The Old Vero Man Site (8IR009): Current Investigations Suggest Pleistocene Human Occupation—Redux

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Abstract

The second season (2015) of modern excavation at the Old Vero Site (8IR009) more than quadrupled the sample of burned bone, and potentially identifiable wood charcoal, recovered from anthropogenic surfaces bracketed between multiple dates of 11,100 and 14,000 cal yr BP. About 50m^2 have been excavated to at least Mid-Holocene-aged levels and Pleistocene-age thermally altered items have been recovered in a 28m^2 area adjacent to a suspected hearth. Continued archival research has re-located specimens and documents across the continent. Sellard's original notebooks have been examined and included unpublished measurements connecting existing landmarks with the original excavations from 1915 to 1917.

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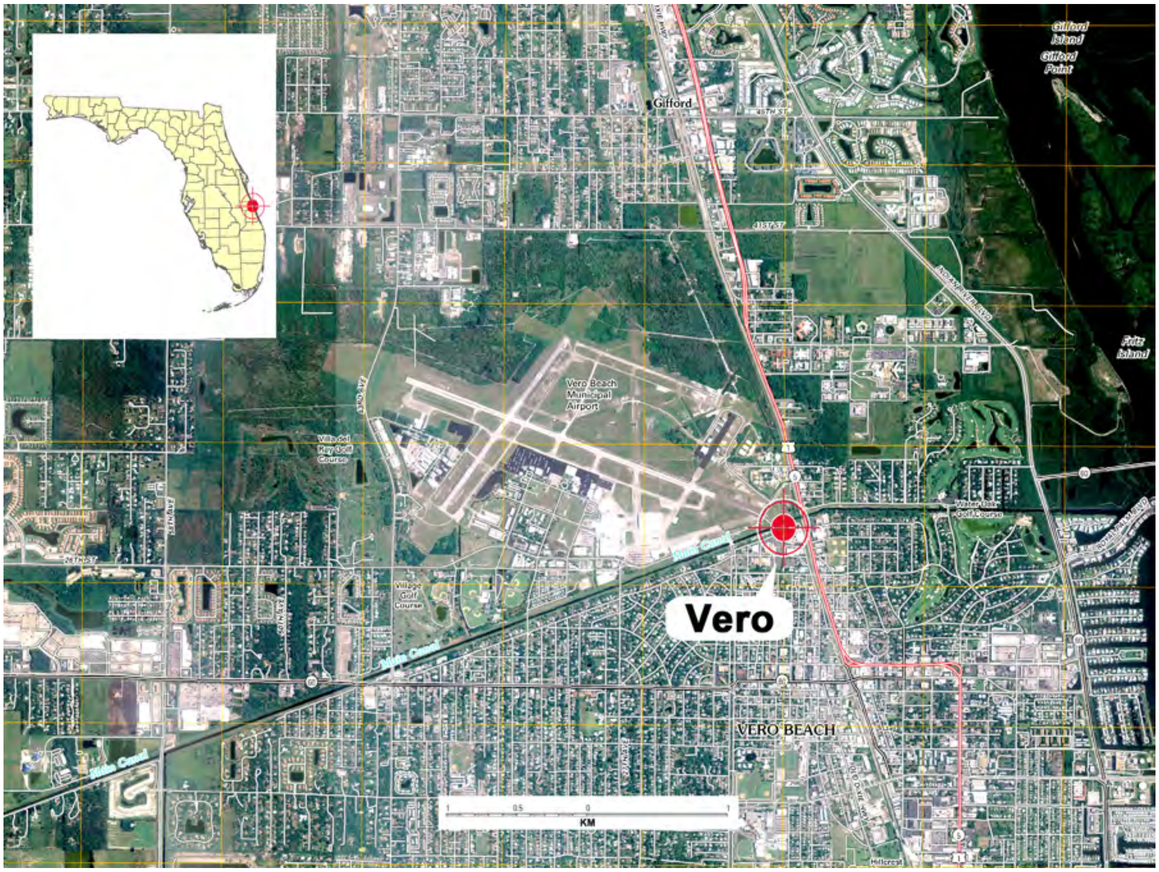

Figure 1. Location of the Vero Man Site (8IR009).

Site Setting and Description

The Vero Site (8IR009), also known as the Vero Man Site or the Old Vero Man Site, is a deeply stratified, multi-component open site located within the city limits of Vero Beach, Indian River County, Florida (Figure 1). The site area lies within the Eastern Valley section of the Atlantic Coastal Plain physiographic province (Figure 2). The Eastern Valley section lies between the Atlantic Ocean on the east and the terrace riser for the Talbot Marine Terrace to the west. The Eastern Valley section in the vicinity of the site is comprised of two distinct marine terraces. The lower and younger is the Silver Bluff Terrace, which lies at a nominal elevation of 5.18 m above sea level (msl) and forms the dune, beach, and wash-over landforms associated with the Atlantic Coastal Ridges. To the west, the section is comprised of the higher and older Pamlico Terrace, which extends westward to its intersection with the Talbot Terrace riser. The Silver Bluff Terrace is of Sangamon age (120,000 BP) and marks a period of time when sea level was 1–3 m higher than the present (Figure 3).

Interestingly, the Vero site proper is situated at the stratigraphic boundary between the high sea level stand associated with the Sangamon-age Anastasia Formation, which is comprised of a coquina beach deposit and relict dunes to the west, also of Sangamon age. The Anastasia Formation lies just 5 m east of the site near the active channel of the Lateral E canal. This formation was encountered only in deep auger probes emplaced along the filled margin of the canal and along an east–west 10 m long backhoe trench that extended from the canal toward the active excavation area. It is also interesting to note that between the existing canal and the excavation area, the Anastasia Formation pinches out and grades into aeolian sands that are disconformably capped by alluvial deposits of late Wisconsin through Holocene age emplaced by

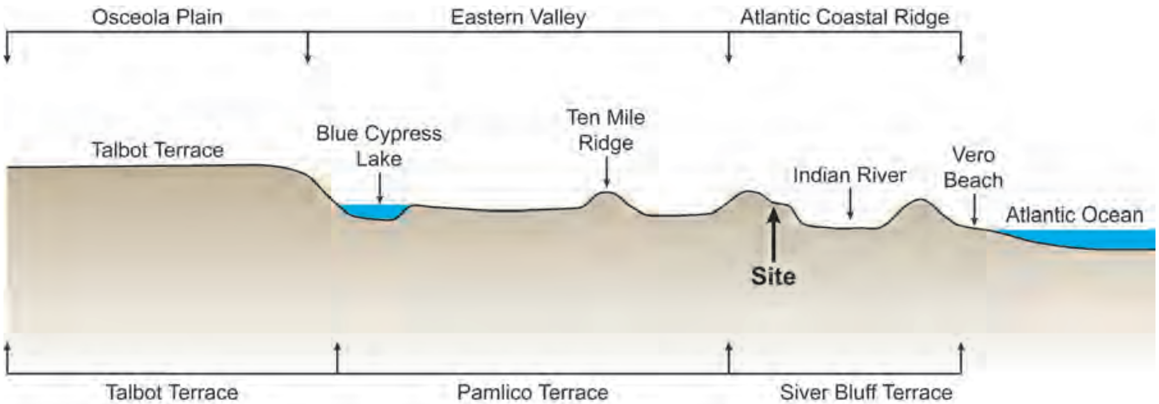

Figure 2. Location of the Vero Man site within the Eastern Valley section of the Atlantic Coastal Plain physiographic province.

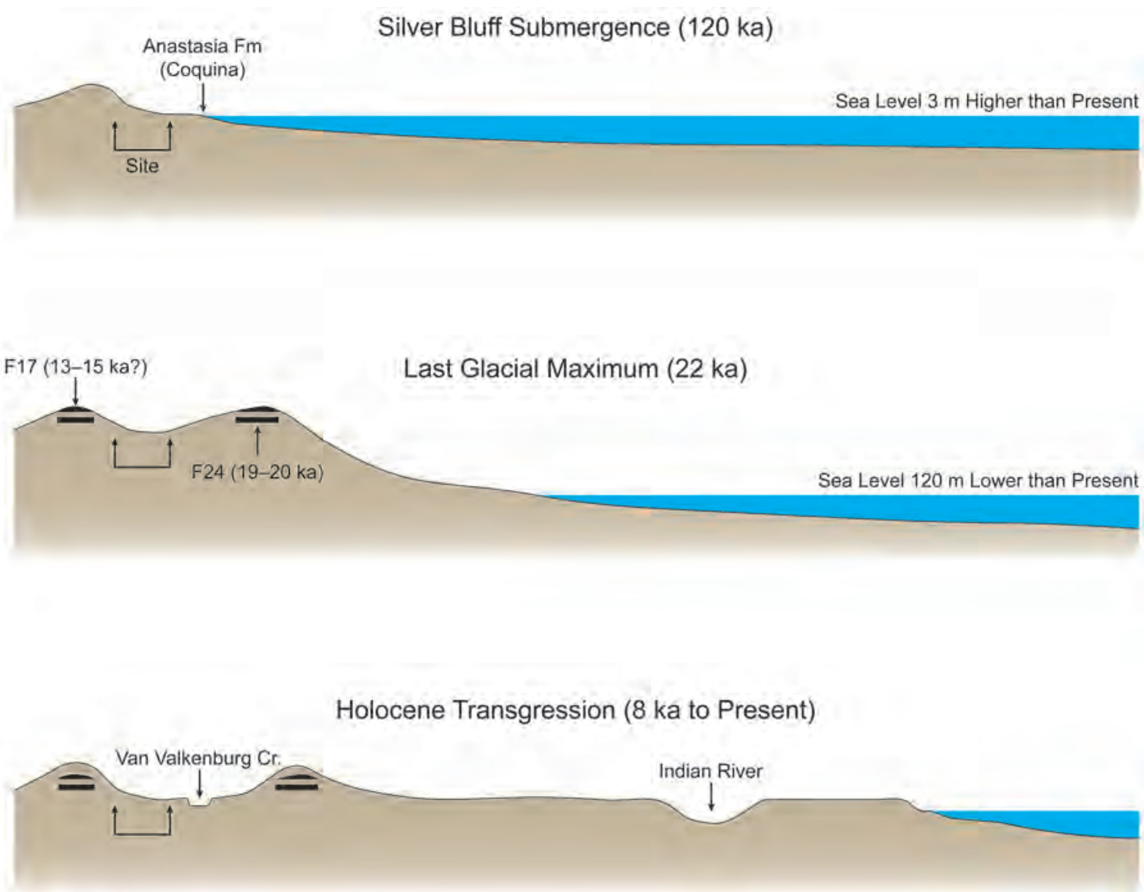

Figure 3. Geologic evolution of the general project area from the Sangamon Interglacial to present.

overbank deposition from Van Valkenburg Creek. The Holocene soils thin appreciably to the west, or away from the then active stream channel.

