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A Hypercane Deposit at Little Stave Creek, Clarke County, Alabama, USA

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Abstract

Unique atmospheric conditions during and immediately following the Flood have recently been postulated based on the results of numerical computer modeling. This modeling suggests that the heating of the atmosphere and oceans could have produced conditions suitable for the development of super hurricanes, or “hypercanes.” Unfortunately, the atmosphere provides no historic record of such events. However, proxy records might be found in the rock record. In fact, it is probable that hypercanes would have created large-scale tempestites (i.e., storm deposits) across various portions of the continents while they were covered by Floodwater. Such storm deposits occur across the United States Gulf Coastal Plain. One such stratigraphic unit is the Gosport Sand Member of the Lisbon Formation (Eocene), which extends across southwestern Alabama. A Gosport Sand outcrop at Little Stave Creek in Clarke County exhibits sedimentary evidence that it formed from a single massive hypercane during the Middle Flood Event Division.

Introduction

Modern hurricanes are defined by the National Weather Service Saffir-Simpson scale (National Hurricane Center/National Weather Service, 2006). This ranking system is based on the storm’s wind speed, storm surge, and the destruction of property. The size of a hurricane is dependent on the available heat energy derived from warm surface water and a warm atmosphere (Emanuel, 1988; Holland, 1997). Today, insufficient heat is available to create anything larger than a Category 5 hurricane.

But scientists have proposed larger storms in the past. Hypercanes are envisioned as large-scale hurricanes, but these super storms exist only as theoretical computer models. Uniformitarians believe that hypercanes may have formed as a result of excessive heat held in both the atmosphere and ocean derived from volcanic eruptions and extraterrestrial impacts (Emanuel et al., 1995). These massive storms would have been much larger and more powerful than any modern hurricane (Table I).

Atmospheric events such as hurricanes and hypercanes leave no climatic evidence that they ever occurred. However, their confirmation might be captured in the rock record by tempestites (i.e., storm deposits). The Gosport Sand Member of the Lisbon Formation (Eocene) extends across a portion of southwestern Alabama (Figure 1). Perhaps the best outcrop to examine the Gosport Sand occurs at Little Stave Creek in Clarke County, Alabama. This locale provides an excellent exposure of a tempestite most likely formed from a single hypercane.

Hypercanes

The concept of a super hurricane, or hypercane, was first postulated by atmospheric scientist Kerry Emanuel (1988) based on his numerical computer modeling of atmospheric heating by warm

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Table I. Comparisons between a modern Category 5 Hurricane (Saffir-Simpson scale) and a hypercane. Modified from National Hurricane Center/National Weather Service (2006).

Storm Category	Storm Characteristics	Storm Surge	Top Wind Speed Along Eyewall	Elevation of Cloud Tops*
Category 5	Winds greater than 155 mph (249 km/hr). Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3–5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5–10 miles (8–16 km) of the shoreline may be required.	Storm surge generally greater than 18 ft (5.5 m) above normal.	200–250 mph (322–402 km/hr)	Top of the Troposphere** (~ 4.0 to 11 miles/6.0 to 18 km)
Hypercane	Winds greater than 400 mph (644 km/hr). The massive storm would likely stir not only surface water but extend downward several hundred feet mixing marine waters and eroding/depositing sediments across the seafloor. Any vegetation seeking to establish itself along an existing coastline would be either washed away (if within the zone of storm surge) or be severely damaged by the high winds as the storm made landfall. Hypercanes would have had a dramatic effect on the morphology of any developing coastline.	Storm surge would probably be greater than 50 feet (15.2 m) but could have been twice this elevation due to the length of time and distance over the very warm Floodwater heated by subaqueous/subaerial volcanism.	500 mph (805 km/hr)	Upper Stratosphere (~ 11 to 31 miles/18 to 50 km)

* Unique Flood/post-Flood climate conditions may have resulted in different atmospheric elevational boundaries due to heating.

** Few modern hurricanes have penetrated the lower stratosphere (Monastersky, 1998), but this would have been typical of hypercanes which probably extended up into the middle to upper stratosphere (Emanuel et al., 1995)

oceanic water. This work demonstrates that a hypercane could develop from sufficiently warm seas where surface temperatures are greater than 113° F (45°C) (Emanuel et al., 1995). The resulting super storm would reach higher into the atmosphere, extend across a greater distance, and have faster sustained winds than the most powerful modern hurricane.

Hurricane Camille, a Category 5 storm, had the highest wind speed of any hurricane to date—estimated at more than 200 mph (322 km/hr) (National Weather Service, 2006). This wind speed pales in comparison to an estimated hypercane wind speed of 492 mph (792 km/hr) (Emanuel et al., 1995). Winds generated by a hypercane also would create an exceptionally large storm surge, with surface waves that would move in

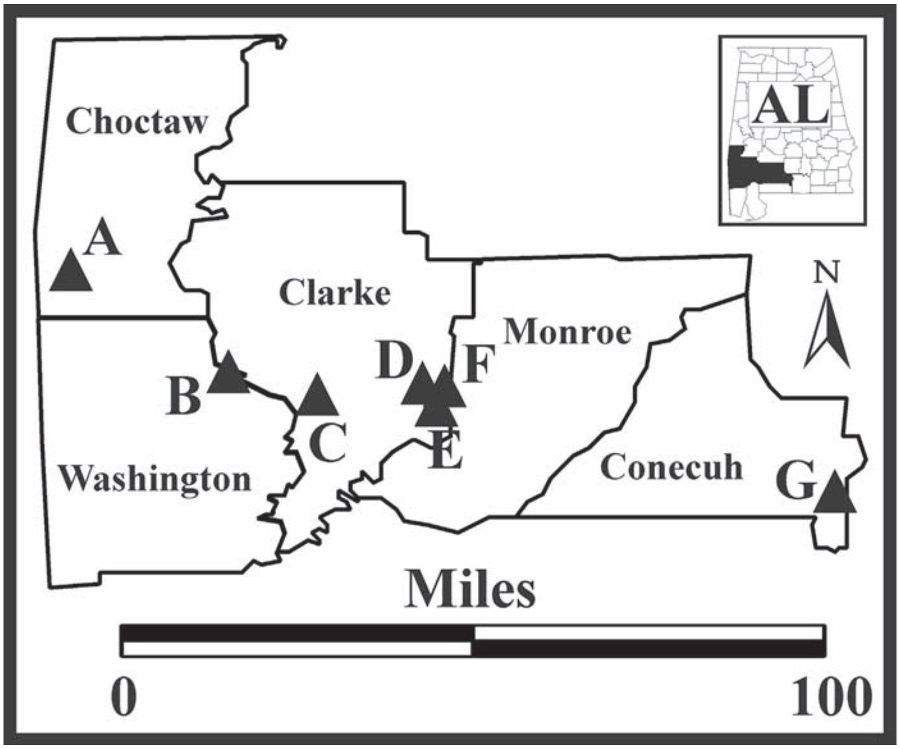

Figure 1. Base map showing the Gosport Sand Member outcrops cited in this article. The stratigraphic unit is consistent with the general strike of the coastal plain sediments in this area. See Table II.

