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OPEN FILE REPORT 67

TOPOGRAPHIC MAPS: USEFUL TOOLS FOR THE FLORIDA FOSSIL HUNTER

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FLORIDA GEOLOGICAL SURVEY

Tallahassee
1995

Topographic Maps

Useful tools for the Florida fossil hunter

by Frank R. Rupert, P.G. 149

*Maps are important tools to anyone working in the field, especially in unfamiliar terrain. One of the more useful maps for the avocational and professional paleontologist alike is the **topographic map**. Topographic maps have many applications in Florida. In this article we will examine some topographic map basics and discuss their use by fossil hunters.*

A topographic map is a map illustrating the topography or shape of the land surface. Topographic maps show the locations and form of hills, valleys, streams, and other features as well as many man-made landmarks. They illustrate the shape and elevation of surface features by the use of ***contour lines***. Contour lines are imaginary lines (they exist on paper only) which connect points of equal elevation on the earth's surface. They provide a means of displaying three-dimensional information on a two-dimensional sheet of paper. The vertical difference in elevation between adjacent contour lines is called the ***contour interval***.

Consider the illustration in Figure 1. As shown in the upper portion, this figure illustrates a section of hilly coastline bisected by a flat stream valley, and featuring a flat, sandy spit enclosing a small bay. If we were to go to this site and actually paint horizontal lines of equal elevation on the hills and valley floor at each 20 feet interval above sea level in elevation, then look down on the scene from above, we would see a view similar to the map in the lower part of the figure. The lower portion of Figure 1 is a topographic map of this section of coast. Notice several things about the map in this figure which hold true of all topographic maps:

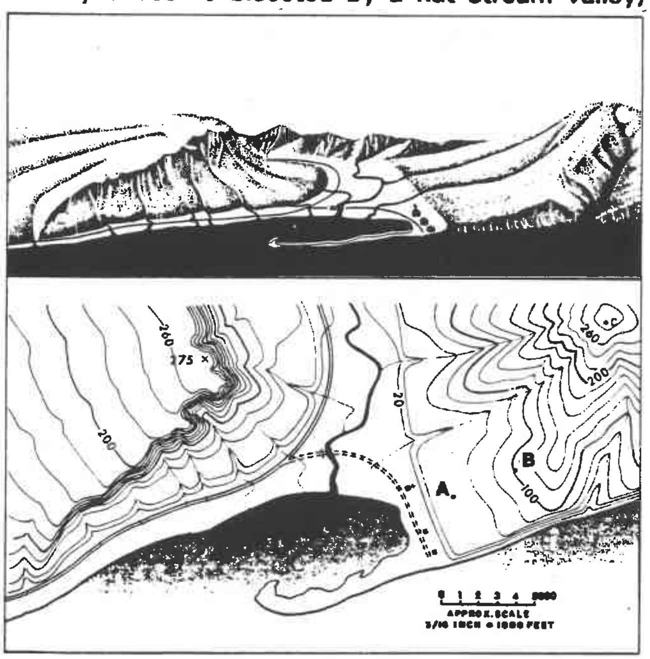

Figure 1. Perspective view and topographic map of a section of hilly coastline (Yon, 1972).

1) Contour lines appear closely packed together on the steep bluff face on the left. In the flat valley and on the gently-sloping hill top above the bluff, they are widely-spaced. This is because on steep slopes elevation increases occur with greater frequency per unit of horizontal map distance and thus appear closer together. To visualize this, imagine a yardstick with the inch markings representing short, parallel contour lines; looking straight down at a yardstick lying flat on the ground, the inch marks appear spaced uniformly at 1 inch apart. Now slowly lift one end of the yardstick to form an imaginary slope face while still looking down at it and watch the inch marks appear to move closer together as you increase the slope of the stick.

2) The land slope, or the ratio of vertical to horizontal distance, may be determined from topographic maps. Slope is usually expressed as a ratio (ie: 1:100) or as a percent (1 percent). The slope between points A and B on Figure 1, for example may be calculated by dividing the elevation increase (vertical distance) from A to B by the horizontal distance between the points. In this case the vertical distance is the elevation at B (100 feet) minus the elevation at A (about 50 feet, as it is halfway between the 40 and 60 feet contour lines), which equals 50 feet. The horizontal distance between A and B is measured from the map bar scale at the bottom of the map, and is approximately 3500 feet. Therefore, the slope is 50/3500 or 1:70, or .014 (1.4 percent).

3) Contour lines do not intersect, cross, or branch. They may touch or coincide only on very steep

slopes (and this is commonly due to the thickness of the printed contour lines - only on vertical slopes would the lines truly coincide).

