Science degree from the New Mexico School of Mines (1935) and a Master of Science (1941) and Doctor of Philosophy (1949) from Northwestern University. Before joining the USGS in 1938 he worked in New Mexico in 1935, in southeastern China in 1936, and in the Philippine Islands 1936-38.

The historic occasion that led Brown to Mississippi was public concern about marked declines in water levels in and discharges from wells made in the artesian (confined) aquifers that underlie the "Delta" (the alluvial plain of the Mississippi River in northwestern Mississippi). The first flowing well in the Delta was drilled at Greenwood in 1896 and by the mid-1930s it was estimated that there were over 500 in the region.



Glen F. Brown in Hawaii in 1949 on his way to an assignment in Thailand (photo by George C. Taylor, Jr., USGS).

Many, if not most, of these wells flowed to waste or were under limited control.

Recognizing the magnitude of the problem, Dr. Morse agreed to participate in the state's first cooperative ground-water program with the U. S. Geological Survey's Ground-Water Branch (a cooperative program with the Surface-Water Branch was started after the 1927 flood on the Mississippi River). Glen Brown was assigned to the program and arrived in Oxford in September. Apparently, he was accompanied by Victor T. Stringfield, an experienced ground-water geologist who was in charge of the Ground-Water Branch operations in the southeastern states.

Records indicate that Brown, accompanied by Stringfield, made his first well record on September 15, 1938, at Hollandale in Washington County. On September 16, he made measurements in Tallahatchie County. By September 20 he was working in Leflore County where he inventoried 215 wells, mostly during the period September 20 - October 20 (he returned to Tallahatchie County later).

By today's standards, field work at that time was performed under less than optimum conditions. Most of the secondary roads were gravel or dirt. Topographic map coverage was incomplete; in the Delta coverage was related to the needs of the Mississippi River Commission. Benchmarks for referencing well elevations were sparse.

Most of the Delta wells flowed and water levels were measured with pressure gauges after being "shut in." Standard complete well records include location, elevation above sea level, depth, casing diameter, screen diameter and length, water level, discharge, water temperature, water use, pump data, and other incidental information. Brown's location sketches and well-head diagrams are models of detail and precision. If an obvious measuring point on the well could not be described, permanent marks (such as filed crosses - called "Brown's crosses" by later workers) were made. Temperatures were measured to one-half degree accuracy. He collected drill cuttings for laboratory determinations of hydraulic parameters and geologic unit identification, and water samples for chemical analysis. His routine included nearly all of the elements of modern ground-water investigations. Most of the original records are still in the files.

The state-wide observation-well program began when Brown measured Leflore County Well D160 on September 27, 1938. An earlier measurement made September 1, 1919, (by coincidence, the author was born on this date) is on record for this well (Brown, 1947, p. 219) and the well is still in the state-wide network. The network included 13 wells in 1938. Two others (Holmes County P159 and Humphreys County B14) are still active.

During the winter of 1938-39, Brown was joined by another USGS ground-water geologist, Edwin W. Reed. Early in 1939 their work in the Delta was interrupted by the international situation. To meet the needs of the War Department in establishing military bases and shipyards, Brown and Reed began an investigation in March, 1939 of the six-county coastal area. In January, 1940 the coastal study was assigned to another new USGS geologist, Vellora M. Foster, who had several years previous experience with the Mississippi Geological Survey.

In February, 1941 Brown's work was again interrupted by an assignment to the USGS California District to find a water supply for another new military installation - Camp Cook. During the preceding two years, Brown's acquaintance with Laura Cameron, Dr. Morse's secretary, developed into a marriage. She accompanied him to California and was his inspiration until her death 36 years later.

The untimely death of V. M. Foster in September, 1941 left unfinished his study of Forrest County (begun in 1939?) and marked the loss of a highly competent professional for the coastal work. On his return to Mississippi in October, Brown assisted Dr. Morse in completing the maps of alluvial and terrace deposits in Forrest County, completed Foster's well inventory in the Hattiesburg-Laurel area, and resumed work in the coastal area.