advance of the storm, similar to those of modern hurricanes. For example, Hurricane Katrina had top wind speeds measured at 140 mph (225 km/hr), which created an open water storm surge combined with surface waves estimated at 55 ft (16.8 m) (Graumann et al., 2005). Hypercanes could have created massive storm surge/surface waves in open water at least double that of any modern hurricane. Landfall of a hypercane likely would have impacted the coast with storm surge/surface waves 50 ft (15 m) or higher. This volume of displaced water is important when considering the generation of counterflowing bottom currents across the inner shelf setting as the storm moved landward.

Young-earth creationists also have investigated the possibility of hypercanes. Woodmorappe (1998; 2000) invoked them to generate the 40 days of rain at the onset of the Flood, while Vardiman (2001; 2003) proposed that they occurred during and following the Flood. A combination of global volcanism and extraterrestrial bombardment during the Flood could have provided the necessary heat to form hypercanes (Froede, 2007).

Modern hurricanes generally occur within the troposphere (Figure 2), although occasionally they can penetrate the tropopause and cross over into the lower stratosphere (Monastersky, 1998). Computer modeling by Emanuel et al. (1995) suggests that with sufficient heat derived from both the atmosphere and oceans, hypercanes would have extended upward to the middle/upper stratosphere (see appendix). At this extreme elevation, water droplets carried upward by a hypercane would be converted to snow and ice crystals that could drift in this portion of the atmosphere for years (Emanuel et al., 1995).

Atmospheric Stirring of Oceanic Water

Large storm-generated surface waves can mix horizontally stratified oceanic water layers across the continental shelf (e.g., Halper and Schroeder, 1990; Powell, 1982; Shay and Elsberry, 1987). With sufficient near-bottom orbital velocities, they can even stir the seabed. This can result in considerable displacement of seafloor sediment and associated fauna. Storm wave energy would greatly disturb sea life living within those sediments. Bottom currents would effectively erode and transport sediments and any organic materials seaward (Figure 3). For example, moving across open water in the Gulf of Mexico, Hurricane Ivan had top wind speeds estimated at approximately 165 mph (266 km/hr) (Category 5 hurricane). The Naval Research Laboratory measured Hurricane Ivan's peak storm surge and wave height on the outer continental shelf using submerged acoustic Doppler current profilers. These devices measured wave elevations as high as 92 ft (28 m) near the areas of maximum wind stress (Wang et al., 2005). These large waves had sufficient near-bottom orbital velocities to stir approximately 130 million cubic yards (100 million cubic meters) of seafloor sediment along the 22 by 9 mile (35 by 15 km) path of the hurricane (Teague et al., 2006). Bottom currents operating within this area scoured seabed sediments in places up to 14 inches (36 cm) deep in water as deep as 197 ft (60 m) (Teague et al., 2006). With this much impact to the seafloor from a Category 5 hurricane, it is not difficult to imagine the tremendous seafloor erosion and deposition that would have occurred on the continental shelf due to a passing hypercane.

Little Stave Creek, Alabama

Little Stave Creek is located in Clarke County, Alabama (Figure 1). The creek flows toward the west-southwest into Stave Creek, which eventually discharg-

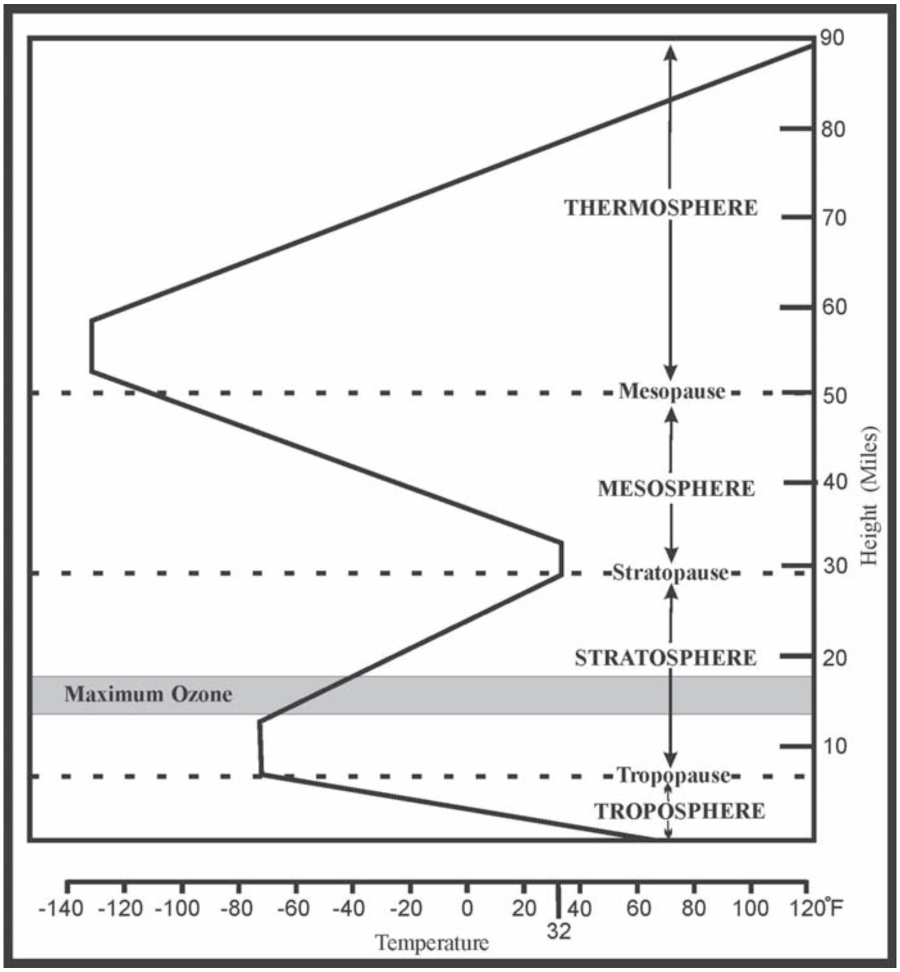

Figure 2. The layering and thermal structure of the modern atmosphere. The elevation of the tropopause increases, moving from the poles toward the equator. Our weather occurs within the troposphere, but atmospheric scientists suggest that hypercanes could have extended into the middle/upper stratosphere. This is not inconsistent with the biblical framework of Earth history. Adapted from Lutgens and Tarbuck (2004, Figure 1–22).