4) Contour lines form a "V" pointing upstream (or up-gradient) in stream valleys or drainage rivulets. In closely spaced stream valleys, such as those shown on the hill on the right in Figure 1, a series of "W" shapes may result; the stream valley "V's" point towards the top of the hill, the down slope-pointed "V's" are the intervening noses of higher ground between streams.

5) The contour interval is constant on any map. Every fourth or fifth contour line is labeled with their elevation for reference; on actual topographic maps, the contour lines representing every 50 feet of elevation are commonly labeled, while those in between are not. Spot elevations are sometimes shown for specific points on the map. All elevations are relative to mean sea level, which is taken to be "0" foot elevation.

6) Wide rivers and streams are defined by parallel lines approximating their mean width; narrow streams and creeks are shown with single blue lines; coastlines and lake shores are shown with a single unlabeled line.

7) Local man made structures, including buildings, roads, and bridges are commonly shown. Some of these symbols are shown in Figure 2.

On actual topographic maps, many of the different features are delineated in color; contours lines are brown, water is blue, roads are printed in red or black, and structures are printed in black. Cities and other large areas of manmade disturbance are usually printed in either purple or gray shading. Areas of vegetation are shaded green. The maps illustrated on the following pages of this article are, by necessity, printed in black and white. Some of the inherent "readability" is therefore lost.

Topographic maps are prepared today largely from composite aerial photographs, with field checking where needed, and provide some of the most accurate local detail available. Therefore they are a useful tool for locating possible new sites, planning fossil-hunting expeditions, and as references in accurately documenting the location of known fossil sites. Topographic maps can be especially useful in locating areas where fossiliferous strata may be exposed, either naturally by stream erosion and karst activity, or by man's excavations.

Topographic maps in Florida

The entire state of Florida has been mapped by the U.S. Geological Survey in 7.5 minute topographic quadrangles. These maps are termed *seven and a half minute quadrangles* because each map covers a rectangular area of land surface equal to 7.5 minutes of longitude in width (about 7.5 miles) and 7.5 minutes of latitude in height (8.5 miles). Latitude and longitude tick marks are provided along the margins of topographic maps. One thousand and thirty seven 7.5 minute quadrangles are required to cover the entire state. The actual paper quadrangle maps are about 23 inches wide by 27 inches high. This size allows a standard scale for the map of 1:24,000 (one unit of map distance in inches, feet, or millimeters, etc., equals 24,000 of the same units on the surface of the earth). The fractional scale and a bar scale of distance is part of the information printed at the bottom of the map. The direction of true north is always towards the top of the map. Magnetic north, which may be a few degrees east or west of true north, is also indicated on the map.

Earlier topographic maps, generally dating from prior to 1940, were based on 15 minute quadrangles. These covered an area equivalent to four of the 7.5 minute maps, and had a scale of 1:62,500. The larger, modern 7.5 minute maps generally provide better detail, although the older maps can often be used to document historical changes in land features or urban sprawl.

Today, each topographic quadrangle map is given a specific name, usually based on some local geographic feature (i.e., Tallahassee Quadrangle, Okeechobee NW Quadrangle, etc.). Certain of the maps, especially those in highly-populated areas, are updated every several years to show the expansion of civilization. Others in more remote locations may not have been updated since the original mapping in the 1940s. A handy index (see Figure 3) showing the locations and names of all 1,037 quadrangle maps covering the state is printed by the United States Geological Survey.

Some practical examples of topographic map usage for the fossil hunter

In some regions of Florida, topographic maps may prove extremely useful to the avocational paleontologist in search of fossiliferous exposures. They are an aid in locating mines, quarries, sinks and incised streams, all features which might expose otherwise buried fossiliferous strata. Topographic maps may also serve to document the location of sites to revisit. Following are examples of topographic maps from several different areas of