The general site area encompasses ca. 8,000 m^2, although the exact site boundaries are unknown due to recent construction. A packing plant, Hogan and Sons, lies to the east and intrudes upon the site, the Indian River Administrative Complex lies directly south and west, and the Vero Beach Municipal Airport lies directly north.

Currently, the elevation of the artificially infilled surface of the site is ca. 6 m above normal canal pool level and ca. 5 m above msl. Prehistorically, the elevation of the site was much higher above the depressed sea levels of the late Pleistocene.

The project area is situated within the Myakka-Holopaw-Pompano soil association. This association consists of soils on broad, low flats, and in sloughs, poorly defined drainage ways, and depressional areas. At the site itself, the soils are mapped to the Pomello series. The Pomello series are classified as sandy, siliceous, hyperthermic Arenic Haplohumods. The Pomello soils are moderately well drained, moderately rapidly permeable soils that form in thick beds of marine sediment (Wettstein et al. 1986). An examination of the soils encountered during excavation at the site indicated that the soil designation is neither accurately mapped nor classified. Rather, the soils at the site have formed in either aeolian sands of Pleistocene through Holocene age or in late Wisconsin through Holocene age alluvium associated with overbank deposition and active lateral channel migration of Van Valkenburg Creek. Within the excavation area, these alluvial soils rest disconformably on aeolian sands, while to the east near Lateral E are Anastasia Formation coquina, beach deposits of Sangamon age.

At the time of the 2014 excavations, local vegetation consisted of unidentified pine (*Pinus* sp.), baldcypress (*Taxodium distichum*), sedge (*Carex* sp.), saw palmetto (*Serenoa serrulata*), cabbage palm (*Sabal palmetto*), waxmyrtle/southern bayberry (*Morella cerifera*), corkwood (*Leitneria floridana*), southern live oak (*Quercus viginiana*), water oak (*Quercus laurifolia*), chapman white oak (*Quercus champani*), knotweed (*Polygonum* sp.), sweetbay magnolia (*Magnolia virginiana*), pond apple (*Annona glabra*), water shield (*Brasenia schreberi-purpurea*), holly gallberry (*Ilex glabra*), southern red maple (*Acer rubrum*), muscadine grape (*Vitis rotundifolia*), unidentified grape (*Vitis* sp.), possumhaw viburnum (*Viburnum nudum*), and cocklebur (*Xanthium* sp.). Aboriginally, the area supported a more diverse flora that included both extant and locally extinct species (Table 1 [Weigel 1962]).

Table 1. Aboriginal Flora Recorded at the Vero Locality.

Species Name	Common Name
Pinus sp.	Unidentified pine
Taxodium distichum	Bald cypress
Carex sp.	Sedge
Serenoa serrulata	Saw palmetto
Sabal palmetto	Cabbage palm
Morella cerifera	Waxmyrtle/Southern bayberry
Leitneria floridana	Corkwood
Quercus virginiana	Southern live oak
Quercus laurifolia	Water oak
Quercus chapmani	Chapman white oak
Polygonum sp.	Knotweed (5 FL species)
Magnolia virginiana	Sweetbay magnolia
Annona glabra	Pond apple
Brasenia schreberi-purpurea	Water shield
Ilex glabra	Holly gallberry
Acer rubrum	Southern red maple
Vitis rotundifolia	Muscadine grape
Vitis sp.?	Unidentified grape
Viburnum nudum	Possumhaw viburnum
Xanthium sp.	Cocklebur

The modern climate of Florida is categorized as humid subtropical, or Cfa in the Koppen climate classification system. The region is characterized as having relatively mild winters and long, hot summers. Much of this is due to the significant maritime influence exerted upon the area by the North Atlantic Ocean and the Gulf of Mexico.

Average cold-month temperatures are ca. 15–16^{o} C. Freezing temperatures, although unexpected in most years, are not uncommon through the state. The coldest month on average is January, the time of most frequent Arctic outbreaks.

In Florida, two general synoptic conditions produce freezing temperatures (Rohli and Rodgers 1993; Rogers and

Rohli 1991). The first is associated with migratory cold air masses or Arctic outbreaks, the second involves night-time radiational cooling. Both situations may result from the same synoptic conditions following a cold front passage. Indeed radiational cooling may bring further surface cooling to an area already affected by an Arctic outbreak (Vega and Binkley 1994). This may be particularly damaging to the fragile swamp ecosystems which dominate the state. However, considerable modification (warming) of the Arctic air masses is typical as the air masses approach the Gulf of Mexico. Therefore, as noted above, extremely cold temperatures are relatively uncommon.

History of Research

In early 1913, Florida State Geologist Elias H. Sellards appealed to the public for information on fossil finds across the state for a volume the Florida Geological Survey was compiling on the land animals of Florida. In a *St. Lucie Tribune* article (21 February 1913), Sellards alerted readers to the specific species and skeletal elements they might encounter.

Isaac Weills, who assisted Sellards and many other workers at the Vero site, was interviewed by the *Indian River Farmer* (5 November 1914). Weills spoke about the faunal remains he was finding near the spillway of the Vero canal and indicated that several bones had already been identified by Sellards. Weills also noted that he was arranging to have Sellards visit the site. Shortly thereafter, the *Fort Pierce News* (19 February1915) carried a brief note discussing the Sellards visit and some of the Pleistocene faunal remains they had recovered. This newspaper article chronology confirms that Sellards not only knew of the site, but had also visited and collected below the spillway *prior* to the site becoming a locus of archaeological investigation. Sellards later stated that at the time Vero was brought to his attention, it was one of about 10 sites under study in the area (Sellards 1917a, 1917b).

The first publication of Vero fossil material from the canal excavation also predates the discovery of human remains and artifacts. The Florida Geological Survey 7th Annual Report includes an article by Sellards (1915:25–116) that provides several pictures and descriptions of extinct horse (*Equus* sp.) and giant armadillo (*Holmesina septentrionalis*) skeletal elements recovered from Vero.

Vero evolved from a Pleistocene fossil locus to an early man archaeological site in October 1915, when Frank Ayers found in situ human bones eroding from the canal wall (Figure 4). In early February, Sellards had returned to the site and discovered additional in situ human remains with the help of Ayers, Weills, and others (*Fort Pierce News*, 18 February 1916). These discoveries set in motion additional fieldwork throughout the year as well as site visits by a considerable number of the Early Man "authorities" of the time. Sellards announced the Vero Man site to the world in the 1 July 1916 issue of *Science* and published an open invitation to examine the site (Sellards 1916a:1–18).

The first of two small Vero symposia was held in October 1916, and attended by O. P. Hay, R. Chamberlin, A. Hrdlička, G. G. McCurdy, T. W. Vaughn, E. H. Sellards, and several local individuals. This meeting led to a special January issue of *Geology* in which the conflicting interpretations of the site's geology, archaeology, and physical anthropology were aired (The Journal of Geology 1917:1–3). A second smaller conference was held at the site in March 1917, and attended by botanist E. W. Berry, E. H. Sellards, H. Gunter, and R. T. Chamberlin.

These conferences were followed by a veritable torrent of claims, counterclaims, and contradictions. Chamberlin correctly described the unrelated, undisturbed, upland geologic sequence west of the fossil and putative human remains bearing pond/creek deposits. Hrdlička created enough doubt in the context of the recovered material to achieve a victory, at least in his own mind. McCurdy and William H. Holmes pronounced the artifacts to be recent. Hay attributed many of the faunal remains from the site to new, previously unknown species and declared the human occupation to be hundreds of thousands of years

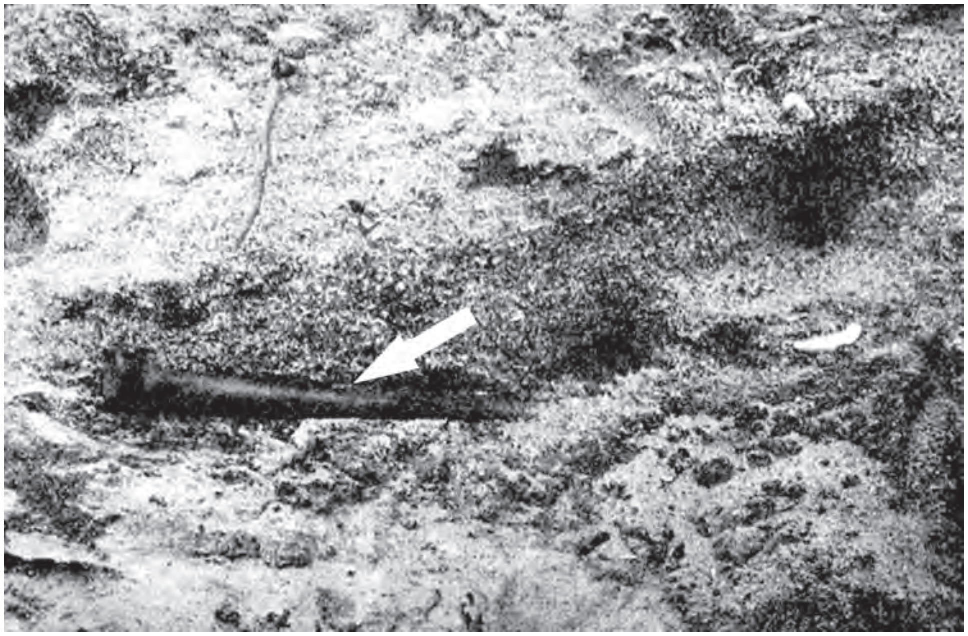

Figure 4. Human radius recovered during the Sellards excavations at Vero (Sellards 1917a:245).

old. Sellards correctly described the pond/creek basin sediments but did not accurately interpret the extent of post-depositional disturbances. Close examination of the published literature, surviving archival notes, and known collections of materials unequivocally demonstrate that the precise age of all stratigraphic layers at Vero was unknown. Furthermore, the actual age of the human remains and artifacts has remained problematic to the present.