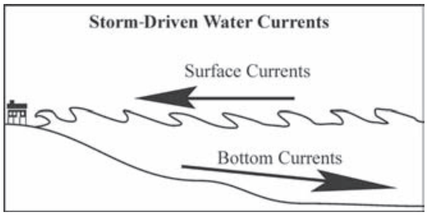

Figure 3. Incoming storm surge and surface waves can create a counter-flowing bottom current of sufficient velocity to scour seafloor sediments, transporting and burying them some distance from their original location. The resulting deposit of shells and matrix would not represent the original environment from which it was derived.

es into the Tombigbee River. The exposure of the unique stratigraphic section along Little Stave Creek is a direct result of underlying salt tectonics. Uplift and faulting of the area has created surface exposures of strata that normally would be found several hundred feet below the ground surface. Alabama state geologist Michael Tuomey in 1850 (Toulmin, 1962) first recognized these unique conditions. Hopkins's (1917) geologic map of the area was the first to document exposures of Claiborne and Jackson age (Eocene) strata along the creek.

Approximately 400 vertical feet (122 m) of strata are exposed in the sidewalls along Little Stave Creek over a distance of one mile (Bandy, 1949). Active study of the fossilized shells began in the 1930s and resulted in a publication describing some of the preserved pelecypod shells (Gardner, 1939). In 1940, Toulmin published the first stratigraphic section exposed along the creek (Toulmin, 1940). In the years that have followed, Little Stave Creek has become an internationally known site of paleontological interest. The stratigraphic layers extend from the uniformitarian lower Eocene upward to the lower Oligocene Epochs. Many of the stratigraphic units contain key index fossils allowing further subdivision into discrete time intervals (see Bandy, 1949; Gardner, 1957; Mancini and Tew, 1988; 1990; Toulmin, 1962; 1977).

Paleoecological Setting

Many investigators have noted the unique conditions of the stratigraphic section exposed along Little Stave Creek. Bandy's (1949) examination of foraminifera led him to propose that the entire section was deposited in "a predominately warm, shallow sea with relatively little turbidity" (p. 38). Gardner (1957) suggested a more turbid setting:

> The entire sequence of Eocene and Oligocene sediments was probably laid down on a shifting continental shelf beyond the intertidal zone. The shores were low and not rocky. None of the load brought down by the streams was very coarse; the desirable habitat of most of the Mollusca, at least of most of the pelecypods, was just beneath the surface of the

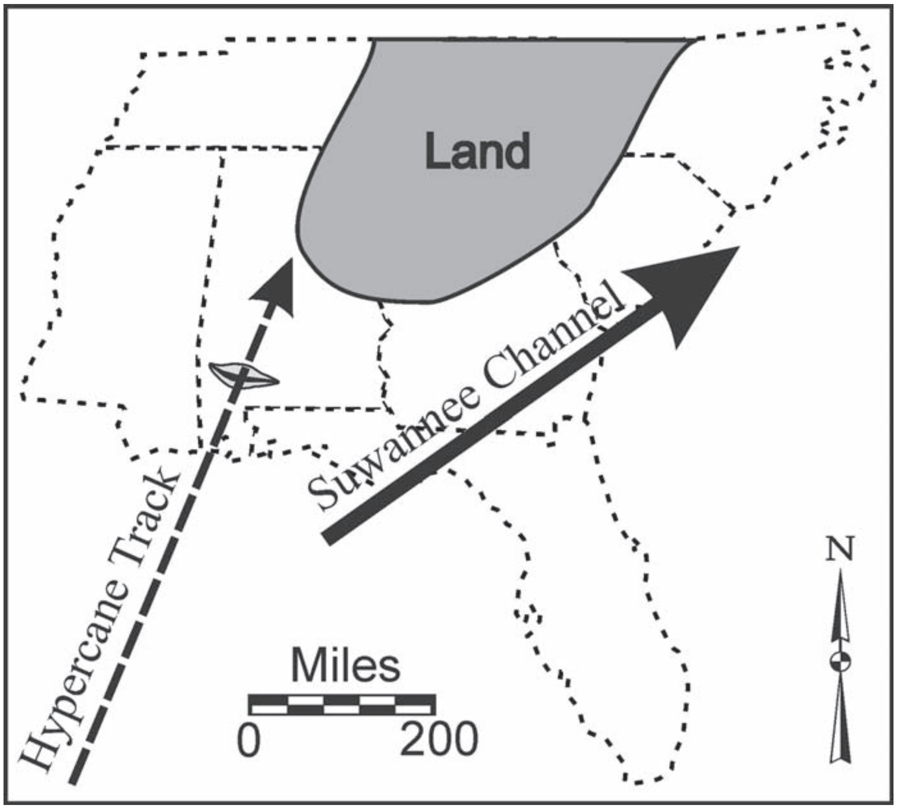

Figure 4. Proposed scenario for the deposition of the Gosport Sand Member across southwestern Alabama. Large arrow shows the position and flow direction of the Suwannee Channel. The Gosport Sand outcrop area is black; the source area for the sediments and fossils is gray. The hypercane track is approximated by the dashed line—likely originating to the south-southwest in volcanic/meteoric heated seawater.

> sea floor; few of the sands were pure, and the mixture of silt and clay rendered the bottom easier to penetrate. (p. 586)

Estimating the water depth during the deposition of the Little Stave Creek stratigraphic section is based on the fossilized macro- and micro-invertebrate remains. Gardner (1957) proposed an average depth of about 240 ft (73 m) or less. This depth corresponds with other invertebrate fauna (e.g., Wrenn, 1996). However, Sparks's (1967) examination of both planktonic and benthonic foraminifera at the Eocene-Oligocene boundary suggests even deeper water depths, ranging between 295 and 656 ft (90 to 200 m).

Changing Sea-Level Position

Sea-level variation estimated from both lithology and paleontology also has influenced approximations of water depth. An examination of foraminifera collected from different stratigraphic units along Little Stave Creek led several investigators to conclude that sea-level changes are best defined by the diversity of planktonic foraminifera rather than by their sheer abundance (Landow-Smith et al., 1994).