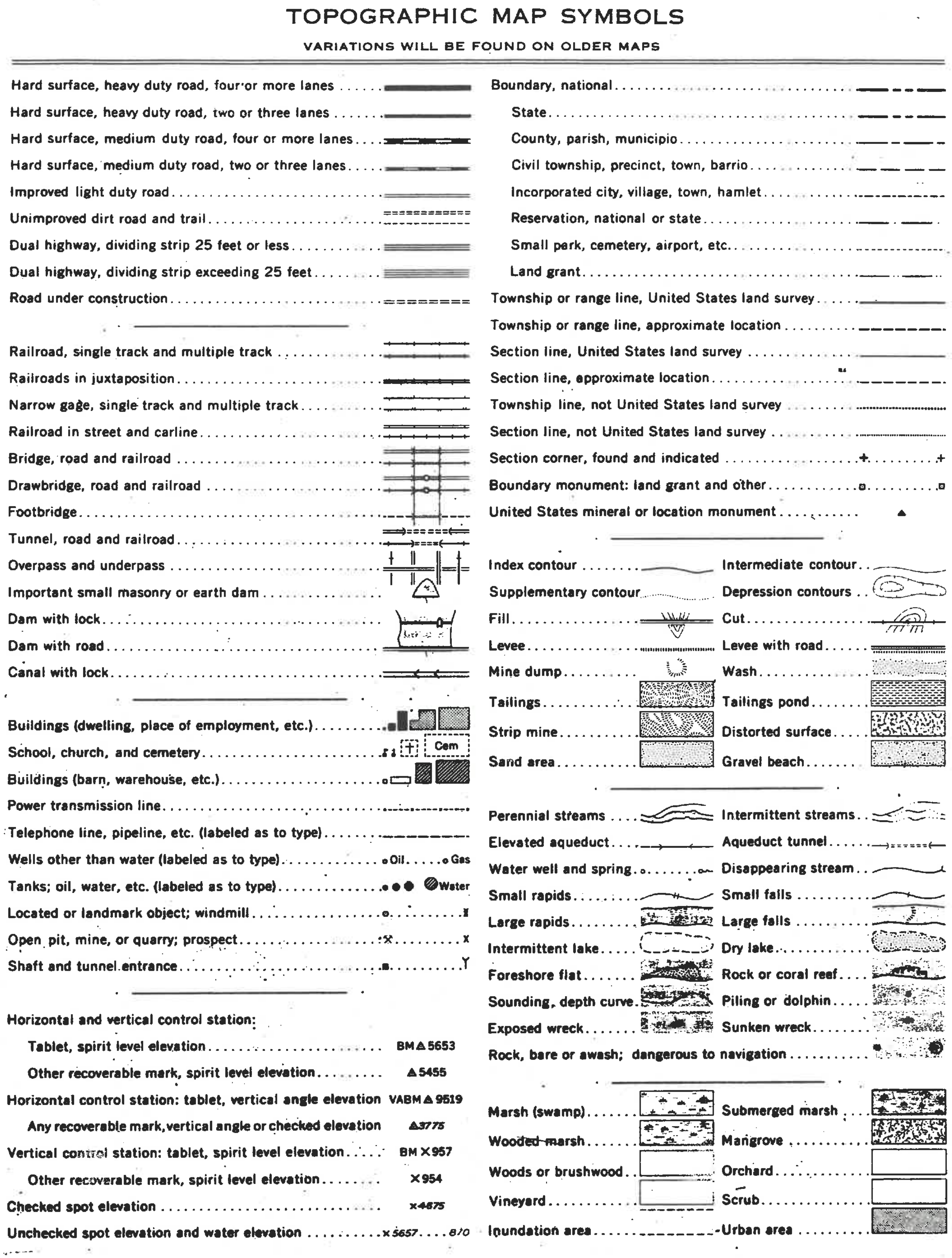

Figure 2. Some topographic map symbols

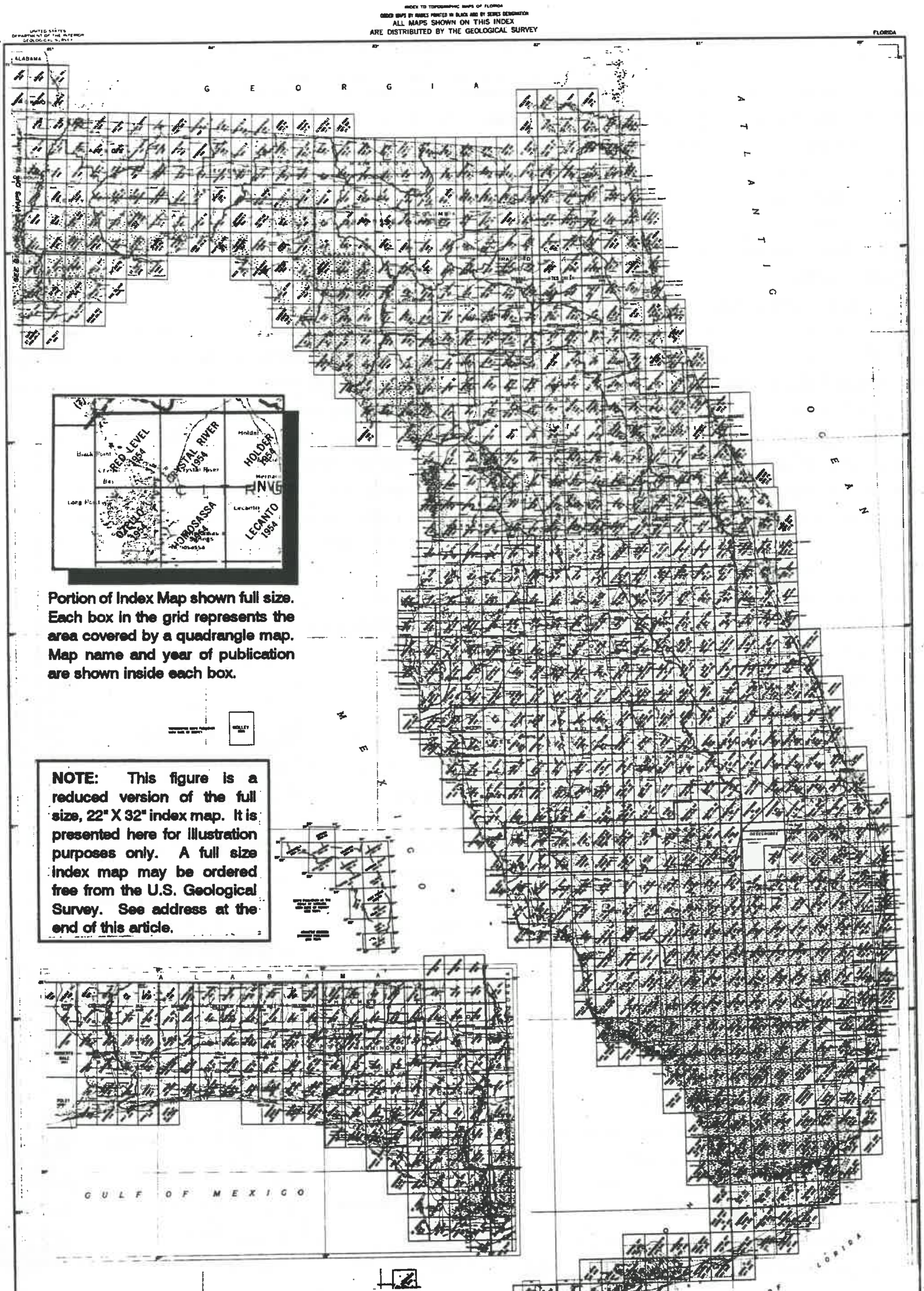

Figure 3. Topographic map coverage for Florida.

Florida. We will discuss these maps and the information they contain for the fossil hunter. Hopefully, the reader can apply some of these ideas to his or her own unique collecting areas.

Alum Bluff - *Florida's classic geologic exposure:*

Alum Bluff is a 120 feet high bluff on the east bank of the Apalachicola River, about two and a half miles north of Bristol in Liberty County. The actively-eroding bluff was cut by the eastward advance of the river, and exposes Middle Miocene to Recent sediments. It is by far the most spectacular geologic exposure in Florida, and the area is also treasured by botanists for its unique living plant communities. The bluff and associated land is presently owned and managed by the Nature Conservancy.

Alum Bluff is illustrated on the Bristol topographic quadrangle map (see Figure 4). Its steepness is readily apparent by the very closely spaced, 10-foot contour lines which represent the bluff face. On this map, the contour lines representing multiples of 50 feet of elevation are thicker in width and selected lines are labeled with the appropriate elevation. The finer lines between labeled lines represent successive 10-foot elevation lines. As an example, the second fine contour line above the 50 feet line would represent 70 feet in elevation.

Alum Bluff rises from the edge of the river, which lies at approximately 50 feet above mean sea level (MSL), to 170 feet above MSL at its crest. The land surface plateau above the bluff is rolling, sandy terrain reaching a maximum elevation of nearly 200 feet above MSL. Note the 195 feet spot elevation, just southeast of the bluff, near the junction of the two dirt roads shown by parallel dashed lines. Immediately north and south of Alum Bluff are more bluffs, with less-steep faces, bordering the flat, swampy floodplain of the Apalachicola River. Extending eastward from the bluffs are several deeply incised creeks, such as Little Sweetwater Creek and Kelly Branch. Each is fed by smaller streams branching off the main creek. These feeder streams originate at the base of rounded, amphitheater-like features called *steepheads.* Steepheads form when the small spring seeps feeding the creeks undercut overlying strata, causing slumping of the overburden into the stream. The steepheads migrate laterally by on-going undercutting and slumping, thus lengthening the streams in some preferential directions. These spectacular features are impressively deep, and may also contain unique floral and faunal communities.