Interruptions continued. In March, 1942 Brown was assigned responsibility for developing water supplies for two new U. S. Army training facilities, Camp Van Dorn at Centreville and Camp McCain at Grenada. This work provided an opportunity for an innovation in ground-water exploration — geophysical logging. Brown contracted for the first log made by the USGS for a ground-water study. The log, furnished by the Mississippi Geological Survey, was made at the Camp Van Dorn site on March 31, 1942. This log demonstrated the potential of logging in ground-water exploration and it was followed by ten logs at Camp McCain. Brown continued the same thorough data collection in the new areas as in the Delta. In addition, he made extensive aquifer pumping tests and mapped the outcrop (recharge) areas of the aquifers. He had made a reconnaissance of the Camp McCain area during his study of the Claiborne-Wilcox outcrops of the Delta aquifers but the Camp Van Dorn aquifer outcrops were new terrane.

By 1943 the military anticipated a 25 percent increase in pumpage at Camp Shelby, a World War I vintage Army camp. Brown's team was given the responsibility for assessing the adequacy of the 13-well water supply. He proceeded by drilling a test hole near the center of pumping, making a geophysical log (July 16, 1943) and installing an observation well in the principal aquifer for pumping tests (probably another first). Three aquifer pumping tests and analysis of drawdown and recovery at other sites showed that the projected increase would be acceptable. The study included a reconnaissance of the outcrop-recharge areas as far north as Laurel, part of which Brown had covered in the fall of 1941 while completing Foster's work. He recognized a deeper unused aquifer that was penetrated by a well at Camp Shelby in 1918.

Reports on the Army camps and on the coastal area were completed by December 1944. William F. Guyton, co-author of the Camp Van Dorn report, was a pioneer in aquifer testing

and later became one of the best known ground-water consultants in the nation. Still active, he is a native of Blue Mountain, Mississippi, and a brother of the well-known physician Dr. Arthur Guyton. Paul H. Jones and Robert W. Adams assisted with field and laboratory work. Jones is known for his early work in geophysical log applications and in geopressure hydrology. Guyton and H. D. Padgett assisted with the Camp Shelby study. Robert W. Adams was co-author of the Camp McCain report and Guyton assisted with analysis of pumping tests (both were Federal employees). Foster, Adams, Reed, and Harold D. Padgett, Jr. were co-authors of the coastal report.

Brown was transferred to Washington, D.C., in December, 1944 and in January, 1945 to Dhahran, Saudi Arabia. King Abd al-Aziz (Ibn Saud) had requested assistance in finding ground water for farming. Brown returned to Mississippi in July, 1946 and completed the Delta report in 1947. Dr. Morse, in the report's Letter of Transmittal, stated that, "--- through many vicissitudes and interruptions...it represents sustained enthusiastic study through the years" (Brown, 1947).

On educational leave, Brown completed requirements for a PhD at Northwestern University in 1949 and returned to the USGS. His next assignment was a mission to Thailand (October 1949 - April 1950). On completion of the Thailand report in April, 1950, he returned to Saudi Arabia. Although his principal activities were in Saudi Arabia, he was an advisor to the governments of Egypt, Jordan, Kuwait, and Oman. He spent most of the next two decades in the Arabian Gulf region or in Washington.

In addition to the five Mississippi classics (Selected References), Brown is the author or co-author of more than 100 publications (the author does not have a complete bibliography), of which at least 94 relate to the Arabian Gulf region. He is a co-author of the first modern geologic map of Mississippi (Belt and others, 1945) and the senior author of the first modern geologic maps of the Arabian Peninsula and Thailand. His work covers the entire geologic realm - geography, geology, geophysics, tectonics, hydrology, and mining. In a summary of USGS activities during the period 1945-70, he "is considered by many to be the man best informed on the overall geology and hydrology of the Arabian Peninsula" (Taylor, 1976, p. 97).

The Mississippi reports are models of format and content. During the past 50 years they have been basic references for the subject areas and his interpretations in general are still valid. The descriptions of ground-water interchange between the Delta's Quaternary alluvial aquifer and the underlying Tertiary aquifers have been proven correct. His conceptual model of the coastal area wherein irregular occurrences of saline water are attributed to connate (long-trapped) water, infiltration from estuaries, and movement through deteriorated wells rather than from true saltwater intrusion has not been disproven. His descriptions of hydrogeologic systems in geographically widely-dispersed areas are thorough. All of the significant pertinent data are translated into his illustrations. He was among the first to use geophysical logs on hydrogeologic cross sections. Most reports include geologic, structure, and potentiometric maps. Extensive tabular material includes lists of wells, chemical analyses, hydraulic parameters, aquifer pumping test data, driller's logs, and descriptions of drill cuttings. His prose is simple, concise, and clear.