The failure to resolve the age of the Vero deposits can be attributed to several factors. First, Sellards departed for a new position in Texas in 1919 and ceased his investigations at Vero, leaving the site's interpretation somewhat under a cloud. Second, the materials (artifactual, botanical, and faunal) recovered from Vero were dispersed to at least 18 repositories throughout North America and thus were never systematically organized, inventoried, studied, or published. Unfortunately, the human remains recovered during the initial investigations are widely scattered and some have been missing since 1946 (Stewart 1946). A note card found among Vero casts at the Smithsonian Institution indicated the skull of Vero man was returned to the Florida Geological Survey in the 1950s. The known materials are being incorporated in our active research and this task has been greatly aided by recent access to Sellards's original notebooks.

The field books of Dr. Sellards have been examined and portions copied from the library of the Florida Geological Survey in Tallahassee. The information specifically regarding excavation at Vero is not as extensive as might be hoped but several important notations have been found.

Published descriptions of the site and the location of individual specimens typically refer to Strata 2 or 3 being a certain distance east or west of the present railroad tracks. Sellards made multiple measurements below the top of the tracks and the ground surface on the north and south canal banks, also indicating where on the rail line measurements were taken. This information permits accurate plotting of all of the previous finds that have measurement data and includes sediment descriptions and measurements from stations between 500 feet east and west of the tracks.

Sellards transcribed portions of several letters exchanged by Ales Hrdlicka and Isaac Weills in November and December of 1916 that illuminate the "behind-the-scenes" discussion occurring outside of the published records. Hrdlicka asked Weills several questions about the location of important early finds and attempted to softly dismiss Sellards's interpretations of the stratigraphy and where the human remains had been found. Weills rejected these self-serving overtures. At one point Weills invoked Galileo saying "I can wait…there will be no doubt when full investigations have been made of the fossils" (Weills to Hrdlicka November 29, 1916, in Sellards's Notebook 27:28). Weills had every confidence in Sellards and the integrity of the site and had no problem so informing Hrdlicka.

There is a considerable amount of Vero site data in Sellards's notebooks, the bulk of which relates to his processing and analysis of both the human and animal remains that had been recovered over several years by numerous named collectors and his crew. Sellards's notes regarding stratigraphic sequences, especially those under and around the extant railroad bridge, are particularly important in helping form future research priorities in other parts of the site when coupled with recent archival finds. The Atlantic Coastal Ridge (ACR) was widely used by historic settlers and would have been a very attractive camping area back into prehistory. A brief passage in a compilation of pioneer histories of the area, *Stories of Early Life Along Beautiful Indian River* (Newman 1953), indicates the Coastal Ridge was considered to be among the most productive land prior to excavation of the drainage canals as seen in the following:

> When drainage was put in, it left the ridge, which had been called Golden Ridge and was so fertile, too dry. Even the groves which once thrived so beautifully on this ridge are poor now. The ridge had served as a dam for back waters. There was a break in the ridge at the Jungle Gardens where Willsey Creek runs through, and when water was high it would seep through a low gap at Oslo, but it acted as a reservoir and made the ridge very fertile [Helseth 1953:51].

The same situation existed at the Vero site prior to canal excavation in 1913.

Two recently discovered photographs clearly indicate that the railroad bridge at the site, and the Vero depot 400 meters south of the site, were built by adding material to the ACR, essentially capping this highly attractive area *without disturbing the underlying stratigraphic integrity*.

Despite the failure to resolve the age of the human and artifactual material that Sellards recovered from the site, interest in the site continued and additional work was sporadically conducted. Nels Nelson dug at Vero for two days in May 1917 and produced a brief summary of his visit (Nelson 1918:100–102). Later visitors included J. Gidley, F. B. Loomis, J. C. Merriam, E. B. Howard, A. Jenks, P. McKellar, H. M. Ami, O. Abel, H. Richards, and I. Rouse, among many others. Most of these visitors did not publish on the site, although Sellards continued to do so until his death in 1961.

Following Nelson's brief excavations, very little work was conducted at Vero until 1956–1957, when University of Florida graduate student R. Weigel initiated limited horizontal excavations with Sellards in attendance (Weigel 1962). Weigel recovered some 20,000 small amphibian, reptile, and animal bones from creek basin sediments. After Weigel's research, professional interest in the site waned, although collectors still visited the locality in search of fossils. The site continues to be mentioned in discussions of the peopling of the New World.

Interest in the site was renewed in 2008, when plans to develop a water treatment plant threatened negative impacts on a considerable portion of the site. Compliance inquiries by then State Archaeologist Ryan Wheeler and research activity by Barbara Purdy prevented the destruction of the site and generated considerable local interest that ultimately initiated new professional archaeological scrutiny. Site coring and trench examinations by Doran, Stafford, and Purdy between 2008 and 2010 indicated that although considerable disturbance had occurred, large pockets of intact sediments still existed (McFadden et al. 2012). In 2010, a citizen group called The Old Vero Ice Age Sites Committee (OVIASC) was formed to promote new research at the site. In 2012, OVIASC contracted with C. A. Hemmings and Mercyhurst Archaeological Institute (MAI) to conduct excavations and attendant analyses at the site in 2013–2014. In 2014, Harbor Branch Oceanographic Institute of Florida Atlantic University joined OVIASC and MAI as a third partner in the new ongoing Vero research.

The first season of excavation began on 6 January 2014 and ended on 30 May 2014. An 11-person team composed of trained crewpersons and highly experienced supervisory staff worked 10–12 hours per day, 6 days per week. Excavation and documentation protocols were exceedingly rigorous and precise. These protocols were initially developed during the multi-year, multi-disciplinary excavations at Meadowcroft Rockshelter (36WH297) in southwestern Pennsylvania. The excavations at that National Historic Landmark site are widely considered to be the most carefully excavated of any Paleoindian locality in the entire New World. Refined and enhanced in literally hundreds of excavations throughout the United States and seven foreign countries, the Meadowcroft-developed protocols (see below) were employed throughout both Vero excavation.

The 2015 field season began 5 January 2015 and ended 13 May 2015. Investigations have focused on further exposing and excavating the late Pleistocene bone veneer and the deeply buried 4A horizon. Although limited, a 25 cm by 25 cm portion of this stratum was excavated to a depth of 41 cm. Additionally, a 14.1 m^2 area to the west of the 2014 excavation block was excavated exposing the 0 cm surface of the 2A horizon (Stratum F5) and in three units, exposing the 0 cm floor of the Bhs horizon (Stratum F9).

Research Design

The current investigations at Vero were designed to be a multi-year, multi-disciplinary empirically oriented, research initiative. The strategic project goals include the systematic acquisition, analysis, and integration of any and all data bearing on the archaeology, history, paleoecology, geology, geomorphology, pedology, hydrology, climatology, and floral and faunal succession of the immediate project area and surrounding localities. The specific primary goals of the ongoing field investigations are: (1) detailed documentation of the site stratigraphy, (2) characterization and correlation of the stratigraphic units identified by Sellards with those exposed during the current excavations, and (3) systematic collection of all data utilizing the most precise instrumentation and techniques of which the research staff was cognizant.

The implementation of the basic research strategy, simple though it was in theory, was very complex in practice. Extensive recent and past construction events have significantly modified the landscape in the project area, and subsequently buried potentially pristine deposits. The aforementioned coring and trenching succeeded in confirming the presence of potentially intact early Holocene and late Pleistocene stratigraphic sequences at the site underlying at least 1.8 m of early 1900s canal dump and modern fill. Five specific cores emplaced immediately southwest of the confluence of the Main Drainage Canal and Canal Lateral E and northeast of Indian River County Administrative Complex were of the most interest, as they indicated the presence of at least two deeply buried superimposed paleosols that directly dated to 7060 ± 30 ^{14}C yr BP and 17,620 ± 80 ^{14}C yr BP.

The 2014 excavations were confined to a relatively small portion of the site measuring ca. 28 m east–west by ca. 16 m north–south. (Formal excavations were confined to an even smaller area measuring ca. 18 m east–west by ca. 7 m north–south.).

In order to expose the apparently intact buried paleosols, the overlying modern fill was excavated to a maximum depth of ca. 2.5 m using two Badger 1085c Cruz-Air mechanical excavators. Excavation was terminated at ca. 20–83 cm above the deposits of interest, and a 60 ft by 24 ft WeatherPort Shelter System was erected on the exposed surface to protect the formal excavation area, deposits, crew, and equipment during the course of the field investigations. The enclosed site area was equipped with lights, phone and data lines, electricity, and a security system (Figure 5). Preparing the site for the formal excavations was extraordinarily complex and time-consuming. These site preparation procedures were extensively documented and photographed with a Nikon D3 digital camera and a variety of lenses.