Alum Bluff has been a premiere fossil collecting site in the Florida panhandle because of its unique geologic position and because it is actively being cut in an eastward direction by a meander loop of the Apalachicola River. It exposes a variety of sediments, including Middle Miocene Chipola Formation, containing abundant fossil mollusks and corals, and Alum Bluff Group equivalent strata, containing both vertebrate and plant fossils. Fresh strata is generally exposed by each flood stage of the river, and vegetation has little opportunity to become established. The bluffs both north and south of Alum Bluff are of nearly equivalent elevations, but are not actively eroded, are less steep (as indicated by the wider-spaced contour lines), and are more heavily vegetated as a result. However, fossiliferous strata could be found by the ambitious collector at elevations similar to those in Alum Bluff in the nearby bluffs and steephead streams. It would likely require digging, as slumped sediment and organic debris commonly cover the adjacent bluffs and stream valley walls.

The Haile quarries - *works of man in typical limestone terrain:*

The small "hamlet" of Haile, Florida, is situated about 3 miles northeast of Newberry, in western Alachua County. Eocene limestone lies close to the surface in this region, where it is covered only by variably thick quartz sands and clayey sands. Mining of this high purity limerock has occurred throughout this region for years.

The Haile area is shown on the Newberry topographic quadrangle map, a portion of which is illustrated in Figure 5. The surrounding terrain shows a typical contour line pattern of numerous closed loops of various sizes and shapes. Some have short perpendicular lines or ticks extending from the contour line inward towards the center of the loop. These tick marks are called ***hachures***, and are used to indicate depressions in the land surface. They form a visual method of differentiating contour lines which designate decreasing elevation from nearby lines of increasing elevation. In effect, they allow the viewer to tell whether a feature comprised of a series of unlabeled, concentric contour lines is a hill or a bowl-shaped depression.

The terrain around Haile is underlain by shallow limestone bedrock. Dissolution by slightly acidic ground water has produced a highly irregular bedrock surface pocked with sinkholes, solution pipes, and intervening pinnacles. This terrain type is known as ***karst***. Much of the limestone surface roughness is masked by the thin blanket of relict marine sands covering the region. These sands tend to smooth and in-fill the karst depressions. Even so, many of the karst features are expressed at the surface as