The Mississippi Geological Survey's cooperative ground-water program with the USGS was suspended in 1947. The observation-well program was continued by the Mississippi Geological Survey until the program was resumed in 1953.

By coincidence, the program was resumed as a result of new but different water problems in the Delta. The combination of a rapid expansion in rice farming and a severe drought in 1953 led to near total depletion of surface water in the Sunflower River Basin and the beginning of large withdrawals from the Mississippi River alluvial aquifer. Public concern about water shortages and water rights led to the formulation of water laws, the establishment of the Office of Land and Water Resources (originally the Board of Water Commissioners), and eventually to the State Water Management Plan.

Brown's 41-year career with the USGS was notable for the highest levels of achievement in geology and hydrology, generally while operating under adverse conditions and in extremely dissimilar parts of the world. His reputation is international and he has been the recipient of many honors, including the Department of the Interior Distinguished Service Gold Medal in 1964. Recently he received the 1995 Hollis D. Hedberg Award in Energy at the Institute for the Study of Earth and Man at Southern Methodist University.

Brown and his wife, Helen, reside in Reston, Virginia. His daughter by his first marriage, Dr. Elizabeth H. Brown (professional name), is the mother of two sons and lives in Cincinnati, Ohio.

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NEW PUBLICATION AVAILABLE FROM THE MISSISSIPPI OFFICE OF GEOLOGY

THE PETROPHYSICAL CHARACTERISTICS OF JURASSIC RESERVOIRS OF THE COASTAL MISSISSIPPI COUNTIES AND ADJACENT STATE WATERS

The Mississippi Office of Geology announces the availability of Open-File Report 42, "The Petrophysical Characteristics of Jurassic Reservoirs of the Coastal Mississippi Counties and Adjacent State Waters," by Stephen D. Champlin.

Open-File Report 42 is a study of the potential of the Jurassic-age rocks and the only Jurassic-age reservoir (Catahoula Creek Field, Hancock County) in the coastal counties and state offshore waters of Mississippi. The report includes core data and log-derived porosities from field and wildcat wells drilled in the study area. Additional data are included from selected Jurassic fields in adjacent southwestern Alabama and the Federal offshore waters of the Mobile OCS area. Also included as part of the study is a review of Mississippi's statewide Jurassic oil and gas production through December 31, 1994. The report, with 80 pages including 26 figures and 12 tables, was completed as a research project funded by a grant from the Minerals Management Service of the U. S. Department of the Interior.

Open-File Report 42 may be purchased from the Office of Geology at Southport Center, 2380 Highway 80 West, for $10.00 per copy. Mail orders will be accepted when accompanied by payment ($10.00 per copy, plus $3.00 postage and handling for the first copy and $1.00 for each additional copy). Send mail orders (with check or money order) to:

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"Nearly all factors influencing quality of life, such as infant mortality, life expectancy, literacy, and availability of clean water and adequate medical care, correlate with energy consumption and also with income. Those countries wherein both income and energy consumption per capita are lowest in the world are the most polluted in regard to water and indoor air. Poverty is the world's worst pollutant."

Hal Gluskoter, in his response to presentation of the Geological Society of America's Gilbert H. Cady Award for 1994

RESEARCH IN GULF COASTAL PLAIN TERTIARY MOLLUSKS AND THE ROLE OF KATHERINE V. W. PALMER — REMEMBERED ON THE 100TH ANNIVERSARY OF HER BIRTH

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INTRODUCTION

The May 5, 1995, annual meeting of the members of the Paleontological Research Institution honored a past director, Katherine V. W. Palmer, on the one hundredth anniversary of her birth (February 4, 1895). Carole Hickman was the keynote speaker at this event and spoke on the role of women in American paleontology, a discussion (Hickman, 1995) that began with Dr. Palmer and quickly moved to other women and interesting observations. Hickman was unsure if Palmer ever spoke on the subject of "women in paleontology" but noted that upon receiving the Medal of the Paleontological Society in 1973 she acknowledged the "Men in My Life."

