SUNDAY SEPTEMBER 14, 2003

TRIP B-1

A VISIT TO THE LAND OF GILBOA

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Introduction

Hartwick College has been built upon Oyaron Hill. The slopes here offer a number of outcrops which intermittently expose almost 200 m of strata. These record a complete facies pattern spanning environments that range from offshore marine, to coastal, to well inland on the Catskill Delta complex. All sedimentary environments are well exposed and so Oyaron Hill offers a compact opportunity to visit nearly all facies of the famed Catskill Delta, herein called the "Land of Gilboa."

Gilboa, Back Then*

The 23rd of Caligulary, 365,841,916 BC, high summer. There are more than 400 days in the year in this time and 14 months. One of those extra months is Caligulary. We are the mind's eye, and we are drifting high above what will someday be the town of Morris. Below us is the dark blue of the Catskill Sea. Ahead of us, the curvature of the Earth's surface is bringing a rising eastern horizon into view. First to appear are the rugged white summits of a very tall mountain range, the Acadians. As we continue eastward, we see that white extending down to the bottom of the snow line, and then steel blue slopes appear beneath.

Ahead the blue slopes grade downward into purple and then brick red foothills. Below those, as the horizon unrolls, we see light, sandy lower slopes. Then, finally, the greens of the delta foliage appear. It is the hottest part of the summer, here in the Southern Hemisphere, and ahead of us, it is the monsoon season. Ahead of us, great masses of terribly hot air rise as plumes above the delta. This natural chimney creates a draft, and behind us storms are being drawn from off of the sea and on toward the interior of the delta. Back there is the first of three very powerful lines of thunderstorms. On modern weather radar images these would be blinking masses of yellow, and orange, surrounded by dark green. What we actually see on the western horizon are great billowing dark clouds, periodically illuminated by flashes of lightning. It is a frightening sight and it would be scarier if we could see the two lines of storms that follow the first; they are worse.

Now we can see that we are approaching the shores of the Catskill Delta. Below us, the Catskill Sea is shallowing and the dark blue is becoming paler. We are the mind's eye; we can go

as fast as we want and as high as we want[1]. We drop down closer to sea level and speed forward. Soon we cross the delta coastline, extending to the north and south. The beaches are not like the brilliant white sands we know today on the East Coast; these are of a dull brown color.

Behind the beaches is the delta interior. A complex of interfingering distributary streams flows lazily toward the coast. We pick out one of the biggest and finest among them and drop down to just above its mouth and then we fly up the river; it will be our avenue into the delta interior. It is immediately obvious that this landscape has been suffering from a serious drought. The water is low and the riverbanks are composed of parched bleached sands.

The river flows lazily down narrow stretches, interrupted, here and there, by wider and deeper pools. It is in the pools that we observe primitive fish nervously swimming in tight circles; the drought conditions seem to have them on edge. The fish are heavily armored with dermal bone and are often hard to recognize as even being fish. Only the fins give them away. Some stretches of streambed are densely littered with colonies of clams. Their shells gape widely as they struggle to glean food from the slow moving currents.

Beyond the banks of the stream, the land of Gilboa is nearly silent. The foliage is made up of tall but primitive looking trees. In the ground cover below are numerous millipedes, centipedes and spiders. These are the only familiar looking elements of the Gilboa Forest.

We are the mind's eye, we can go anywhere and do anything; we accelerate and rush along our stream channel, heading up the river. The banks zoom by in a blur as we go 50, then 60 and then 75 mph. We rise up high into the air and look down upon the vast expanse of dry flatness below. All around, the trees of the delta are pale and yellow, suffering from the drought. All around, there are light colored shrunken pools. It is a desolate, hot and dry delta; it won't be for long.

Behind us, those lines of thunderstorms have continued their approach, covering ground nearly as fast as we have. The flashing of lightning illuminates the darkness of the clouds. But we are the mind's eye and lighting cannot harm us; we drop down again and soar forward even faster. The banks fly by at a giddying pace. But soon the greenery is replaced by a blur of yellow, red and tan and the banks steepen and rise above the river. We are approaching the lower slopes of the Acadian Mountains and these are heaps of gravel that have washed down out of those mountains.

We slow down and gradually enter into a large steep-walled canyon. It takes us up the slopes and into the mountains. There is no green up here; it has instead abruptly become a dead landscape. A brick red earth is soon replaced by a purple color. Then the canyon walls are gray and even black. It is a spooky place, a dark and shadowed natural maze of gray ravines, and it would be very easy to get lost in this dark and alien landscape.

But we are the mind's eye and we cannot get lost. We continue our ascent, always following the widest and steepest ravines as we climb the middle slopes of the Acadians. There is no life up

[1] This section adapted from Titus (in press).

here at all; Nature has not yet solved the evolutionary problems of living at such elevations. We ascend; we rise to 5,000 feet, then 10,000 feet and then even 20,000 feet. Pockets of snow bring the contrast of gleaming white to the surrounding dark. Then there is some ice, and then it is all ice and snow.