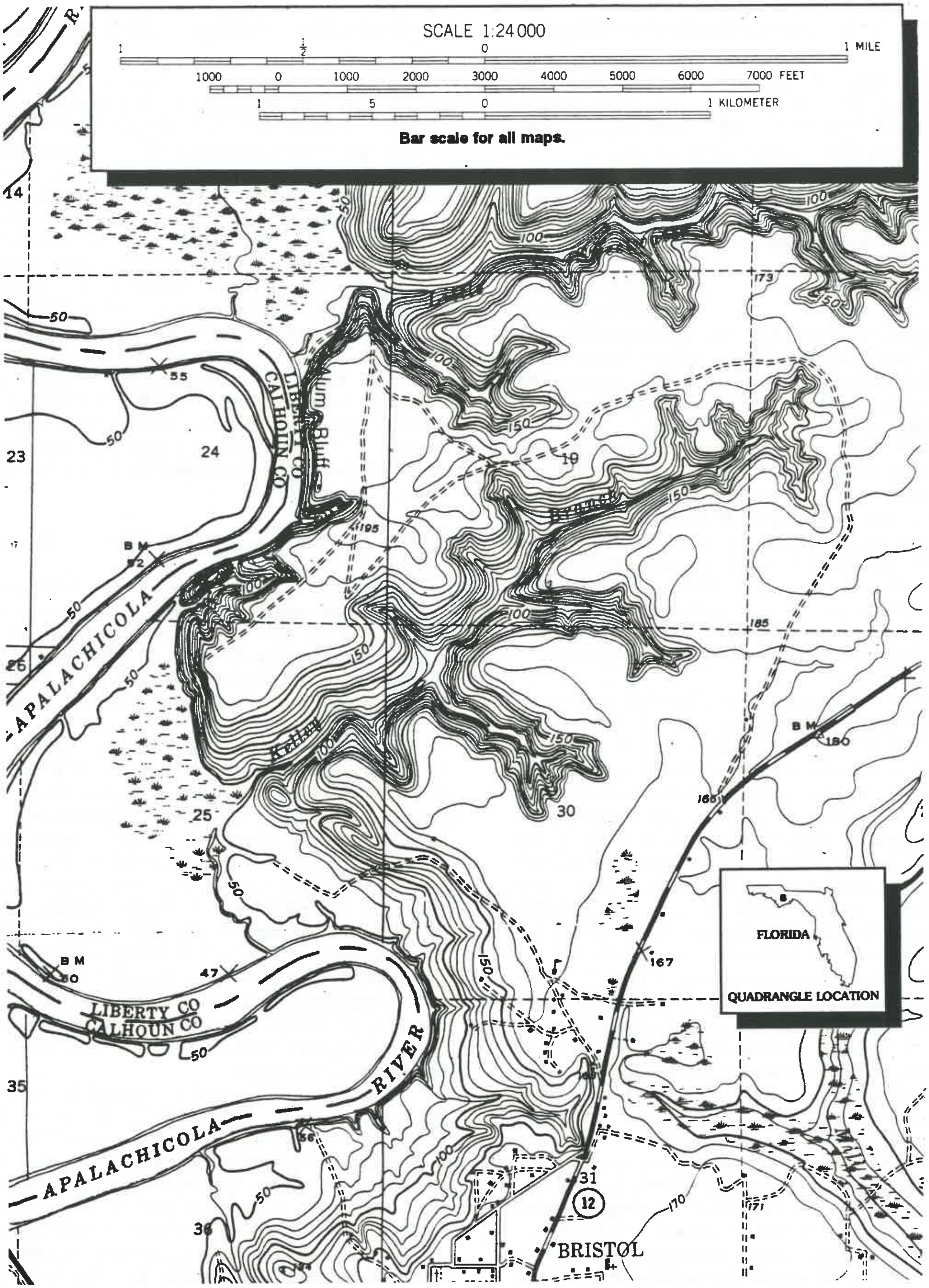

Figure 4. Portion of the Bristol Quadrangle map (Liberty County) showing Alum Bluff