Figure 5. Field crew assembling the WeatherPort Shelter System over the active excavation area.

The sequence of events, processes, and specific excavation and sampling procedures involved in establishing and executing this project are too lengthy to discuss here in detail. They will, however, be exhaustively addressed in future project reports, but a summary of the excavation methodology is warranted.

After the WeatherPort and associated utilities were in place, an arbitrary 1 m interval grid system, oriented 12 degrees west of magnetic north (348º) was established within the WeatherPort interior. The physical position of the WeatherPort within the project area had been oriented parallel to the southern boundary of the Main Drainage Canal. To maximize the number of excavation units that could be established within the structure, the grid system was not oriented to magnetic north. Horizontal and vertical coordinates were reckoned with a Spectra Precision Focus 10 Total Station setup daily over a permanent bench mark (PBM) designated Datum A (5000 east, 5000 north, 2.85 m above msl). All elevations were recorded in relation to the Carter Associates Benchmark (elevation 16.64 ft, North American Vertical Datum [NAVD] 1988) located at modern ground surface, and also in relation to depth below Datum A. The interior of the WeatherPort was then extensively photographed and mapped via total station. Wooden access platforms were constructed around the interior perimeter of the WeatherPort to allow the field crew and supervisors to move around the site with minimal disturbance to the sediments.

Due to the volume of rain that can be received during the Florida rainy season, it was essential that all overburden that had been removed at the start of the 2014 season be replaced, completely refilling the active excavation area to the level of the modern ground surface. Therefore, shutting down the site for the off season proved to be nearly as complicated as the initial setup. All utilities such as phone, data, and electric were removed from the excavation. At the end of the 2014 field season all excavation units were lined with landscape fabric and carefully backfilled by hand. Additionally, the location of the WeatherPort was plotted with the total station to allow the structure to be re-established in the precise location during the 2015 field season.

Prior to backfilling the ca. 28 m east-west and 16 m north-south excavation area, orange construction fencing was laid across the hand backfilled excavation ca. 40 cm above the surface of the units. The fencing was emplaced to serve as a visual warning during mechanical backfill removal during the 2015 season for the backhoe operator to proceed with caution.

Reopening the 2014 excavations during the 2015 field season presented a new series of logistical challenges. To reopen the previous ca. 28 m east-west and 16 m north-south excavation area, utilizing total station coordinates, the crew relocated and marked the 2014 locations between which the overburden had been removed during the first year of excavation. As in 2014, removal of the overburden proceeded from east to west, but with a single Komatsu PC300 LC excavator. Crew and supervisory staff carefully monitored the removal of the overburden to prevent damage to the underlying 2014 excavation units. As the construction fence barrier was exposed the remaining overburden was removed by hand to expose the outline of the excavation as well as the support posts for the access platforms which had been left *in situ*.

Upon fully exposing the boundaries of the 2014 active excavation area, the total station cogo function was utilized to re-establish the 2014 location of the WeatherPort, which ultimately was erected within 5 cm horizontally and vertically of the 2014 location. Re-establishing the structure as close to the original location as possible was essential to reopening the remainder of the excavation. After re-establishing the access platforms within the WeatherPort interior, the grid system was re-established and the remaining backfill was removed from the 2014 excavation units. As during the 2014 season, the site area was equipped with lights, phone and data lines, electricity, and a security system.

Overall, the excavation units survived intact during the off season, although very minor damage was sustained during the mechanical removal of the overburden (Figure 6). This damage occurred primarily on the northeastern end of the excavation along the 5004.700 N meter line. The damage consisted of the partial

Figure 6. . General view of F4 (E horizon) and F5 (2A horizon) in profile along the north 5004.700 meter grid line, facing north after backfill removal. Note damage to F4 indicated with arrows.

collapse of unexcavated portions of stratum F4 (E horizon) in two excavation units and extraction of one 4x4 post for the access platform in the northeastern corner of the excavation area.

Excavation Methodology

Excavation was conducted within natural strata in 5 cm arbitrary levels, and when required, 2.5 cm arbitrary levels, again, within natural strata. The removal of all sediment was completed with masonry trowels (5.5 in and 4.5 inch) and, when warranted and/or feasible, flat bladed shovels and single-edged razor blades. Arbitrary levels within natural stratigraphy never exceeded 5 cm even when shovels were employed during the excavation of the stable overbank deposits (labeled F5 between the north 5001 m and 5004 m grid lines [see Site Stratigraphy and Dating]). Additionally, shovels were only permitted when it was determined that within the first 7 m^2, the ca. 50 cm thick stratum was completely devoid of artifactual or ecofactual material. The crew switched to trowels approximately 10–15 cm above the stratigraphic interface between this stratum and underlying stratum F9 and this entire interface was exposed entirely by hand. Shovel excavation of stratum F5 was terminated prior to the exposure of a piece of flaked stone debitage in situ on the 39 cm floor of the stratum.

Excavation proceeded by determining the vertical relationship of the excavation post-mechanical removal of the fill to the previously examined stratigraphy in the cores. This necessitated the removal of the remnant fill by hand, moving from the eastern to western end of the WeatherPort across 80 m^2 to expose a “clean” surface. These 80 units were then individually photographed and mapped prior to further excavation (Figures 7 and 8).

Visual and tactile observation of the cleaned units and a series of five 3¼ in bucket auger tests around the WeatherPort exterior suggested that paleosols identified in the cores could be easily reached on the eastern end

Figure 7. General view WeatherPort interior after mechanical removal of overburden with grid system emplaced. Active excavation area prior to “cleaning.”

Figure 8. General view WeatherPort interior with grid system emplaced. Units within the active excavation area are clean. White string demarcates areas of remnant overburden.

of the WeatherPort interior; thus, an east–west trench spanning seven grid units was opened on the southern end of the WeatherPort. The excavation proceeded by exposing stratigraphic interfaces within a 7 m by 1 m trench between the east 5009 m and west 5016 m grid lines proceeding from the southern end of the site to the northern end. As interfaces were exposed, profiles and floors were photographed and mapped. As each interface was completely exposed across the active excavation area (32.9 m^2), a series of interface photos were taken from various angles with various lenses with the grid strung and unstrung.

Strata and microstrata were defined by subjective criteria including texture, apparent composition, friability, degree of compaction and, to much more limited basis, color. Objective, quantifiable verification of the integrity of these units will be provided by chemical, grain size, and compositional analysis.

All fill from all strata was dry processed through stacked 1/8 inch and 1/16 inch screens. In order to recover materials smaller than that, a constant volume sample (CVS) of sediment was taken from the southwest corner of every arbitrary level of every stratum, unless a stratigraphic unit was not present or had been fully excavated in the southwest corner. If a CVS could not be taken, a soil sample was collected from a portion of the excavation unit where the stratum still existed. When possible, the volume of sediment collected for the soil sample was the same as the CVS. If the same volume of sediment could not be collected, the total volume available was collected and recorded. The rational for collecting these samples is two-fold: (1) artifactual and ecofactual remains that pass through the screens are captured during flotation processing, and (2) only 1,000 cm^3 of the collected sediment is processed via flotation and the remaining "split" is retained for grain size analysis, analysis of the silt clay fractions, carbonate analysis, palynological assay, geochemical composition, trace element scrutiny, microfaunal study and at the most minute level, electron microscope analysis of the digenesis of individual sand grains.

Specific geological sampling procedures employed during the excavation included the extraction of three pollen columns and one geologic column. Bulk samples of ca. 362.87 g were collected at 5 cm or 2.5

cm sampling intervals in each column. Where sediment changed composition, that is, at stratum interfaces, samples were taken on both sides of the change. The sample columns were placed to insure complete coverage of all major strata at the site within the active excavation area. Samples were also collected from the seven bucket augers extracted to the east, west, and north of the active excavation area during the course of the field season.

All notes pertaining to the excavation were recorded on five kinds of standardized MAI forms in electronic format, which were subsequently printed in duplicate. During the 2014 field season, over 1,200 pages of notes were amassed with another 1,000 added in 2015. Additionally, the excavation was extensively photo-documented prior to, during, and ending the field seasons. In all, over 6,000 photographs were taken during the course of the excavation.

Over the 124 working days at Vero, in 2014, an area measuring 32.9 m^2 was hand excavated, removing ca. 46 m^3 of sediment. In 2015 the active excavation block was expanded from 32.9 m^2 to a total of 47 m^2 over 106 work days. A subset of these units were excavated to a maximum depth of just over 4 m below modern ground surface. In total, over 3,400 samples (^{14}C, soil, CVS, pollen columns) have been collected in two seasons.

Results

Site Stratigraphy and Dating

During the course of the archaeological investigations at the Vero Man Site, 17 distinct natural strata were defined. These strata comprise four distinct soil generations. The lower two soil generations have formed in aeolian sands of late Wisconsin age while the overlying three upper soil generations are developed on late Wisconsin through Holocene age alluvium associated with Van Valkenburg Creek. The lowermost soil generation consists of a 41 cm thick, dark brown (10YR3/4) sand cumulic A horizon designated F24/F30 (4A1/4A2), which was only encountered in the deep hole excavation units (east 5013 m, north 5001 m; east 5014 m, north 5001 m; east 5014 m, north 5002 m) and in auger probe excavations lying west of the excavation area. The top of this horizon (4A1) has been dated to between 19,780 ± 70 ^{14}C yr BP and 21,840 ± 70 ^{14}C yr BP (Table 2). The F24(5A) horizon likely formed during a prolonged period of dune stability during the late Pleistocene in Florida when sea levels were as much as 120 m lower than today.