A higher sea-level position during Gosport Sand deposition would correspond to a more open Gulf of Mexico; the Suwannee Channel would have connected the Gulf of Mexico and the Atlantic Ocean (Figure 4). Geoscientists believe that marine water movement during this time was from the Gulf to the Atlantic across the submerged coastal plains of Georgia and South Carolina, exiting near Charleston, SC. However, in his examination of the Eocene echinoid *Echinocyamus* found along the Carolina Coastal Plain, Zachos (2005) proposed that the flow of the Suwannee Channel reversed direction during Gosport deposition in order to explain the sudden appearance of *Echinocyamus* along the Gulf Coastal Plain.

Possible Water Temperatures

Gardner (1957) believed that the variety of invertebrate fossils found along Little Stave Creek indicated water temperatures as high as, if not higher than, today's northern Gulf of Mexico. Based on palynomorph (i.e., spore and pollen) fossils collected from Eocene strata across the southeastern United States, Frederiksen (1988) envisioned a coastal latitude analogous to the modern Florida Keys. However, Wolfe (1985) believed the water was even warmer and proposed that water temperatures were closer to those of northern South America, based on his examination of plant fossils.

Allochthonous versus Autochthonous Fossil Faunas

Gardner (1957) noted that most of the fossil faunas exposed along the creek section were allochthonous:

> Probably very few of the fossil faunas represent biocoenoses or natural assemblages of living faunas; rather they are assemblages of shells that were swept along the bottom and mingled with other faunas from other feeding grounds. A large percentage of the community has probably been lost. (p. 573)

The extraction, transport, and burial of the shells would fail to fully represent all of the marine life that likely coexisted in the original communities. The loss of invertebrate community information could also occur with the dissolution of shell material from the rock record (Lawrence, 1968; Stephens et al., 1973).

From the micro-paleontological perspective, an examination of calcareous nannofossil assemblages from within the tests of *Hantkenina* foraminifers collected from the Shubuta Formation (Eocene) and Bumpnose Formation (Oligocene) also supports the reworking of the original deposits (Bybell and Poore, 1983). This reworking could have occurred from intensive bioturbation or mechanically by passing storms.

Sequence Stratigraphy

In the early to middle 1980s, sequence stratigraphers set out to reinterpret the eustatic history of the Late Cretaceous-Tertiary geologic section across the United States Gulf Coastal Plain. This group focused on classic outcrops and type sections (e.g., Baum and Vail, 1988; Loutit et al., 1988; Vail et al., 1987). Little Stave Creek was no exception. Loutit et al. (1983) examined various stratigraphic units spanning the Eocene-Oligocene boundary at Little Stave Creek and determined that the combination of lithologic and paleontologic information reflected a rising and falling of sea-level position across this boundary. In the following years, some Alabama state geologists also have sought to apply the concepts and principles of sequence stratigraphy to the southwestern portion of the state, including the strata exposed along Little Stave Creek (Mancini and Tew, 1988; 1990).

The most pronounced and obvious unconformity boundary found at Little Stave Creek occurs at the contact between the Lisbon Formation and the overlying Gosport Sand (Figure 5). This boundary is identified as a disconformity as it is viewed as an erosional contact between the two formations. Gardner (1957) identified this break between the clay of the Lisbon Formation and overlying Gosport Sand Member as the most striking stratigraphic feature in the entire Eocene section exposed along Little Stave Creek.

Shell Beds in the Rock Record

Sedimentary layers containing high concentrations of invertebrate shells are not unique or unusual in the rock record. Three different ideas have been suggested to account for their formation: (1) shells accumulate in areas of extremely low deposition (e.g., hiatus or condensed section), (2) they are concentrated within the shallow subsurface by the bioturbation of the sediments, and (3) they are created by storm processes.

We will focus on shell bed formation by storm events, since the shell layers found along Little Stave Creek have been interpreted as a series of storm deposits. Early work in both the field and laboratory revealed that shells can be buried by the scouring effect that the surface shape creates on the surrounding sediments (Johnson, 1957; Menard and Boucot, 1951). However, this does not explain how shells might become concentrated into a fossiliferous layer. Further experimentation revealed that the resuspension of sediments during a passing storm might excavate material, concentrate the shell lag by hydrodynamic suspension and settling, and bury the invertebrate materials (Powers and Kinsman, 1953). This process could account for the accumulation of shells in a single buried layer, but it would be limited to the depth of scoured sediment—no more than 1 to 2 ft (0.3–0.6 m).

Shell beds also may form from bottom currents that transport shell material and sediments into low-lying areas farther out on the continental shelf. The movement of water along the seafloor by bottom currents would follow the geomorphology of the seabed. Morton (1981) stated that bottom current velocity could exceed 6.6 ft/sec (2.0 m/sec) in

Figure 5. The contact between the top of the Lisbon Formation and base of the Gosport Sand Member occurs along the dashed line. Immediately above the contact are very coarse-grained sands that have been removed in an effort to collect sharks teeth. This has resulted in cliff face instability and has created a dangerous setting. As a result, the property owners no longer allow the public access to the property. The exposure is approximately 20 ft high.

association with larger-scale hurricanes like Hurricane Camille (a Category 5 hurricane). He further proposed that this velocity would be sufficient to move water analogous to large-scale rip currents or coastal jets. These velocities would be sufficient to scour depressions and channels along the seafloor.

What would the resulting tempestite look like? According to Morton (1981), the storm deposit would have a lobate form that would thin in alongshore and offshore directions, and the storm bed would be thickest in the vicinity of maximum storm influence. This morphology describes the Gosport Sand Member exposed across southwestern Alabama.

The Gosport Sand Member

In examining the various stratigraphic sections exposed along the Alabama River, Smith (1907) was the first person to identify and describe the Gosport Sand section from an outcrop at Gosport Landing. At this locale, the unit is a 30 ft (9.1 m) section of calcareous, medium- to coarse-grained, abundantly fossiliferous sand (Swann and Kelley, 1985). Palmer and Brann (1965–1966) identified 483 species of mollusks from this unit. Tables listing specific species collected have also been compiled in Lindveit and Lindveit (1977).