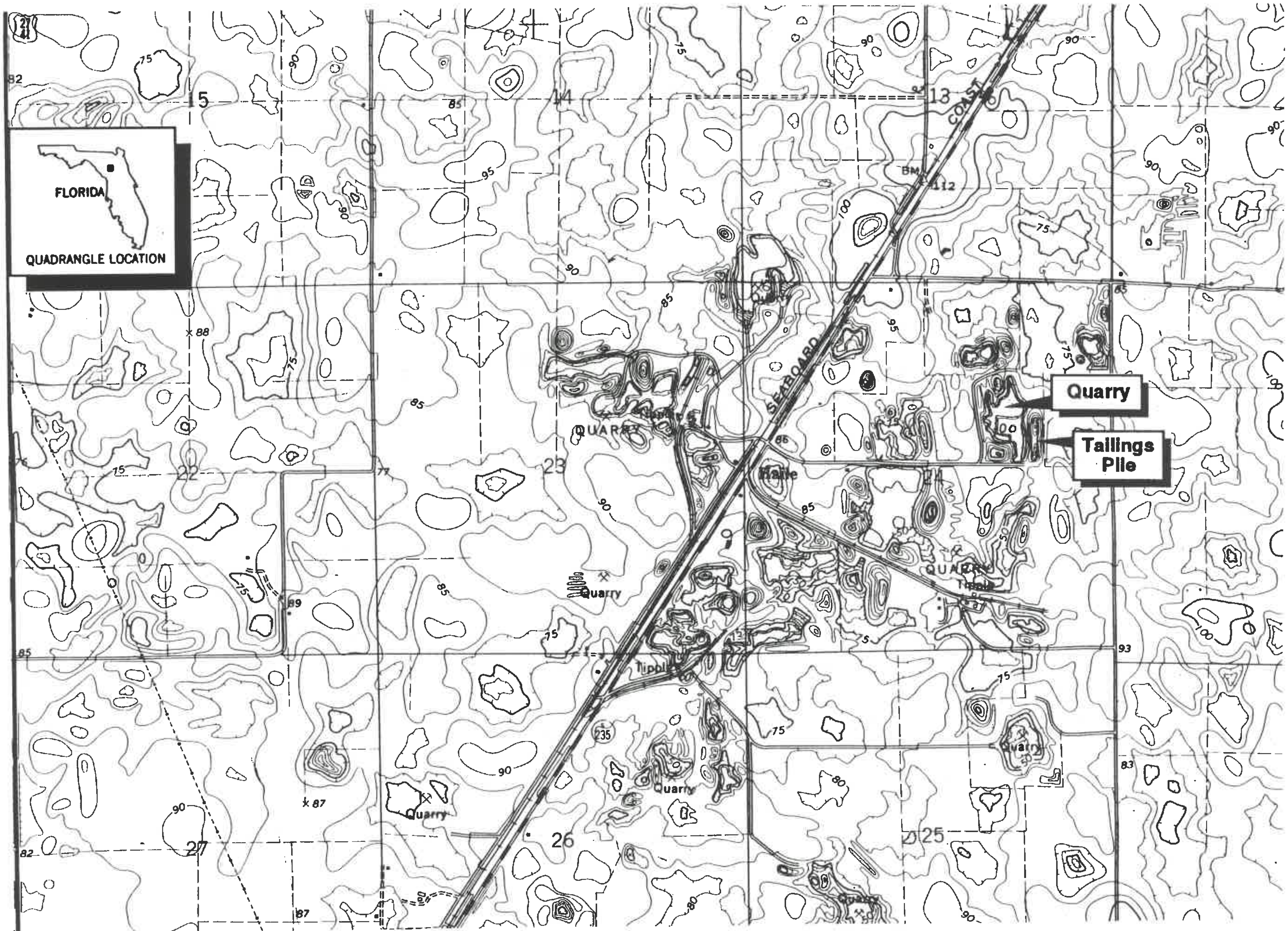

Figure 5. Portion of the Newberry Quadrangle (Alachua County) showing the Haile area

variably-shaped depressions, caused by settling of the overburden sands as the underlying limestone collapses or dissolves.

The proximity of high-purity limestone to the surface in this area has historically made limestone mining economically feasible near Haile. Quarries are open pit mines, generally excavated to some practical depth determined by the capabilities of the excavating equipment as well as the ability of mechanical pumps to keep the pit free of encroaching ground water. The large inactive quarries in the Haile area appear on the topographic map as water filled pits of various unnatural shapes. Mining areas are commonly denoted by the crossed pick symbol. Quarries active at the date of mapping may appear dry on the map. But once abandoned, they typically re-fill with ground water unless they are fortuitously perched above the local water table. Lying near the pits are small, steep, oval hills (see Figure 5). These represent man made piles of overburden and mine tailings. Some of those illustrated may attain heights of thirty feet.

Quarries provide the fossil hunter access to numerous invertebrate fossils and occasional vertebrate remains. The Eocene Ocala Limestone, which is mined locally for roadbase material, contains large foraminifera as well as abundant mollusks and echinoids. The limestone may rarely contain Eocene whale material as well. More commonly, younger vertebrate fossils are found in the undifferentiated sinkhole fill sediments, which are exposed in cross-section in the mine walls. Most active mines turn amateur collectors away for liability reasons, but the above-water portions and spoil piles of abandoned mines can provide excellent hunting sites. Old mines, as well as deep sinks which may potentially expose limestone may easily be located on topographic maps. Many are located near roads, allowing easy access. Today, more than ever, it is important to remember our fossil hunting ethics. Be sure to obtain current landowner permission before entering any mines, old or new. It is also wise to use caution around potentially unstable sheer mine walls, rock piles, and water-filled pits.

Gainesville - *There's Miocene in those ditches:*

In contrast to the karst plain terrain near Haile, the city of Gainesville is largely situated atop stream-dissected clayey sand hills at the southwestern edge of the Northern Highlands geomorphic zone. Figure 6 is a portion of the Gainesville East topographic map. The extent of the city is indicated by the gray shading, and many of the streets are labeled on the map for reference. Clayey fossiliferous sediments of the Miocene Hawthorn Group form the core of the hilly terrain, which attains elevations of about 185 feet above mean sea level, and which is punctuated by deeply incised creek channels. Because the clayey sands form a protective layer over the underlying limestone in much of eastern Gainesville, ground water has not had the opportunity to form the extensive karst features seen at Haile. Occasional sinks do occur here however, and generally form deep, circular depressions as they perforate the Hawthorn sediments. The Devil's Millhopper, a large, deep sinkhole located in northern Gainesville, is a classic example. West of the University of Florida campus, the Hawthorn sediments thin, and numerous karst features are more evident.

The Hawthorn Group sediments lie near or at the surface in the Gainesville area. As a result, the sinkholes, road cuts, and stream channels which cut down into the Hawthorn offer the fossil hunter the best local collecting opportunities. Among the more common finds are shark teeth and dugong rib pieces, but more exotic finds, such as Miocene long-beaked dolphin are also known from Gainesville proper. The topographic map allows the aspiring collector to accurately locate the deeper stream ravines which likely expose fossiliferous sediments. Potential sites are indicated by the closely-spaced contour lines along Hogtown Creek and its tributaries, just northwest of the U of F campus. Although it is sometimes difficult in urban settings to find access to such creeks, it may be possible to enter the streambed at a road crossing. In doing so, remember to be cognizant of other's property rights.