Vento and Stahlman (2011) have identified multiple, late Wisconsin age paleosols that correspond with the 3A horizon (ca. 13,000 BP) and the 4A horizons (ca. 22,000–18,000 BP) on St. Catherine's Island, Georgia. Geoarchaeological investigations in eastern Maryland from the Miles Point site, Elliot Island, Paw Paw Cove, and Oyster Bay have yielded correlative paleosols (aged ca. 25,000–12,000 BP), some of which allegedly contain in situ flaked stone artifacts (Lowery 2005, 2007, 2009; Lowery et al. 2010). At Miles Point a basal loess (Miles Point Loess) was dated 41,000–25,000 BP and is overlain conformably by a buried paleosol (Tilghman Soil) which contains diagnostic artifacts of Clovis age disconformably overlying the Tilgman soil). The Tilgman soil is dated 25,000–18,000 BP and corresponds temporally with the basal 5A horizon at Vero Beach and multiple dated deeply buried paleosols on St. Catherine's Island Georgia (Vento and Stahlman 2011). This regionally persistent paleosol documents a rather lengthy episode of stability during the Last Glacial Maximium (LGM), when the coastal barrier islands stood as high (>90 m above sea level) hills and were welded to the continent lying well inland from the shoreline.

At Elliott's Island, a presently buried peat deposits are capped by a variably thick package of terminal Wisconsin and Holocene aeolian sands. The peat has been dated to calibrated ages of 24,342 ± 305 ^{14}C yr BP and 23,946 ± 318 ^{14}C yr BP. once again during the height of the late glacial maximum (Lowery et al. 2011). At Paw Paw Cove a loess deposit (Paw Paw Loess) has buried Clovis-age lag artifacts and other

Table 2. Samples submitted to Beta Analytic and the Center for Applied Isotope Studies at the University of Georgia for radiocarbon dating.

Lab Number	Material	Provenience	Age (^{14}C yr BP)
Beta-357933	organic sediment	Core 16, 272 cm bmgs[a]	6440 ± 40
Beta-357934	organic sediment	Core 15, 198 cm bmgs	7060 ± 30
Beta-357935	organic sediment	Core 16, ca. 352.6 cm bmgs	17,620 ± 80
Beta-357936	organic sediment	Core 15, ca. 427.76 cm bmgs	5180 ± 30
Beta-362859	organic sediment	Core 15, ca. 375.5 cm bmgs	990 ± 30
Beta-362860	organic sediment	Core 15, ca. 471.5 cm bmgs	102.5 ± 0.3 pMC
Beta-362861	organic sediment	Core 14, ca. 145.0 cm bmgs	410 ± 30
Beta-362862	organic sediment	Core 14, ca. 174.5 cm bmgs	9030 ± 40
Beta-362863	organic sediment	Core 14, a. 403.5 cm bmgs	5100 ± 30
Beta-378226	organic sediment	Auger 6, 191–199 cm bmgs (A horizon)	2260 ± 30
Beta-378227	organic sediment	Auger 7, 280 cm bmgs (A horizon)	5570 ± 30
Beta-378228	organic sediment	Auger 7, 280-290 cm bmgs (A horizon)	7010 ± 30
Beta-378229	organic sediment	Auger 7, 380-394 cm bmgs (A horizon)	21,840 ± 70
Beta-378230	organic sediment	5015R5000, F 5, 0.5–5 cm	4240 ± 30
Beta-378231	organic sediment	5015R5000, F 5, 50–55 cm	9620 ± 40
Beta-378232	organic sediment	5015R5002, F 9, 0 cm floor	7780 ± 30
Beta-378233	organic sediment	5009R5002, F 9, 0 cm floor	7990 ± 30
Beta-383037	organic sediment	5014R5001, F 24,0–1 cm (A horizon)	19,880 ± 70
Beta-383038	organic sediment	5013R5001, F 24, 0–3 cm (A horizon)	19,780 ± 70
Beta-395402	organic sediment	5014R5001, F17, 12.5–15 cm (A horizon)	12,120 ± 40
UGAMS-A22336	charcoal	5014R5003, F9,7.5-10 cm (Bhs horizon)	15,988 ± 49
UGAMS-A22337	charcoal	5009R5001, F9, 22.5-25 cm (Bhs horizon)	16,902 ± 52
UGAMS-A22338	charcoal	5010R5002, F18, 0 cm floor (Bhs horizon)	14,749 ± 47
UGAMS-A22339	charcoal	5013R5002, F19, 0-5 cm (C horizon)	5212 ± 32
UGAMS-A22340	organic sediment	5008R5003, F5, 25-27.5 cm (A horizon)	9132 ± 37
UGAMS-A22341	organic sediment	5014R5002, F24, 40-41 cm/F30, 0 cm floor (4A Horizon)	21,897 ± 37
Note: (a) bmgs = below modern ground surface.			

artifacts older than 132,000 BP. This loess deposit resulted from reworking and subsequent deposition of non-glacial upland sediments that filled the valley bottom of the lower Susquehanna River ca 12,700–11,500 BP (Lowery 1989, 2002, 2005; Wah 2003).

The 4A horizon was then overlain disconformably by a ca. 40–45 cm thick white aeolian sand 3C horizon (designated Strata F18, F19, F20, F21, F22 and F23) that was likely emplaced during drier climatic conditions which promoted aeolian deflation and deposition. The 3C horizon consists of a very fine (0.125–0.063 mm), well-sorted white aeolian sand which lacks any heavy mineral component. Relict root rhizomes from the overlying 3A horizon extend into the 3C horizon and are in-filled with Fe and Mn oxides. The 3C horizon was then disconformably overlain by a significantly coarse grained (gravelly sand to coarse sand), dark brown (10YR3/3), dense, sand cumulic A horizon (3A [designated F17). This horizon has been dated to 12,120 ± 40 ^{14}C yr BP.

Given its stratigraphic positon, the 3A horizon likely corresponds with the warmer and moister Boelling-Allerod interval (ca. 15,000–13000 BP) and documents wetter conditions concomitant with increased overbank deposition and active later channel migration of the creek. This same horizon has been identified in buried contexts along the eroding Silver Bluff Island Core along the north shore of the St. Catherine's Island (Vento and Stahlman 2011). The 3A horizon is the earliest evidence of sediment deposition from Van Valkenburg Creek. The 3A horizon was then overlain by a thin white sand 2C horizon. The 2C horizon was the single autogenic event during Younger Dryas times that terminated the stable conditions and organic activity that allowed for the development of the cumulic A horizon designated as the 3A horizon. Unlike the persistent and horizontally continuous 2A (F5) horizon, the 3A (F17) horizon is discontinuous and is primarily situated on what would have been the relict levee zone of Van Valkenburg Creek.

The 2C horizon was then conformably overlain by a 12.5–22.5 cm thick, reddish brown iron-rich sand, strongly mottled in its lower part, spodic B horizon which has been emplaced by slow vertical accretion from Van Valkenburg Creek. As detailed below, this horizon is associated with burned bone and several identified faunal elements of Pleistocene age. The 2Bhs horizon contains abundant redoximorphic features created both from a fluctuating ground water table (illuviation from the overlying organic rich F5 [2A] horizon) and from bioturbation. As one proceeds north or toward the main line canal, the 2Bhs horizon becomes white in color (2E) and reflects intensive eluviation of the B horizon where the overlying 2A (F5) horizon is significantly more organic rich. The 2Bhs and 2E horizons are time equivalent and likely span the period between the end of the Boelling-Allerod and the initiation of hydric soil development associated with the Holocene transgression at 8,000 yrs. B.P. (Figure 9).

The 2Bhs and 2E horizons are then overlain in the western portion of the site by a thick, 2A1, 2A2 and 2A3 horizon (F5) which documents a long period of very slow overbank deposition and floodplain stability along Van Valkenburg Creek (Figure 10). The F5 (2A package) horizon ranges from a histic epipedon

Figure 9. Figure 9. General view end of field season F 4, F 5 in profile along the 5016 E meter line facing east. F 9, F 17, F 19, F 20, F 22, F 23, F 24 in profile along the 5015 E meter line facing east.