Despite its relative thickness at various outcrops, the Gosport Sand as a specific lithologic/paleontologic unit is very limited in its lateral extent (Osborne et al., 1989). Moving westward toward Mississippi, the unit changes in composition to a non-marine, cross-bedded sand and carbonaceous clay, identified as the Cockfield Formation. Moving eastward across Alabama, the Gosport Sand transitions into a yellow to orange highly cross-bedded glauconitic sand and brown carbonaceous shale (Toulmin, 1967). This stratigraphic unit thins laterally moving both east and west along strike (Table II).

Table II. Selected outcrops of the Gosport Sand Member across southwestern Alabama.

Site	County	Location	Thickness Fossiliferous Layer	Description	References
A	Choctaw	Road cut on AL12/ U.S. 84	0.5–1.5 ft (15–46 cm)	Bed 3. Sand, clayey, black, compact, with thin stringers of loose black sand. Contains lignite flakes (pebbles) and a number of well-preserved fossils.	Toulmin et al., 1951, p. 117.
B	Washington	Tombigbee River—Baker's Hill	15–18 ft (4.6–5.5 m)	The upper part of the Gosport Sand is exposed to best advantage and contains abundant well-preserved shells of a diversified molluscan fauna.	Smith et al., 1894; Toulmin, 1977, p. 381.
C	Clarke	Little Stave Creek	15 ft (4.6 m)	See text.	Toulmin, 1977; Hazel and Pitakpaivan, 1993.
D	Clarke	Gosport Landing	30 ft (9.1 m)	Calcareous, medium-to-coarse-grained abundantly fossiliferous sands.	Swann and Kelley, 1985, p. 2.
E	Monroe	Rattlesnake Bluff	10–12 ft (3 –3.7 m)	Claiborne ferruginous, fossiliferous sands, the counterpart of those at Claiborne Bluff.	Smith et al., 1894; p. 708; Toulmin, 1977.
F	Monroe	Claiborne Landing	17 ft (5.2 m)	Glauconitic quartz sand packed with shells of pelecypods and gastropods. Rare solitary corals and bryozoans, and leaf impressions in isolated clay layers are also present.	Toulmin, 1977, p. 115.
G	Conecuh	Sepulga River	3 ft (91.4 cm)	Bed 2. Fine blue-green sand loaded with Claiborne shells (USGS Station 6737).	Adams et al., 1926, p. 273.

The Gosport Sand at Little Stave Creek

According to Rindsberg and Henderson (1987, p. 70), the Gosport Sand at Little Stave Creek "is an extraordinary fossil deposit containing more than 400 species of well-preserved mollusks in a matrix of shelly, muddy glauconitic sand." They postulate that the highly fossiliferous portion of the Gosport Sand is actually an accumulated shell lag formed over time by a succession of storm events.

Toulmin (1962) divided the Gosport Sand into three informal units, totaling approximately 11 ft (3.4 m): (1) a basal unit composed of a glauconitic, medium- to coarse-grained sand that marks the disconformity with the underlying Lisbon Formation, (2) a middle unit consisting of medium- to coarse-grained, glauconitic sand with abundant well-preserved mollusk fossils, and (3) an upper unit that contains a medium- to coarse-grained, silty, calcareous, fossiliferous sand. The basal sand unit is approximately 1.0 ft (0.3 m) thick and covers a clayey bioturbated surface along the top of the Lisbon Formation. The poorly sorted coarse-grained sand actually infills the burrows along the top of the Lisbon and contains isolated pieces of various fish fossils (sharks teeth, stingray plate, and small diameter fish vertebras) that are usually worn or broken. An occasional broken or highly abraded shell also can be found within this basal unit. Interestingly, Arata and Jackson (1965) reported finding a sirenian rib fragment within this sandy zone, and Siler (1964) also found a rib fragment in this same interval 40 miles (64 km) east in Monroe County. Gardner (1957) believed that this sand layer represented a considerable span of time as she interpreted it to be a battered beach deposit.

According to Toulmin (1962), the middle fossiliferous unit is approximately 5.0 ft (1.5-m) thick and contains an amazing assortment of mollusks with the disarticulated pelecypod shells in random orientation (Figure 6). Gardner (1957) compared this shell-rich zone to the multitude of shells exposed along the beach at Sanibel Island, Florida. Many of the mollusk shells are so well preserved as to retain their original color patterns (Kelley and Swann, 1988; Swann and Kelley, 1985). The unique preservation of the shell material led Kelley and Swann (1988) to postulate the following depositional setting and conditions:

> The depositional environment is interpreted to be a shallow nearshore marine environment. This conclusion is based on: 1) the presence of glauconite; 2) excellent condition of the fossils, suggesting little transport; 3) the lack of a clean, well-sorted sand matrix; and 4) the lack of valve orientation or sedimentary structures which would indicate a beach environment. If this interpretation is correct, then the lack of bedding could be due to bioturbation by the indigenous fauna. (p. 83)

CoBabe and Allmon (1994) conducted a paleoecologic and taphonomic assessment of the fossiliferous zone and determined that the lack of any vertical community structure combined with the high concentrations of shells prevented them from characterizing the full diversity of the invertebrates.

At its type locality at Gosport Landing, Toulmin (1977) noted carbonaceous leaf-bearing clays within the fossiliferous section, which led him to believe that the paleosetting represented a near-shore marine environment. However, there are no leaf-bearing clays present at the exposure along Little Stave Creek (Hazel and Pitakpaivan, 1993).

Toulmin (1962) identified the top of the Gosport Sand section as approximately 5.0 ft (1.5 m) thick, containing considerably fewer macro-fossiliferous materials, but what is present (i.e., foraminifers, ostracodes, and mollusks) is well preserved. Regarding this section of the Gosport Sand, Gardner (1957) stated:

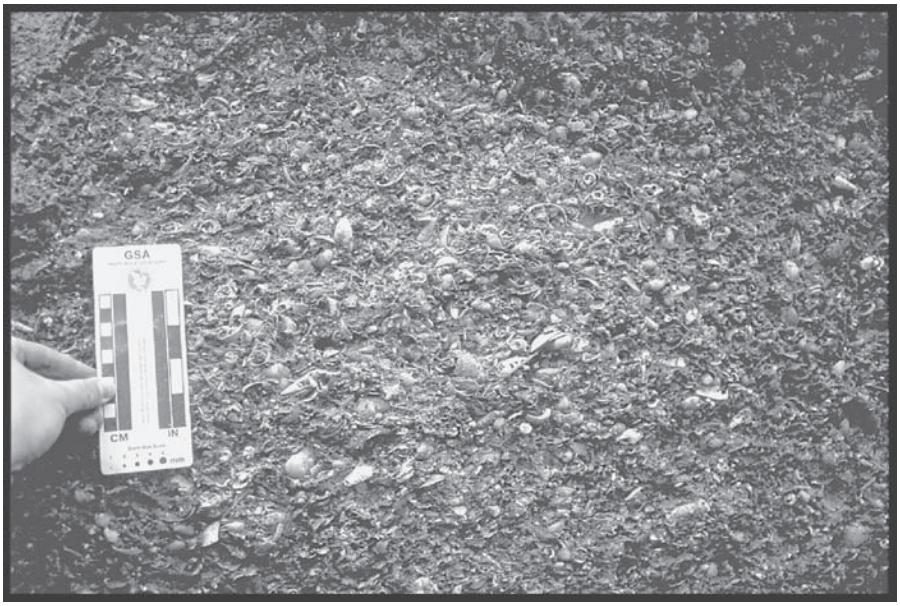

Figure 6. A high concentration of shells occurs within the middle portion of the Gosport Sand Member at Little Stave Creek. The excellent condition and preservation of the shells indicates limited transport and rapid burial. The absence of lithologic breaks within the shell layer or over- and underlying sediments suggests deposition in a single massive storm. Scale in inches and centimeters.

> The upper part of the Gosport is much more disturbed than the lower, though probably the entire Gosport sand [sic] was laid down in less than 20 fathoms (120 ft/36.6 m) of water. (p. 584)

Differentiation between the two 5 ft sections of the Gosport Sand is based on a reduction in macrofossil content (Kelley and Swann, 1988). The actual boundary location appears to be rather subjective, based on individual lithologic or paleontologic preferences.

The 11 ft of section defined by Toulmin (1955; 1962; 1966; 1968; 1977) as the Gosport Sand along Little Stave Creek is based on his own ideas regarding biostratigraphic divisions. Gardner (1957) believed that the Gosport Sand extended up 25 ft (7.6 m) from the contact with the underlying Lisbon Formation. Based on foraminifera, Bandy proposed that the Gosport Sand was 18 ft (5.5 m) thick. Using ostracodes, Hazel and Pitakpaivan, (1993) have more recently proposed moving Toulmin's (1962) contact upward into the Moodys Branch by 4 ft (1.2 m), making the section 15 ft (4.6 m) thick.

This variation in defining the boundary between the Gosport Sand and overlying Moodys Branch Formation arises from their lithological similarity (Hazel and Pitakpaivan, 1993). Some investigators who have examined the contact between the top of the Gosport Sand and base of the Moodys Branch claim that it is marked by an unconformity (e.g., Mancini and Tew, 1988; 1990; Swann and Kelley, 1985), an irregular contact (Toulmin, 1962), or a gradational sedimentary sequence so subtle as to make the boundary an arbitrary decision (Bandy, 1949; Gardner, 1957; Hazel and Pitakpaivan, 1993; Mancini and Tew, 1988; 1990; Stenzel, 1952; Toulmin, 1940). Based on my own observations at Little Stave Creek, there is no discernible erosional contact between the two stratigraphic units. While there is a rapid decrease in overall fossil content moving up into the Moodys Branch, there is no visible erosional contact (Figure 7).

Figure 7. The Gosport Sand Member, exposed along Little Stave Creek, shows no distinct break in sedimentation. There is no indication of any post-depositional mixing of sediments or stirring of the fossiliferous layers by mechanical or organic processes. Scale in six-inch (15 cm) divisions.

The Gosport Sand Member: Is it a Tempestite?

Is the Gosport Sand Member a hypercane deposit? If so, was it created by only one storm or several? The answer can be found in an examination of the areal extent, sedimentary features, and thickness of the deposit.

Areal Extent

According to Toulmin (1977), the Gosport Sand is present from "the vicinity of the Alabama River west to the Mississippi line" (p. 115). Gardner (1957) estimates the distance as approximately 40 miles (64.4 km), from exposures along Santa Bogue Creek in Washington County to just east of the Claiborne Landing in Monroe County. However, adding the locale along the Sepulga River (see Adams et al., 1926) extends the Gosport Sand outcrop eastward along strike an additional 49 miles (79 km) and results in a fossiliferous deposit that extends across southwestern Alabama approximately 104 miles (167 km).

Sedimentary Features

The basal sand unit of the Gosport Sand appears to be a lag deposit. The abraded nature of the few shells and fish material found within the coarse-grained and highly angular sand suggests transport, and the lack of any sedimentary features indicates that it was transported along the seafloor by suspension. There is no indication of a hiatus or break in deposition anywhere in the Gosport Sand section, suggesting continuous deposition. The concentrated shell layer contains delicate shells that exhibit little to no abrasion. This is reflective of localized transport, rapid burial, and preservation. The physical evidence in support of the passage of extended periods of time over which the deposit was slowly accumulated, such as might be demonstrated by changes in sediment composition, abraded shells, and the formation of coquina layers is not present.

Thickness of the Deposit

The thickest exposure of the Gosport Sand occurs at its type locality on the Alabama River at Gosport Landing, where the unit is 30 ft (9.1 m) thick (Swann and Kelley, 1985). Approximately 4 miles (6.4 km) upriver at Claiborne Landing, Toulmin (1977) described the unit as approximately "17 feet of glauconitic quartz sand packed with shells of pelecypods and gastropods" (p. 115). Westward at Little Stave Creek, the Gosport is approximately 15 ft (4.6 m) thick. Moving farther west, Toulmin et al. (1951) reported the Gosport Sand exposed in Choctaw County, Alabama, was approximately 10 ft (3 m) thick. The easternmost exposure occurs along the Sepulga River in Conecuh County Alabama, where the Gosport Sand is approximately 3 ft (91 cm) thick (Adams et al., 1926).

Discussion

Hypercanes versus Hurricanes

It is important to remember that hypercanes exist only as numerical computer models. We have no atmospheric evidence that confirms they ever occurred. Sea surface water temperatures in excess of 113° F (45°C) are considerably higher than anything we have on Earth today. However, conditions associated with the Flood would not exclude hypercanes from consideration. The size and morphology of some of the sedimentary deposits in areas such as across the United States Gulf Coastal Plain appear to support the idea that hypercanes might have occurred in this area in Earth's past. However, these super storms would have very limited applicability within the uniformitarian framework of Earth history due to the heat necessary to form them.