In the 1960s when I became interested in Tertiary mollusks, the gender of the experts had shifted. If I were to remember my mentors it would be the "Women in My Life," including my Ph.D. advisor, Emily Vokes, and the lady who first helped me identify Tertiary mollusks—Katherine Palmer. Together the contributions of these women span the Tertiary, with Palmer working largely on Paleogene mollusks and Vokes largely on the Neogene (with the exception of the older Muricidae). The following is a partial sketch of Tertiary molluscan research largely pertaining to Mississippi and the contributions of Palmer.

TERTIARY MOLLUSCAN RESEARCH IN MISSISSIPPI

Tertiary molluscan faunas of the U.S. Gulf Coastal Plain attracted the attention of this country's earliest naturalists. The fossiliferous marine section at Vicksburg was first studied by Charles Alexander Lesueur in 1828 as he was traveling from the Owenite settlement at New Harmony, Indiana, to New Orleans by flatboat. A stopover at Vicksburg allowed him to measure a section and make a diverse collection of fossil shells and vertebrate remains. These fossils and a stratigraphic section were later illustrated in a series of twelve plates, but, unfortunately, Lesueur never saw their publication. His accompanying manuscript remains unpublished today, and his figured specimens have been named by others.

T. A. Conrad (1848a and b), in a paper for the Academy of Natural Sciences of Philadelphia (ANSP), was first to publish on the Vicksburg fossils. It is safe to assume that he learned of this fauna directly or indirectly from Lesueur as Lesueur had served as a curator at the ANSP from 1817 to 1825 (Raup, 1968) and copies of his plates dated 1828 were deposited there. Though Conrad was first to publish, his three plates were no match for those of Lesueur in either quality of illustration or diversity of fossils. Lesueur's plates were finally published in the course of Dockery's (1982a and b) work on the Vicksburg mollusks. A drawing by Lesueur of the large gastropod *Turbinella* is the cover illustration of a volume on the Vicksburg gastropods (MacNeil and Dockery, 1984).

Conrad later studied fossils at Jackson, Mississippi, at the invitation of B. L. C. Wailes. A series of four plates illustrating late Eocene molluscan fossils from Jackson was published in Wailes' (1854) volume on the geology of Mississippi. Descriptions of these mollusks were later published by the ANSP (Conrad, 1856), in which Conrad gave the sequence of Tertiary stages in the Gulf states as Claiborne, Jackson, and Vicksburg. Conrad (1866) also gave the first correct age assignments for these middle Tertiary stages, recognizing the Vicksburg Group as Oligocene and the Jackson and Claiborne groups as upper and middle Eocene, respectively. This early paleontological achievement is heightened in comparison to Meyer's failed stratophenetic interpretation. Meyer (1885) reversed the sequence, claiming that the Vicksburg mollusks were ancestral to those of the Jackson and Claiborne groups.

It is interesting how paleontologists from institutions in the northeastern United States found the southeastern Tertiary to be so fascinating, especially at a time when Paleozoic paleontology was in vogue. Following the contributions of workers (i.e. Conrad and I. Lea) with the ANSP and the Smithsonian Institution, Gilbert D. Harris, upon leaving the U.S. Geological Survey to teach at Cornell University in Ithaca, New York, begin a new bulletin series as a means to publish the southern Paleocene and Eocene molluscan faunas (Brice, 1996). This series, the Bulletins of American Paleontology (BAP), preempted the U.S. Geological Survey in the research of the Gulf Coast's early Tertiary mollusks. To this day, the U.S. National Museum collections are relatively poor in that area. Numbers 1, 2, and 4 (of 5) of BAP's first volume, published in 1895, were devoted to the Gulf Coast Paleogene. That same year Katherine Van Winkle (Palmer) was born. She would be the successor to Harris as editor of BAP and the most important describer of mollusks from the Gulf Coast Paleogene.

Harris' enthusiasm for the southern Tertiary is seen in his dedication of BAP volume 6 (Harris, 1919) to Truman H.

Figure 1. Top: The Paleontological Research Institution's front facing Trumansburg Road as photographed in 1972. Bottom: Dr. Katherine Van Winkle Palmer, PRI Director, at left; Ms. Marjorie Jones, assistant, center; and Ms. Fay Briggs, "longtime secretary *extraordinaire*" (Palmer, 1982), at right.