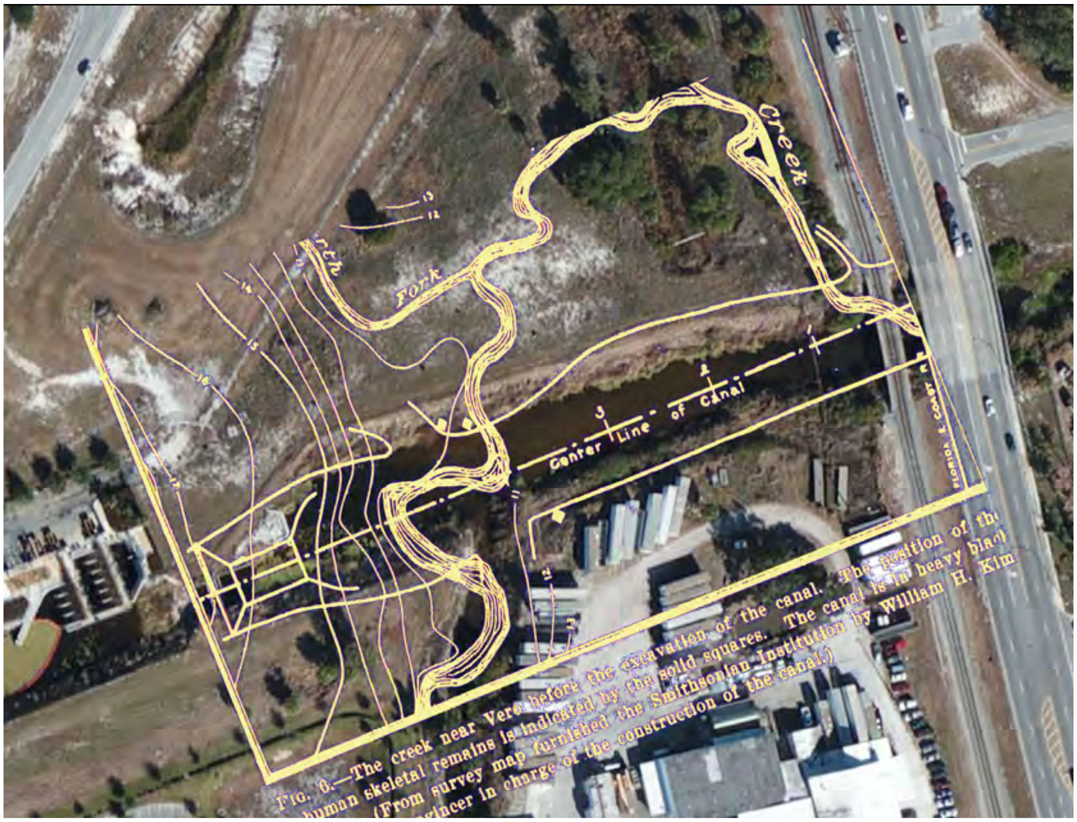

Figure 10. Figure 10. Overlay of Hrdlička's Vero map on modern aerial Orthophotography. Note the location of the Van Valkenburg Creek channel in relation to the main canal, the Lateral E canal, and the excavation block (shown in red).

(northern portion of block excavation) with more than 25 percent organic matter to an ochric less hydric epipedon to the east and southern portions of the excavated block. The F5 (2A) horizon likely began to form when water table conditions related to rising sea levels allowed for ponding along the stream valley. A radiocarbon date of 9620 ± 40 ^{14}C yr BP from the base of F5 (2A3) supports the beginning of ponding and wetland conditions.

In the extreme eastern portion of the block excavation closer to the once active channel of Van Valkenburg Creek, the 2A horizon is presently disconformably overlain by a 1 m thick package of late Holocene age over bank deposits. Along most of the exposed east wall profile the 2A horizon has been removed by flood scouring. The soil profile present in the eastern portion of the block excavation is not present to the west or toward the distal margin of the floodplain where it once abutted the lower slope of the dune. The soil profile along the east wall consisted of a thin, organic-rich A horizon which was overlain by canal fill. The A horizon was underlain by a 5–10 cm thick, grayish white eluviated E horizon. The E horizon was then underlain by a 10–20 cm thick reddish brown medium to fine sand A/AC horizon which in turn was underlain by a 40 cm thick C horizon which as note above has incised and removed a portion of the 2A horizon along the eastern portion of the site. The hydric conditions observed in the soil profiles persisted until approximately 2000 BP, when the surface of the floodplain bordering Van Valkenburg Creek was buried by a thick (greater than 50 cm) white to grayish white well sorted sand horizon (designated C1). The C1 sand horizon was likely emplaced by slopewash from the dune sediments to the west as well as by Aeolian deposition. The C1 horizon was then overlain by a dark brown (10YR3/3) organic rich, truncated

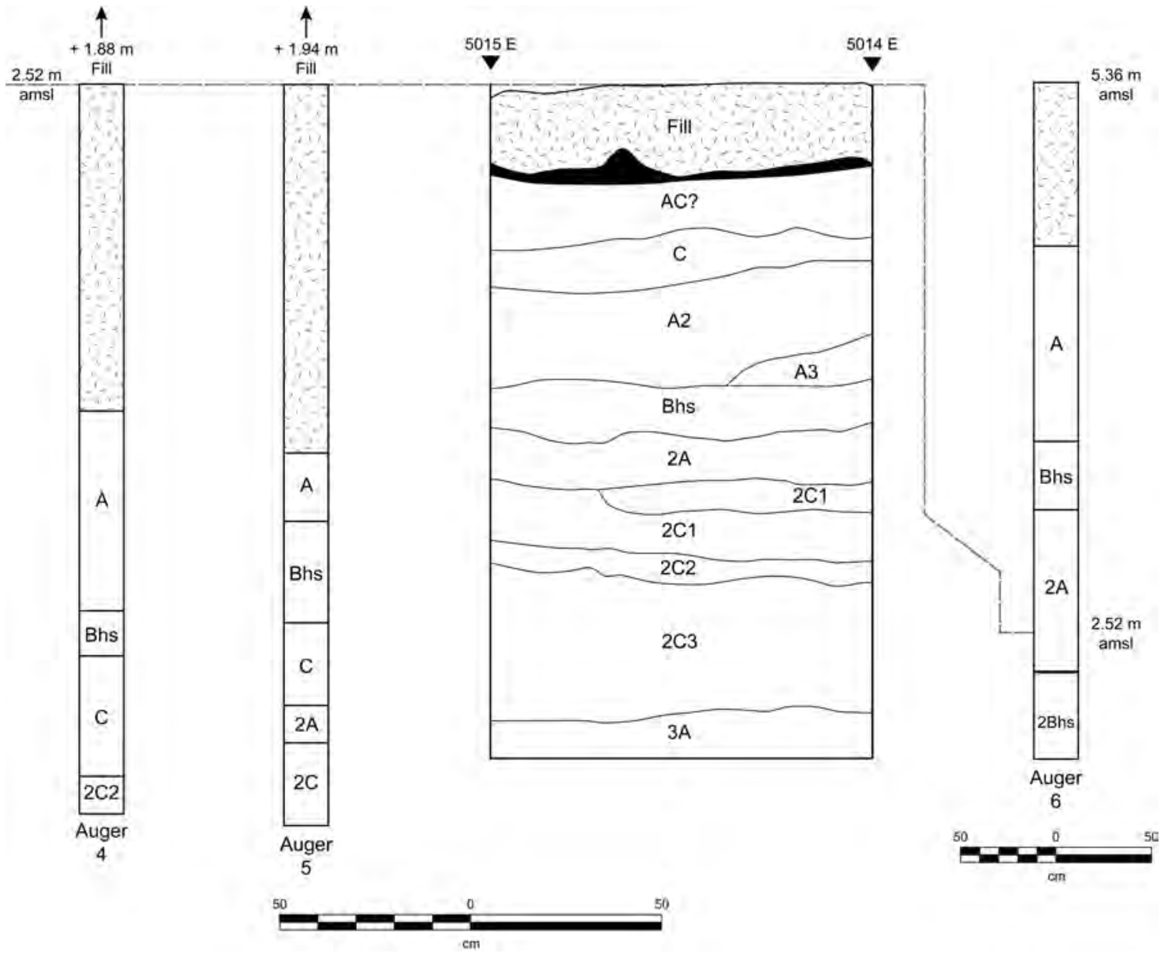

Figure 11. Stratigraphic cross sections of the project area.

cumulic A horizon which documents the ground surface prior to the emplacement of the 2.5 m thick package of canal fill deposited during construction of the main canal and the Lateral E canal. (Figure 11).

Summary of Cultural Features

No circumscribed cultural features such as pits of known function (e.g., fire, storage, trash) were encountered during the 2014 excavations. However, as noted in Site Stratigraphy and Dating (see above), an apron of dispersed burnt/calcified bone and charcoal was exposed on the surface and within depositional unit F9, F17, andF18 (Figure 12). This phenomenon may well be a downslope occupation surface and/or trash accumulation area, though it is presently devoid of definitive archaeological material. At present, several non-cultural items of interest have been recovered from Stratum F19. Within the 0–5 and 5–10 cm levels, two fragments of unmodified wood of unknown origin were exposed. One fragment was removed at the end of the 2015 field season, while the other, which extended into a profile, was left *in situ.* Additionally, the 5–10 cm arbitrary level in F19 yielded one apparent shark tooth, an item so fragile, that it did not remain intact after excavation.

Excavated Material

Lithic Artifacts

During the course of the 2014 and 2015 excavations, more than 800 diminutive flakes (average length >15 mm) have been recovered from the intact Holocene sediment package and/or disturbed overburden. The

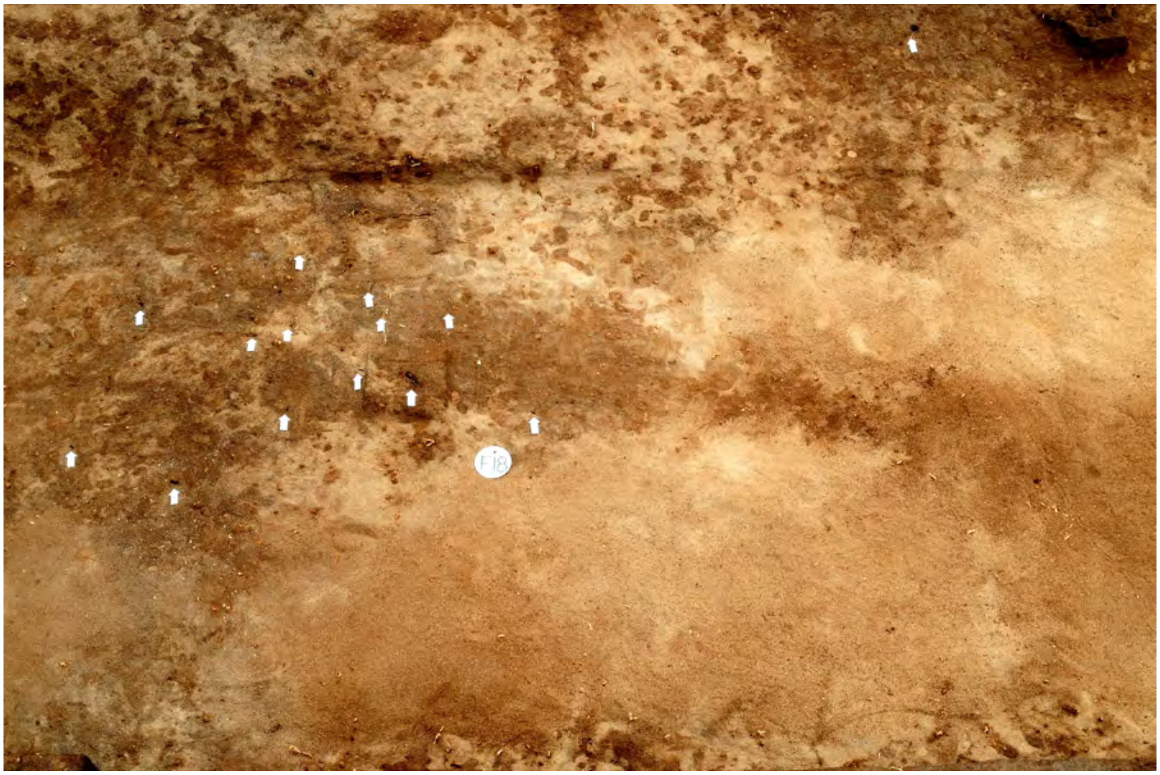

Figure 12. General view F18, 0 cm floor in 5010R5001. Arrows indicate in situ charcoal and thermally altered bone fragments.