We are the mind's eye, we continue upwards until we reach a summit at 27,653 feet. This is not quite a Mt. Everest, but there are taller mountains to the north and to the south. This, however, is as far as we shall go. We turn around and, below us, is spread out all of the Catskill Delta, and beyond that the distant Catskill Sea. It is a grand view, to say the least, but it is marred by those three lines of thunderstorms. They have all crossed the coast and are making a mess of the delta ecology down below. There is no sound of thunder up here, but there is the continuous flashing of lightning below. The first line of storms is lapping angrily at the base of the Acadians, frustrated in its inability to ascend those high slopes.

It is time to retrace our path, and we begin our descent. We swoop down the slopes at nearly 100 miles per hour. Those mysterious canyons fly by faster than we can see. Soon we have almost reached the bottom and there we enter into that first line of storms. It is a most dreadfully furious tempest. Torrents of horizontal rain whip back and forth in the intensity of the wind. The pounding rain bounces off of those heaps of gravel. The previously dry sediments thirstily soak up the water.

We, the mind's eye, continue westward. We leave the first line of storms and find ourselves out on the delta. The place is a mess. Trees have been blown down in all directions. Shattered trunks and broken bits of foliage have been thrown about randomly. Pools of dirty water have formed where, just an hour earlier, the land was parched. Ahead of us is the second line of storms. It towers as a great black mass high above the delta green. The ominous clouds have a dangerous swirling appearance; there is great power there. The inevitable flashes of lightning are worse than before.

We press forward and the results are to be expected. Once again, terrible winds whip back and forth, driving sheets of horizontal rain, first one way, and then abruptly another. If we were not figments of the imagination, these drops would sting our faces. Those trees that were left standing from the first line of storms are now swinging back and forth violently. Many are breaking off at the base of their trunks. Broken shards of trees are careening across the flat delta. Pools that had just filled up with water are now themselves filling up with broken greenery.

This nightmarish scene ends suddenly as the line of storms passes. The sun soon comes out and nature is calm once again. But the broken delta, all around us, is gurgling and hissing with the weight of the water that has fallen into it. We find ourselves standing next to one of the main streams of the Catskill Delta and its waters are flowing gray, then brown and then red, depending on what masses of mud are washing by. What's worse is that the dirty waters are quickly rising up the banks. Soon, the growing power of this flood is manifest. The water swirls and then foams and then white caps appear. Now the water seems to hum like electricity as it rushes by.

Beneath the surface, fish are quickly losing their struggles for life. These clumsy, heavy animals are no match for the currents; their gills cannot function with all the mud. Death is a slide, not a fall; they quietly give up their hold on life, drift upwards, and soon just float like corks upon the swirling flows. The clams fair better, they are being swept along, tumbling in the currents. They stubbornly keep their shells closed tight and that keeps them alive, at least for now.

Now the snarling waters cut into the banks of the streams and hungrily devour great masses of sediment. The flows turn red and rise above the banks, and then the dense waters flow across the whole breadth of the flat Catskill Delta. Curiously, it is in this, their apparent moment of triumph, when the flood currents seem to give up much of their power. As they cross the stream banks, the foaming channel swirls grade seamlessly into the almost languid flows of the flooded delta. Red and brown waters peacefully rise up the broken trunks of the storm-tossed Gilboa Forest.

That's when the third line of storms breaks. The rain of the first line soaked into the dry delta sands; the second line glutted the streams with dirty water, and began the flooding. This, the third line, is the worst. The power of these storms would be bad enough, but they have generated a new complication. Broken tree trunks have concentrated in the stream channels, and there are so many of them that they began to "knit" into log jams. These catch on the edges of the channels and form log dams. Then the water behind those dams rises even higher. Soon the Catskill Delta is a great, fresh water inland sea.

This, at last, is the worst of it. But, even as the waters begin to subside, there are more dangers. Those poor clams, which have been tumbling along in the turbid flows, now come to rest. For them, this is the climax as they are soon buried under meter thick masses of fresh mud. They face a stark choice: dig or die.

Late in the night, near midnight, the skies above the Catskill Delta are clear and a wine colored full Moon shines down upon a land that has been devastated. The day's horrible flooding is over and the waters are actually beginning to subside. At the mouths of the various streams large plumes of dirty water are spreading out into the Catskill Sea. This dirty fresh water floats upon the salt water. Its surface is littered with broken plants and dead fish.

Meanwhile, back inland, the streams are draining off of the delta. The floodwaters are leaving a thick gooey layer of mud behind. Broken and splintered tree trunks rise above that mud. There should be blinking red lights all across the delta; emergency crews should be rescuing those still in peril. But this is the Devonian and the Catskill Delta is a soul-less land. There are no rescuers, nor are there any rescued. Delta creatures are tending to themselves as best as they can. None of them understands what has happened today. In fact, very few of them can even remember the day's terrible events. But all is not lost. In many of the stream channels, the buried clams have turned out to be very able burrowers and virtually all of them have begun to dig themselves out. They open up their shells and hungrily feed upon the currents that flow by. On this evening, the waters are unusually rich in food. Life goes on.