Modern hurricanes can create surface waves with near-bottom orbital velocities that stir the continental shelf seabed. These forces move materials by suspension. Additionally, the shoreward movement of a large storm surge would create bottom currents with sufficient velocity to erode and swiftly transport materials (including invertebrate remains) toward deeper water out on the continental shelf. This occurs even today in association with modern hurricanes. Many of the uniformitarian investigators who have examined the strata exposed along Little Stave Creek have come to the conclusion that the sediments and fossils have been transported some distance. Gardner (1957) suggested that bottom currents were the likely cause of this mixed paleontological assemblage. For the Gosport Sand, Rindsberg and Henderson (1987) envision suspension winnowing of the sediments and shells with very little transport.

A Paleontologic Myth

Uniformitarian/evolutionary assumptions drive the interpretation of paleontological data. Purported paleoecologic settings are extrapolated from comparisons with living animals. This creates problems when a microfossil correlates to a certain setting that is not supported by the associated matrix. For example, Sparks (1967, brackets added) stated:

> It is important to remember when comparing the generic composition of recent and fossil [foraminifera] populations that some genera that live in deep water environments at the present lived in shallower environments in the past. (p. 35)

In this situation many uniformitarians would then declare the microfossil out of place or suggest that it evolved over time to adapt to a deeper water setting. However, the Flood provides a better answer. The biblical record states that wind moved across the Floodwater following the initial 40 days and nights of rainfall. These winds would have contributed to the transport of open water foraminifera across shallow portions of the submerged continents thereby creating a mixed assemblage of deep and shallow water foraminifer deposits—such as we find at the Little Stave Creek section. This same process occurs even today and is most pronounced in association with storm activities (e.g., Collins et al., 1999; Scott et al., 2001; 2003).

The use of palynologic (i.e., spores and pollen) or plant leaf fossils to estimate climate or water temperature would suffer from the same inherent errors as the transported and mixed macro- and micro-fossilized fauna. The transport and eventual deposition of these plant materials would have mixed in a manner that would preclude environmental interpretation. Plant remains were derived from antediluvian settings and could not define the climate during the Flood.

Erroneous Depth Indicators

It is highly questionable whether microfossils can establish sea-level changes within the young-earth Flood framework, especially since the Flood was a short-term event of high energy. Much more time would appear to be needed to create a relatively stable marine environment with well-established foraminifera ecological zones. Even if possible, modern mixing of deep and shallow water marine microorganisms during a hurricane demonstrates further problems with this approach. Clearly, these high-energy storm deposits are inconsistent with current uniformitarian expectations.

Mixed Sediments and Fossils

Interpreting much of the Little Stave Creek section as a series of storm deposits also would invalidate any uniformitarian paleoecological interpretation, since the resulting sediments and fossil shells would reflect a mixed deposit of life-forms not in their original habitat and likely not buried in their original sediments. This would explain why paleontologists CoBabe and Allmon (1994) failed to identify a vertical relationship between the invertebrate shells and why they identified the shell bed as a unique (i.e., worst case) depositional setting in which to conduct a paleoecological assessment.

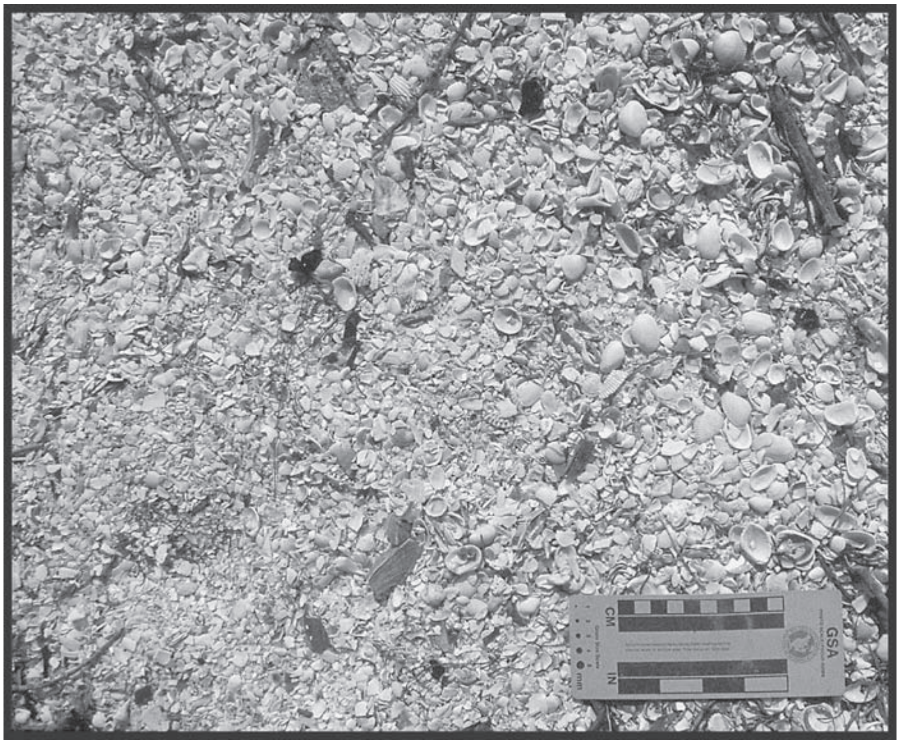

Figure 8. Sanibel Island, on the southwestern side of the Florida Peninsula, is famous to shell collectors. Wave conditions are such that a wide variety of shells are gently washed onshore, and in many cases they are in perfect condition. However, storm waves also serve to batter and break the shells creating a shell hash that if lithified would form a coquina. Such broken shell material can be seen in this image from the beach at Sanibel Island, where whole shells are mixed with broken shells. Note that both the shells and fragments are generally flat-lying. This modern shell deposit is not what is found at Little Stave Creek, so any postulated association between the two locales is inappropriate. Scale in inches and centimeters.

Correlating water depths to stratigraphic sections along Little Stave Creek also suffers when much of the rock record is defined as a series of tempestites. Again, the mixing of the original organic remains during deposition would create an inaccurate record of past water depth. This would be interpreted as a series of rapidly changing sea-level positions, ranging from beach to outer shelf, which is what is demonstrated at Little Stave Creek. From a Flood perspective, both the sediments and shells were derived from various source areas across the inner continental shelf. Clearly, the Gosport Sand was transported a very short distance and deposited in deeper water as a function of hydraulic processes. The nature of the shell deposit and bedding throughout the Gosport Sand reflects rapid deposition, likely by suspension, and not followed by any level of bioturbation.