vast majority of these have lipped edge platforms from removal off the margins of bifacial tools or points. A minimum of four different types of raw material were represented, including Ocala chert, Brooksville chert, Tampa fossil coral, and Tampa agatized coral. All of these raw materials are exotic to the Vero locality. The nearest known occurrences of these materials are 130, 150, 115, and 115, miles from Vero, respectively.

The 2014 excavations yielded two projectile points of apparent late Early Archaic age (perhaps Kirk Stemmed and Kirk Serrated) from the disturbed overburden (Figure 13) and an undisturbed flake from the 39 cm surface of overbank deposit 2A horizon (Stratum F5). All of these specimens are, like the small flakes, made of non-local material from at least 115 miles away. In 2015 a single heavily reworked projectile point was recovered from the 10–15 cm level of the E horizon (Stratum F4). Although difficult to definitively identify, the point is most similar to Westo projectile points which date to the Middle to Late Archaic elsewhere in Florida.

Perishable Material

One item of particular interest, found in 2015, is thought to be a carbonized plant fiber-derived segment of string. (Figure 14). This item appears to consist of multiple plys of very fine elements of an indeterminate plant species. It was exposed in situ on the 24.5 cm floor of F5 and was removed *en bloc*. This specimen will be excavated, exposed, photographed, and conserved in the R. L Andrews Center for Perishable Analysis at Mercyhurst University. Whatever the raw material source, the specimen is definitely anthropogenic in origin. Significantly, one new date (Sample ID 2015-SS-01, UGAMS 22340) is derived from directly below the recovered cordage specimen and indicates that the cordage construction is maximally ca. 9,000 calibrated years old. This age estimate is consistent with the age of similar materials from the Windover Bog.

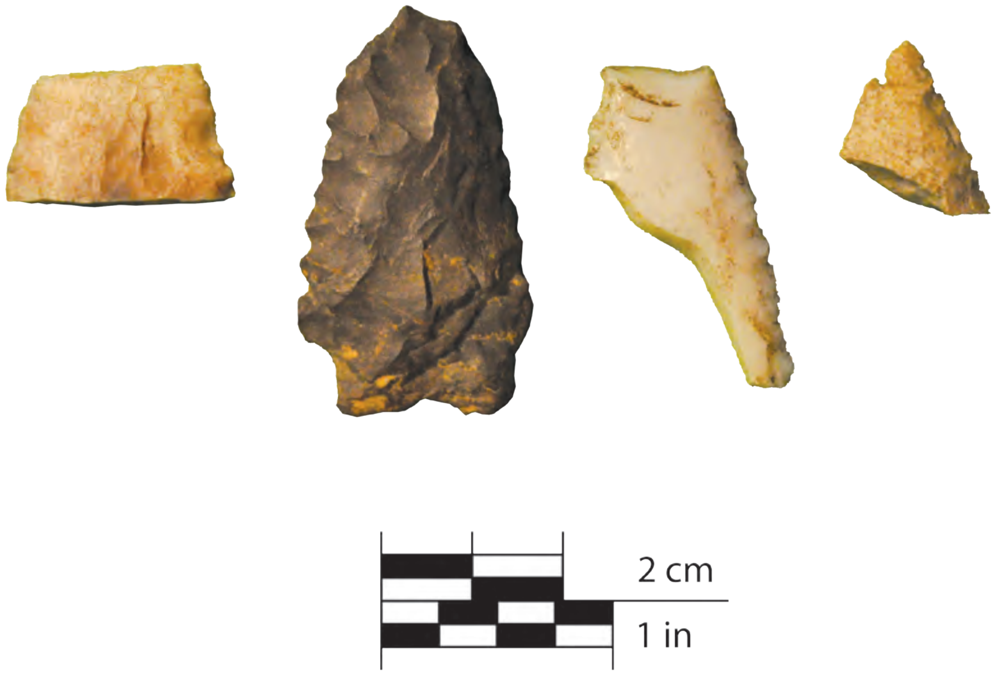

Figure 13. Projectile points recovered from the screened overburden.

Ceramic Artifacts

To date, a total of eight as yet unanalyzed ceramic sherds have been recovered from the disturbed overburden. Among these specimens is one rim sherd. Sellards noted that pottery was common in stratum no. 3 indicating "One hundred or more pieces of broken pottery have been taken from this formation" (Sellards 1917:247).

Faunal Remains

During the 2014 field season a total of 979 macro and micro faunal remains were recovered from the 1/8 inch and 1/16 inch screens. Although these items were recovered from the disturbed overburden, a nearly complete tibia from the extinct genus *Palaeolama* was recovered. This is the largest bone found thus far and is an encouraging indicator that larger items, while displaced, can remain intact despite a century of movement. Further, the specimen was filled with identifiable brown sand probably from Sellards S2 Melbourne layer. This taxon is common at Vero but is nearly unheard of at Paleoindian sites anywhere. Several well preserved *Palaeolama* teeth have been recovered at Vero and in the Aucilla that will soon be part of the ongoing aDNA research.

Twenty one bone fragments were recovered from the surface of spodic B horizon, F9, and underlying F18 in 2014. At least another 17 bone fragments were recovered in 2015. As noted above, these are thermally altered (Figure 15). Two of the pieces have been tentatively identified. One is a lower M1 from a dire wolf (*Canis dirus*) and the other a large molar of an equid (*Equus* sp.)

Floral Remains

A total of 68 CVS samples collected during the 2014 have been processed, and casual scrutiny indicates that both carbonized and uncarbonized floral remains are present. The samples will be more thoroughly examined and recovered specimens will be identified in the near future.

Figure 14. In situ perishable material exposed in 5008R5003 on the F5, 24.5 cm floor.

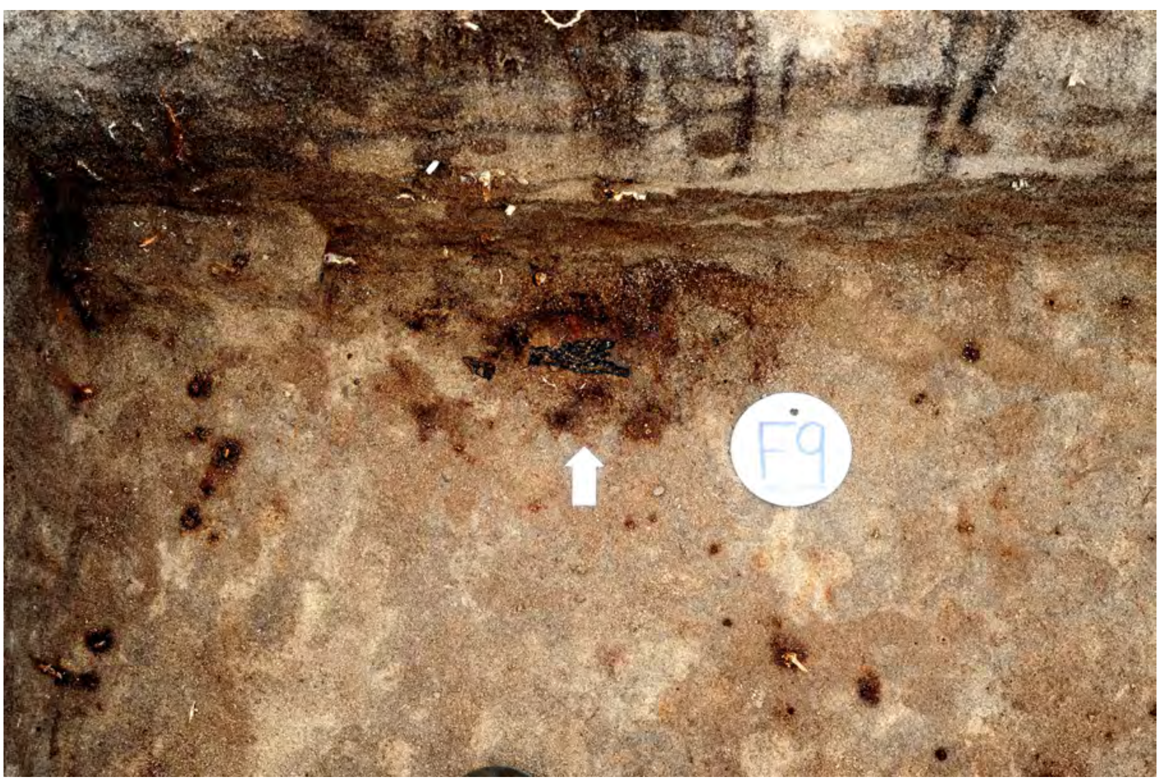

Figure 15. General view F9, 17.5 cm floor in 5010R5001. Arrow indicates in situ thermally altered bone.