Aldrich. Here he recognizes in his colleague a "Conradian love" for the Eocene Mollusca. This love was perpetuated by Harris himself and rubbed off on some of his students, most notable of whom was Katherine Palmer, a graduate of the University of Washington and a student of West Coast Tertiary mollusks under noted Tertiary paleontologist Charles E. Weaver (Caster, 1983). When Harris outgrew the space available for him at Cornell, Palmer was one of those present in 1932 as Harris dedicated the cornerstone for the Paleontological Research Institution (PRI). This institution was to house his collections and publication series (Brice, 1996).

PALMER'S CONTRIBUTIONS TO GULF COASTAL PLAIN PALEONTOLOGY

Palmer worked with Harris on the Mollusca of the Claiborne (Palmer, 1937, BAP v. 7) and Jackson (Harris and Palmer, 1946-1947, BAP v. 30) groups. In both works, her descriptions and locality data were more precise than those of her professor. She became director of the PRI upon the death of Harris in 1952 and continued in that position largely as a labor of love until her retirement in 1978 at age 83. Palmer distinguished herself in not only keeping the institution alive but in moving it to a larger facility on Ithaca's West Hill in 1968 and passing it on to others in good hands. During her tenure as director, Palmer completed one of the most useful and monumental works of Cenozoic paleontology ever published, the "Catalogue of the Paleocene and Eocene Mollusca of the Southern and Eastern United States" (Palmer and Brann, 1965, 1966). Her last research paper was published in 1974, when she was 79 years old.

Though an internationally respected scientist, Palmer had time to correspond with regular folks such as a teenage fossil collector in Jackson, Mississippi (me), who needed help in identifying Tertiary mollusks. This correspondence led to a week-long visit to the PRI in the summer of 1972 to study the type collections, and eventually to bulletins on the mollusks of the Moodys Branch Formation (Dockery, 1977) and the Eocene mollusks of Clarke County, Mississippi (Dockery, 1980). In 1972 at age 77, Palmer was troubled with a bad hip. Even so, I found her so energized by questions concerning Eocene mollusks that she outlasted me (at age 22) in running up and down the Institution's stairs searching out references in a library that she knew so well.

Dr. Palmer was so approachable that she even corresponded with my mother, who was concerned with such personal matters as Palmer's hip replacement. At the time it seemed strange that an eminent paleontologist and my mother could find common ground in everyday concerns. Imagine my chagrin as an aspiring young paleontologist living at home upon seeing a letter from Katherine Palmer in the mail, only to find it addressed to my mother. When Dr. Palmer heard that my sister had pledged her college sorority, Alpha Delta Pi (Palmer was initiated into the Alpha Theta Chapter on June 7, 1917 [Karen Henzl, personal communication]), she sent a gift. Upon arrival, the package from the PRI director contained not fossils or publications of interest to me, but glassware for my sister with the sorority's lion mascot.

It is disconcerting that Palmer was overlooked in M. L. Aldrich's (1982) article in the first issue of *Earth Sciences History* concerning "Women in paleontology in the United States 1840-1960." Of the many women mentioned, including Julia Gardner, who published on Tertiary mollusks for the U.S. Geological Survey, no mention is made of Palmer, who not only published landmark monographs (Palmer's publications are listed in Caster, 1983) but also directed the PRI and its publication series and, in 1972, was the seventh recipient and FIRST woman awarded the Paleontological Society Medal (Caster, 1973). The tragic irony of this is that the PRI is alive and well, while the Paleontology and Stratigraphy Branch of the U.S. Geological Survey (as of September 30, 1995) is no more.

OLIGOCENE STUDIES

While the PRI dominated the field of Paleocene and Eocene malacology in the South, the U.S. Geological Survey and the U.S. National Museum took the lead in the southern Oligocene. William H. Dall contracted with Frank Burns in the 1890s to collect Oligocene mollusks for the Smithsonian. Burns collected by the wagon load and shipped his material to the U.S. National Museum. Other important collectors were T. W. Vaughan, C. Wythe Cooke, and F. Stearns MacNeil.