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Appendix: TRIP LOG FOR STRATA OF OYARON HILL

Field trip assembles at parking lot behind Miller Hall. We hike down to Clinton Street and from there to the bottom of the road where it intersects with Chestnut St.

STOP 1. BAGNARDIS SHOE REPAIR

The outcrop exposed here is of the Unadilla Formation. The sequence is composed of moderately well bedded sandstones and some shales. There are two levels which represent shell hashes. These are interpreted as lag deposits, dating back to times of unusual current activity. There is at least one wave ripple marked horizon. The beds have been thoroughly searched for fossils these past 30 years and not many remain. In the past a brachiopod and clam assemblage dominated. Nautiloids, snails, trilobites, rare bryozoa, trace fossils were also found. The sequence was first described by Prosser in 1899. He listed 13 species, mostly brachiopods and clams. These strata are interpreted as representing a shallow water marine setting lying some distance offshore of the prograding delta sequence.

STOP 2. HARTWICK MAINTENANCE BUILDING

When this outcrop was exposed, about ten years ago, it was hoped that the site would yield numerous fossils. Sadly, this was not the case. Most of the sparingly exposed strata between here and Miller Hall are sparsely fossiliferous at best. These facies may represent a "dead zone" lying just offshore of the delta river mouths.

STOP 3 THE MILLER HALL OUTCROP

The Miller Hall outcrop is situated immediately above a thick sequence of mostly unfossiiiferous black shales. These were exposed when Miller Hall was recently expanded. These are apparently the very first non-marine deposits in the local Catskill sequence and they thus mark the moment in time when progradation of the Catskill Delta complex had reached today's Oneonta. The facies here are therefore most likely to be the most nearshore that is possible. This is of some importance as this level thus marks the lowest level of the Oneonta Formation. This part of the seque3nce was not exposed when workers such as Vanuxem (1840) or Prosser (1899) studied here.

This fine exposure reveals several distinctly different nearshore lithologies. First there is the massive sandstone unit that thins out to the right. Then there are the black shales that underlie the entire outcrop. Between the two lithologies is a thick bedded, rusty sandstone with bedding gently inclined toward the massive sandstones.

The massive sandstone appears to be a stream channel, possibly a sand filled abandoned channel. The base of the deposit rises to the right, apparently up the slopes to the bank. Beyond and

farther to the right is what may be an overbank crevasse splay deposit. In the past the very bottom of the exposure has displayed drag marks which are east to west oriented. These are currently buried.

The black shales are sparsely fossiliferous. A few large horizontal trace fossils have been found along with the brackish water clam *Paleoneilo sp.* There are several horizons of deep scouring in the otherwise very thinly laminated sequence.

The third lithology here is composed of rusty colored sandstone beds that are inclined toward the stream channel. These strata are richly fossiliferous with fragments of land plants. This deposit may represent a natural levee or bar finger deposit.

All in all, the Miller Hall outcrop is related to settings on the lower Mississippi River delta. An analogous location is found on the West Delta 15" Quadrangle. There the Tom Loar Pass distributary flows past Bob Taylors Pond and Zinzin Bay. A channel deposit along with natural levee deposits can be expected to overlay lagoonal black shales.

Stop 4 Upper Oyaron Hill

The remainder of the slopes of Oyaron Hill rise from elevations of about 435 to 525 meters. Throughout this section are a number of sandstone ledges providing good exposures of the Oneonta Formation. In between the sandstones are less well-exposed sequences of red shales and siltstones. The Oneonta was named by Conrad in 1841. Vanuxem (1842) described this location.

The sequence seems to represent the distal reaches of the Catskill delta sequence. The sandstone ledges are likely to be the deposits of meandering distributary streams while the fine-grained deposits are most likely overbank deposits. The sandstones have occasionally been observed lying with erosional truncation of underlying overbank deposits.

The sequence here displays a number of fining upwards sedimentary cycles of the sorts that have been described by Bridge and his colleagues among others (see for example Bridge, 2000, Bridge and Gordon, 1985, Gordon and Bridge, 1987, Willis and Bridge, 1988 and Bridge and Willis, 1994).

Within the sandstones are abundant trough cross beds, especially near the bottoms of the ledges. Also found are planar cross beds and horizontally laminated sandstones. Near the tops of the ledges there are occasional ripple marked horizons.

Of special interest is the presence of vertical clam escape burrows (probably *Archanodon catskillensis*). These are found at the "Table Rock" ledge near the top of the hill. The clams seem to have been buried by a meter of sand at the time of a waning flood (see Thoms and Berg, 1985; Bridge et al., 1986 and Gordon, 1988). They produced well-defined meniscus patterns as they worked their ways up through the fresh deposits.

The best overbank deposits are found at the top of the hill, along the sides of the soccer field. Here red shales and fined grained red sandstones are seen in abundance. The deposits are rich in root casts and also display rare *Isopodichnus* trace fossils. There are ripple marks and possible soil horizons. At the very top is a sequence of alternating shales and sandstones which seem to record a sequence of occasional flood events. One, exposed on the surface of an enormous displaced boulder, has several fossil logs on it. These were apparently displaced during a flood event.