Four pieces of charcoal recovered from strata F9, F18, and F19 recovered in both 2014 and 2015 were identified and subsequently submitted for AMS dating at the Center for Applied Isotope Studies at the University of Georgia. The charcoal specimens were identified by Mercyhurst University biologist Dr. J. Michael Campbell, who examined each specimen utilizing a variable power stereoscopic microscope equipped with a digital camera. Each specimen was rotated with forceps so that radial and cross-sectional views could be scrutinized and photographed. Anatomical details were compared to photographs of wood and charcoal in Alden (2009) and Ferchaud (2008) to determine likely identity of the specimens. Taxonomic keys for softwood and hardwood based upon xylem tissues and other structures of wood visible in charcoal in Alden (2009) were used to confirm identifications based upon simple visual comparison. The inventory of plants and plant fossils documented to occur at the Vero site published in Berry (1917) was used to refine sample classification to the level of genus (Table 3). Identified specimens have been allocated to the genera *Quercus* (oak), *Pinus* (pine) and *Taxodium* (likely bald cypress). The prehistoric presence of each of these has been previously documented at the Vero locality (Berry 1917; Weigel 1962).

Overview

Though incompletely analyzed at present, the results of 2014 and 2015 excavations minimally include the following:

1. A detailed reconstruction of the depositional history of the site which redefined the stratigraphic sequence;
2. The equation of the observed stratigraphy with the units recognized by Sellards and Chamberlin (Chamberlin 1917), specifically, the correlation of F5 from 2014 as Sellards's Van Valkenburg and F9/F18, F10/15? as Sellards's Melbourne;
3. The implementation of trenching and augering project designed to identify ancient buried paleosols;
4. The identification and delineation of at least three such horizons (F5, F17, F24, and F30);
5. The initiation of a broad-based radiocarbon dating project which produced multiple and generally internally consistent ages for the stratigraphic units identified; and
6. The collection of a limited suite of artifactual material of early Holocene age and non-local origin and most importantly, the identification and partial exposure of a thermally altered, undisturbed bone veneer which strongly suggests a human presence at about 14,000–11,100 cal yr BP. Moreover, as this veneer or apron contains extinct late Pleistocene species, it indicates the contemporaneity of humans with extinct fauna at this locality.

In short, the 2014 and 2015 projects were able to resolve most of the dating conundrum which has plagued the Vero locality since its earliest excavations as well as to thereby demonstrate that Sellards's claims of a contemporaneous human and late Pleistocene animal presence were, indeed, correct. We stress that the 2014 and 2015 research did *not* resolve the provenience of *any* of the previously recovered human remains from the site nor did it positively equate any of these remains with Pleistocene fauna. Finally, during 2014 and 2015, concerted efforts have been made to relocate all of the previously excavated Vero site materials and to systematically inventory and analyze these collections.

Whenever the multiyear Vero project is ultimately completed, we confidently expect, at the very least, to be able, ultimately, to etch in much sharper relief, the inter-relationship of human, animal and plant populations upon this once highly controversial part of the ancient Florida landscape.

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References Cited

Alden, H.

2009 *Wood and Charcoal Identification in Southern Maryland. Maryland Archaeological Conservation Lab*, last updated December 30, 2012. Electronic document available at http://www.jefpat.org/wood&charcoalidentification//wood&charcoal_part2.htm.

Berry, E. W.

1917 The Fossil Plants from Vero, Florida. *The Journal of Geology* 25(7):661–666.

Chamberlin, Rollin T.

1917a Interpretation of the Formations Containing Human Bones at Vero, Florida. *The Journal of Geology* 25(1):25–39.

Ferchaud, V.

2008 *A Closer View in the Inside of Trees*. Presentation by Urban Forestry Ph.D. Candidate, Southern University A&M College, Baton Rouge, Louisiana 70813, May 17, 2008. Electronic document available at http://dscej.org/images/stories/pdfs/closer_view.pdf.

Fort Pierce News

1915 State Geologist Studies Fossils Found Here. 19 February 1915. Fort Pierce, Florida.

1916 State Geologist Finds First Fossilized Human Bone at Vero. 18 February 1916. Fort Pierce, Florida.

Helseth, Dr. Inga Olla

1953 The Helseths. In *Stories of Early Life along Beautiful Indian River*, by Anna Pearl Leonard Newman, pp. 49–51. Stuart Daily News, Stuart, Florida.

Indian River Farmer

1914 What They are Doing at Vero. November 5, 1914.

Lowery, D. L.,

1989 The Paw Paw Cove Paleoindian site complex, Talbot County, Maryland. *Archaeology of Eastern North America* 17:143–163.

2002 *A Time of Dust: Archaeological and Geomorphological Investigations at the Paw Paw Cove Paleo-Indian Site Complex in Talbot County, Maryland*. Maryland Historical Trust, Crownsville, Maryland, 224 pp.

2005 *Archaeological Survey of the Fishing Bay and the Fairmount Wildlife Management Areas within Dorchester and Somerset County, Maryland*. Monograph on file at the Maryland Historical Trust, Crownsville, Maryland.

2007 *Phase I Archaeological Survey of Miles Point in Talbot County, Maryland*. Maryland Historical Trust, Crownsville, Maryland.

2009 *Geoarchaeological Investigations at Selected Coastal Archaeological Sites along the Delmarva Peninsula*. Unpublished Ph.D. dissertation, Department of Geology, University of Delaware, Newark.

Lowery, D. L., M. A. O'Neal, J. S. Wah, D. P. Wagner, and D. J. Stanford

2010 Late Pleistocene Upland Stratigraphy of the Western Delmarva Peninsula, USA. *Quaternary Science Reviews* 29:1472–1480.

Lowery, D. L., J. Wah, and R. Torben

2011 Post–Last Glacial Maximum Dune Sequence for the "Parsonburg" Formation at Elliott's Island, Maryland. *Current Research in the Pleistocene* 28:103.

McFadden, Bruce, J., Barbara A. Purdy, Krista Church, and Thomas W. Stafford Jr.

2012 Humans were Contemporaneous with Late Pleistocene Mammals in Florida: Evidence from Rare Earth Elemental Analyses. *Journal of Vertebrate Paleontology* 32(3):708–716.

Nelson, Nels C.

1918 Chronology in Florida. Anthropological Papers of the American Museum of Natural History 22(2):75–103.

Newman, Anna Pearl Leonard (editor)

1953 *Stories of Early Life along Beautiful Indian River.* Stuart Daily News, Stuart, Florida.

Rogers, J. C., and R. V. Rohli

1991 Florida Citrus Freezes and Polar Anticyclones in the Great Plains. *Journal of Climate* 4:1103–1113.

Rolhi, R. V., and J. C. Rogers

1993 Atmospheric Teleconnections and Citrus Freezes in the Southern United States. *Physical Geog*raphy 14(1):1–15.

Sellards, Elias H.

1907–1919 Field Notebooks. Manuscript on file, Florida Geological Survey Library, Tallahassee, Florida.

1915 The Pebble Phosphates of Florida. Seventh Annual Report, pp. 25–116. Florida Geological Survey, Tallahassee.

1916a On the Discovery of Fossil Human Remains in Florida in Association with Extinct Vertebrates. *The American Journal of Science*, Fourth Series, Vol. XLII, No. 247 (July 1916), pp. 1–18.

1916b Human Remains and Associated Fossils from the Pleistocene of Florida. Eighth Annual Report, pp. 121–160. Florida State Geological Survey, Tallahassee.

1917a Further Notes on Human Remains from Vero, Florida. *American Anthropologist* 19(2):239–251.

1917b Review of the Evidence On Which the Human Remains Found at Vero Are Referred To the Pleistocene. Ninth Annual Report, pp. 69–84. Florida State Geological Survey, Tallahassee.

1919 Literature Relating to Human Remains and Artifacts at Vero, Florida. Florida State Geological Survey. Twelfth Annual Report, pp. 1–4. Florida Geological Survey, Tallahassee.

St. Lucie Tribune

1913 Fossil Remains in Florida. February 21, 1913. St. Lucie, Florida.

The Journal of Geology

1917 Symposium on the Age and Relations of the Fossil Human Remains Found at Vero, Florida. *The Journal of Geology* 25(1):1–3.

Vega, A. J., and M. S. Binkley,

1994. Origins of Tropical Cyclones Striking the U.S. Mainland, 1960–1989, *National Weather Digest* 19(1):14–26.

Vento, Frank J., and Patty A. Stahlman
2011 Development of a Late Pleistocene-Holocene Genetic Stratigraphy Framework for St. Catherines Island: Archaeological Implications. In *Geoarchaeology of St. Catherines Island, Georgia*, edited by Gale A. Bishop, Harold B. Rollins, and David Hurst Thomas, pp. 99–112. Anthropological Papers No. 94, American Museum of Natural History, New York.

Wah, J. S.
2003 *The Origin and Pedogenic History of Quaternary Silts on the Delmarva Peninsula in Maryland*. Unpublished Ph.D. dissertation, Department of Environmental Science and Technology, University of Maryland, College Park.

Weigel, Robert D.
1962 *Fossil Vertebrates of Vero, Florida*. Special Publication No. 10. Florida Geological Survey, Tallahassee.

Wettstein, Carol A., Chris V. Noble, and James D. Slabaugh
1986 *Soil Survey of Indian River County, Florida. Soil Conservation Service, Florida. Dept. of Agriculture and Consumer Services, University of Florida*. Agricultural Experiment Station, University of Florida. Institute of Food and Agricultural Sciences, University of Florida.