Cooke undertook a study of the Oligocene stratigraphy and a revision and update of earlier descriptions of Vicksburg mollusks by Conrad, T. L. Casey, and Aldrich. In 1937, he turned this study over to MacNeil, who worked on the Vicksburg gastropods as time permitted until his retirement from the U.S. Geological Survey in 1965. At that time, plates and descriptions had been completed for the gastropods in systematic order through the Melongenidae. In 1973, MacNeil turned his Vicksburg gastropod manuscript and plates over to me while I was then working on the Vicksburg bivalves. The bivalves were published by the Mississippi Office (then Bureau) of Geology in 1982 (Dockery, 1982b), and the gastropods were published in 1984 (MacNeil and Dockery, 1984). The types and figured specimens for the monographs, along with other spectacular collections of Oligocene mollusks, are housed at the U.S. National Museum.

Palmer, who had published on the Oligocene of Washington as an undergraduate (Van Winkle, 1918), related to me in 1972 that she and Harris had collected Oligocene mollusks at fresh outcrops resulting from construction along Highway 61 at Vicksburg (most likely during their trip in 1938). She said that they collected just ahead of the Highway Department as they seeded the road-cut exposures. Frederic F. Mellen of the Mississippi Geological Survey collected from some of these same exposures in January of 1939. Mellen's excellent collec-

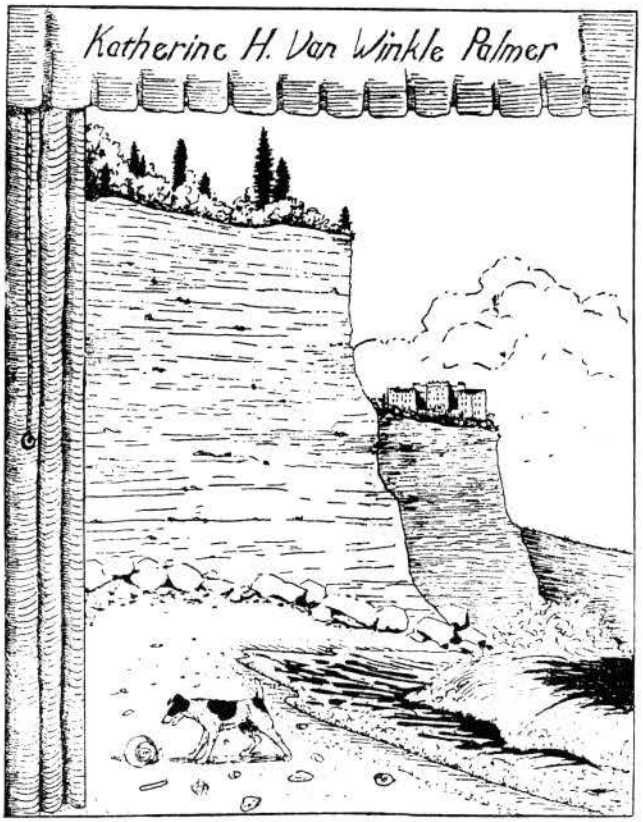

Figure 2. Dr. Palmer's bookplate. According to the Palmer's older son Robin (personal communication via Warren Allmon) the dog in the foreground is the family's short-hair fox terrier Wow, and the bookplate was drawn around 1943 when the dog was alive (it was the favorite dog of Robin's younger brother Lawrence who died at age 15). Wow appears to be barking at a dextrally coiled whelk, possibly *Busycon canaliculatum* (Linné, 1758), that has washed on shore. Such whelks inhabit subtropical and warm-temperate coastlines of the Gulf and Atlantic states with *B. canaliculatum* extending as far north as Cape Cod (Abbott, 1974). In the scene depicted behind the drawn curtains, it seems that Dr. Palmer has created a mythical place where the warm waters of the western Atlantic meet the stratified, rocky terrain of upstate New York as evidenced by the evergreens and precariously perched city. Robin Palmer believes the bookplate to be a memorial to his late brother Lawrence (affectionately known as Punky).

tions, all from the Byram Formation, are housed at the Mississippi Office of Geology. According to Warren Allmon, current director of the PRI, the Palmer/Harris Vicksburg collection is housed at the Institution but is not very big.

TALES OF TWO OUTCROPS

I take the liberty here to relate two stories told by Palmer in 1972 concerning field trips with Harris in the South. The first story, "The Pearl," concerns collecting in the late Eocene White Bluff Formation at its type locality at White Bluff on the Arkansas River in Jefferson County, Arkansas. While searching for fossils along nearly vertical bluffs over the Arkansas River, Palmer and Harris encountered the gaping valves of a fossil oyster. Clearly visible inside was the first fossil pearl that either had ever seen. Not wanting to dislodge the pearl from its setting, they carefully carved out a block of matrix containing the oyster, while balancing themselves against the steep bank. When their excavation was almost finished, the block with its oyster and pearl gave way and fell into the river. It happened so quickly that they could only watch as their one-of-a-kind specimen disappeared beneath the deep water.