In defining the paleo-depositional setting of the Gosport Sand, Gardner (1957) envisioned a battered beach environment for the coarse-grained and highly angular basal sand unit. But if this setting occurred over millions of years, then the beach sand should be more rounded and worn. Directly above this basal sand layer are the delicate shells beautifully preserved in completely random orientation. For this paleosetting, Gardner (1957) invokes a gentle, low energy surf that transported the delicate shells to the near shore, where they accumulated and were eventually buried with a rise in sea level. However, even in this low-energy setting, we should expect that over the course of millions of years some of the shells would have become broken, forming a coquina deposit (Figure 8). No coquina layer(s) are found in the Gosport Sand Member nor have any been reported by past investigators. Gardner's (1957) various uniformitarian paleosettings are not consistent with the expectations of a multimillion-year history for the development of the Gosport Sand Member.

If a hypercane created the Gosport Sand Member, could it also explain the reversal in flow direction in the Suwannee Channel that has been advanced to explain the sudden appearance of the echinoderm, *Echinocyamus*, in Gulf Coastal Plain sediments (Zachos, 2005)? The problem with linking these two events in this manner is that the equivalent age assumptions between this echinoderm and the Gosport Sand are based on evolutionary concepts inconsistent with the Flood framework. But if this time link could be demonstrated, then serious questions would be raised regarding the assumed uniformitarian time span over which the entire Gosport Sand was deposited.

The Fallacy of Sequence Stratigraphy

The application of sequence stratigraphy to the section exposed along Little Stave Creek provides only confusion. A close examination of the rock record at this locale reveals that a number of the proposed unconformity boundaries (both Type 1 and Type 2) appear to be absent. Additionally, many of the stratigraphic units have sediments inconsistent with sequence-derived eustatic cycles. It appears that the sequence stratigraphic framework has been forced on the rock record at Little Stave Creek. The result is a highly detailed but confusing subdivision of the stratigraphic units by questionable unconformity boundaries and implied changes in relative sea level (see Hazel and Pitakpaivan, 1993). The Gosport Sand Member sediments and fossils do not correlate to the sequence stratigraphic interpretation. It proves an excellent example of theory overwhelming evidence; purportedly long, slow changes in sea level interpreted from a stratigraphic unit that was deposited as a storm deposit. Invoking the principles of sequence stratigraphy to possibly enable a Flood interpretation for this entire stratigraphic section or just the Gosport Sand is of no use in this instance.

Multiple Storms

Was the Gosport Sand Member created during a single storm or from a series of storms? Evidence in support of its forming during the course of multiple storms spanning millions of years should include: (1) a succession of normally graded shell beds (or possibly non-fossiliferous high-energy cross-bedded sands) overlain by finer-grained clastics, (2) the bioturbation of the storm-derived sediment, and (3) sedimentary materials indicative of a condensed section (e.g., phosphatic nodules, hardgrounds). None of these features are present in the vertical profile within the Gosport Sand. Rather, the unit appears to be an interrelated sequence of sediments reflective of continuous sedimentation extending upward into the lower Moodys Branch.

Conclusions

The size and morphology of the Gosport Sand Member can best be explained within the context of a very large storm deposit. Even the lower portion of the Moodys Branch Formation also may prove to be a part of the tempestite. Based on the stratigraphic context, I believe that the hypercane passed over this submerged portion of southwestern Alabama during the Middle Flood Division (see Froede, 1995; 2007), moving toward the north-northeast. Extensive subaqueous and subaerial volcanism in western North America, Mexico, and possibly Central America could be a probable oceanic heat source that generated one or more hypercanes during this time interval. Additionally, meteoric impact events also within this area during this time could have supplied heat to both the atmosphere and Floodwater.

Hypercanes would have created extensive seafloor erosion through a combination of sediment resuspension and bottom-current flow. Sediments and shells were hydraulically sorted, transported short distances, and deposited in scoured depressions or low-lying areas across the former seafloor. Moving vertically up the Gosport Sand section, the succession of sediments along with the general decrease in shell materials reflects a reduction in sediment stirring and transport as the storm moved out of this area. The lateral thinning of the Gosport Sand Member both to the east and west of its area of maximum thickness across southwestern Alabama is consistent with the expectations of a storm deposit (see Morton, 1981), but likely on a scale too great for uniformitarian acceptance. However, a hypercane able to produce this massive tempestite is possible and probable within the time and energy expectations of the Flood framework.

Appendix

An interesting part of the computer modeling conducted by Emanuel et al. (1995) is the anticipated destruction of the protective ozone layer in the stratosphere. They stated:

> The injection of large amounts of water into the stratosphere may have significant consequences for the chemistry of that region. Water vapor is the source of the free radicals OH and HO_2, which contribute to stratosphere ozone depletion.... The OH radical plays also another important role: It activates chlorine (by converting the relatively stable HCl species to Cl atoms) and deactivates nitrogen (by converting nitrogen dioxide to nitric acid, a more stable species), the net effect being enhanced ozone depletion by chlorine free radicals.... An important separate effect of water on stratospheric chemistry could result from the formation of clouds: Chemical reactions on cloud droplets activate chlorine and deactivate nitrogen oxides, in a manner analogous to that described above for the OH radical. Such a mechanism explains the formation of the Antarctic ozone hole (Emanuel et al., 1995, p. 13762).

Perhaps the rapid decline in the human life span following the Flood might correlate to the loss of a pre-Flood vapor canopy *and/or* the loss of the protective ozone layer in the stratosphere. Humans would have been exposed to damaging radiation from sunlight until the protective ozone layer was able to re-form—a period of time likely extending over many decades. Could this be a reason that humans do not live as long on the earth today as their pre-Flood counterparts? This might prove to be a fruitful area of further research for young-earth creation scientists.

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Book Review

Investigating Evolution: A Six Part Educational Series

A DVD produced by Coldwater Media, 300 General Palmer Drive,
Palmer Lake CO 81033, 2007, $20.00.

This DVD, which runs for 33 minutes, is composed of modules covering six topics—Embryological Evidence for Evolution, Galapagos Finches, Four-Winged Fruit Flies and Morphological Mutations, Antibiotic Resistant Bacteria, Homology, and The Cambrian Explosion. Topics are explained and discussed by informed scholars, most prominently Jonathan Wells. Most of the scholars are opposed to large-scale evolution.

There are appropriate animations—for example, flies with two wings and with four wings. Attractive full color is employed. The longest module (11 minutes) is the final one and features discoveries of Cambrian fossils in China. Scientists there report finding 136 different kinds of animals and say these represent Darwin's tree, but it is upside down!

I feel that this DVD could be very useful for a discussion in classrooms and meetings with an audience having some familiarity regarding creation topics.

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