The second story, "The Horse-Apple Tree," was an attempt to find a locality at Vicksburg known as the "devil's backbone." This account illustrates the determination of two northerners to collect in the unfamiliar terrain of Mississippi in the 1930s and the communication problems they faced with the local dialect. After searching unsuccessfully for the devil's backbone, Harris and Palmer asked a resident if he knew of a place by that name. He said he knew the site and directed them to follow a wooded trail for a mile or so until they came to the horse-apple tree. A side trail at the tree would lead to the site. Both Harris and Palmer were experienced naturalists and were confident that the other would know this tree. Thus, they took the trail, bidding their native guide farewell. Along the way, they found that neither of them had ever heard of such a tree. They had taken a long walk without knowing what they were looking for. After a mile or so, their uncertainty turned into simultaneous laughter. Before them was the mysterious horse-apple tree, and its identity was perfectly clear. It was a magnificent osage orange.

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REVIEW OF
RESPONSES TO IBEN BROWNING'S PREDICTION OF A 1990 NEW MADRID, MISSOURI, EARTHQUAKE

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Responses to Iben Browning's Prediction of a 1990 New Madrid, Missouri, Earthquake, by William Spence, Robert B. Herrmann, Arch C. Johnston, and Glen Reagor: U. S. Geological Survey, Circular 1083, 1993, 248 p. (see end of review for ordering instructions)

The end of 1995 and early 1996 are a time for reflection about the anniversaries of past earthquakes. Halloween (October 31) 1995 was the 100-year anniversary of the Charleston, Missouri, earthquake at the northern end of the New Madrid Seismic Zone (the latest strong earthquake at the southern end of the zone was in 1843). The 1895 earthquake, estimated at magnitude 6.8, was about the same magnitude as the 1994 Northridge, California, earthquake (magnitude 6.7), but caused shaking at damaging intensities over a much larger area and was felt over a very much larger area. This earthquake is important for us to remember because seismologists expect that an earthquake of about this magnitude could occur at any time in the New Madrid Seismic Zone. Such an earthquake at the northern end of the zone would be felt throughout Mississippi, but, at the southern end of the zone, it would shake the northern half of the state at damaging intensities.

The great New Madrid earthquake series, with the strongest earthquakes known to have occurred in North America, began with the violent event of December 16, 1811. Thousands of aftershocks were felt over the following months. The second of the major shocks, nearly as strong as the first, occurred on January 23, 1812. The third of the strong earthquakes, on February 7, 1812, was called the "hard shock" by the people, and may have been the strongest and most damaging of the series.

If these events don't provide enough earthquake anniversaries for you, think of January 17. On this date in 1995, a major earthquake of magnitude 6.9 at Kobe, Japan, killed over 5000 people and caused over $400 billion in damage. On January 17, 1994, the most costly American earthquake since 1906 struck Northridge, California. The magnitude M_w=6.7 earthquake shook the Los Angeles area and raised the Santa Susana mountains as much as 70 cm; the toll was 33 lives and $20 billion in damage.

However, my reason for writing this review is that December marks the five-year anniversary of the New Madrid earthquake that DID NOT OCCUR on December 3, 1990. Independent scientist Iben Browning, who made his living through lectures and a newsletter providing advice to business based on a numerological analysis of climate and history, had "projected" that the central United States would be struck by a devastating earthquake on or about December 3, 1990. Browning put the odds of an earthquake occurring at New Madrid in a two-day interval at 50-50, meaning odds of 1 in 2. This does not mean "either it will or it won't"—it means the odds are 1 in 2; this is 30,000 times the odds calculated by legitimate scientists, considering many uncertainties. The news media picked up the story, and, in the months preceding the date, tens of thousands of people in the central U. S. got caught up in a media circus and near hysteria. State geological surveys and state and local emergency management agencies were swamped with calls for information and requests for materials and speakers. The Jackson *Clarion-Ledger* printed two or three earthquake articles each week from July through November of 1995. The rate increased to daily articles in late November; the December 2 edition had five articles. (The number of articles dropped off quickly after December 3.) I spent half my time for about six months dealing with the bogus prediction.

In the summer and fall of 1990, there was a lot of talk about earthquakes in this part of the country, some of it outrageous. A lot of earthquake insurance was sold. Many people were educated about the earthquake risk in the central United States. The publication reviewed here documents the events of that time—the good, the bad, and the ugly.

Pages 1-24 of Circular 1083 are text, with background information and photographs of the hoopla in New Madrid on December 3, covering the prediction and its impact. From page 22: "Ultimately then, Browning's prediction became an example of pseudo-science overwhelming mainstream science." Appendix A, pages 25-40, gives examples of the writings and speeches of Browning and David Stewart, the only scientist to support Browning's ideas. Appendix B, pages 41-67, gives the official statements of the Center for Earthquake Research and Information at Memphis State University (now the University of Memphis), the Central United States Earthquake Consortium (CUSEC), and the Ad Hoc Working Group of the National Earthquake Prediction Evaluation Council. The longest section of the book is Appendix C, pages 69-179, the prediction in the press. Here are reproduced many newspaper articles, some providing accurate and useful information, some misleading the public with inaccurate maps and information, and some putting the whole issue into proper perspective. Appendix D, pages 181-187, shows the commer-

cial response to the prediction, reproducing ads for earthquake survival guides, earthquake insurance, 1-900 numbers, t-shirts, and spray cans of earthquake repellent (a product that must have worked very well). Appendix E, pages 189-246, reproduces some of the preparedness literature, some of it excellent, that was available in the region. Finally, Appendix F on pages 247-248 has some cartoons showing "fault zone humor."

All of the material makes interesting and informative reading, both about the earthquake risk in the central United States and about the effects of a well-publicized but unfounded earthquake prediction. Some good came out of the event. To some extent the public awareness of the very real earthquake risk in the central United States was raised. Journalist William Allen of the St. Louis *Post-Dispatch* provided good information about the true nature of the "prediction" and how that related to the realities perceived by seismologists. The bad side is that many citizens were unduly alarmed and became anxious. Many schools and factories were closed unnecessarily in the region; this meant loss of production and loss of revenue to those schools that were reimbursed by days of operation. There is also a concern among geologists, seismologists, and emergency management personnel that members of the public may have the opinion that "the experts" predicted an earthquake and it didn't happen, so why should I listen to them in the future. In reality, the true experts did not, and would not, make such a prediction. The ugly side is addressed in one of the clippings, written by a college professor to address the huge amount of attention given to Browning and his unscientific prediction, saying "a naive public, poorly educated in scientific matters, is overreacting." He closed his article with "I fear for the future of such an ignorant society." The editor of the Paducah *Sun* wrote that it was "time to stand up to fear of the stupid." Mississippi had to spend 5% of the state's emergency management budget on extra travel and materials for presentations.

The book is not all heavy reading. For example, page 164 has an amusing newspaper article where a reporter called people with names like Richter, Shake, and Trembley.

Earthquake "scares" have happened before, in North Carolina in 1976, Peru in the early 1980s, the "Jupiter effect" nonsense about the planetary alignment of 1982. Such scares may happen again. It is important for scientists and responsible citizens to know how to react to such episodes. USGS Circular 1083 is very useful in documenting the unfolding and the effects of the unfounded Browning earthquake prediction of 1990. Browning was wrong, just as he was wrong about the collapse of the United States government and the deep depression of 1992.

Responses to Iben Browning's Prediction of a 1990 New Madrid, Missouri, Earthquake, by William Spence, Robert B. Herrmann, Arch C. Johnston, and Glen Reagor, is a publication of the U. S. Geological Survey. Copies of Circular 1083 may be ordered from the USGS (single copies free) by writing to: USGS Map Sales
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An up-to-date index of *Mississippi Geology* is available from the Office of Geology. Open-File Report 15, "Current Index to *Mississippi Geology*," compiled by Michael B. E. Bograd, is available for $2.00 ($2.50 by mail) from the Office of Geology, P.O. Box 20307, Jackson, MS 39289

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- **and a review of a USGS Circular about responses to the Browning earthquake prediction of 1990, by Michael Bograd of the Mississippi Office of Geology**