Shell Creek - *a southern Florida invertebrate site:*

As a final example of topographic map usefulness, we will look at a typical area in southwestern Florida. Brown (1988) describes a fossil shell site in western Charlotte County along the appropriately named Shell Creek. The stretch of stream he mentions is illustrated on the Cleveland Quadrangle, a portion of which is shown in Figure 7. Most southern Florida streams are sluggish, winding bodies with low banks. The terrain around shell creek is comprised of low, gently-rolling sandy sediments attaining maximum elevations of about 20 to 25 feet above mean sea level. At the western end of Shell

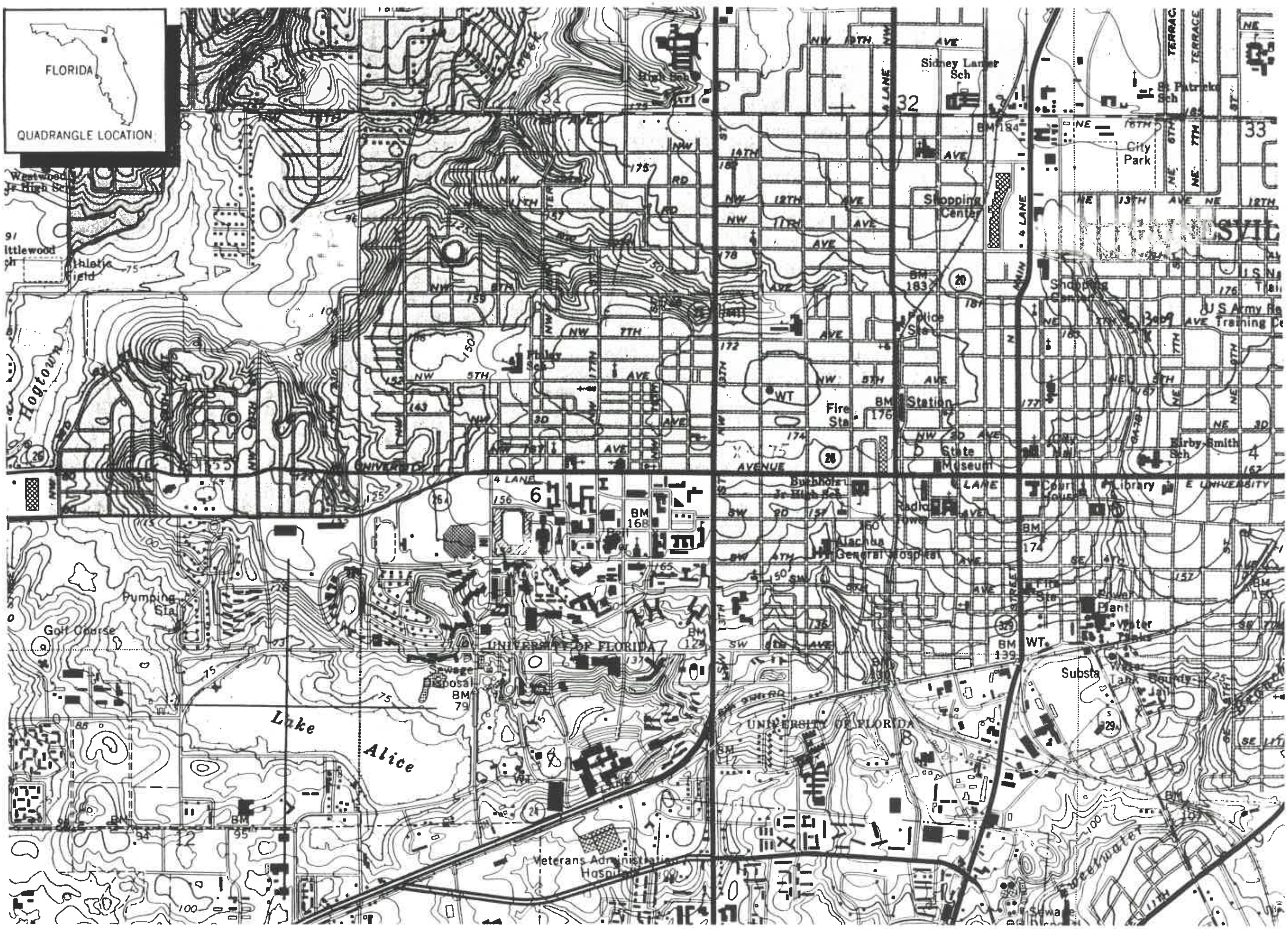

Figure 6. Portion of the Gainesville East Quadrangle (Alachua County) showing southwestern Gainesville

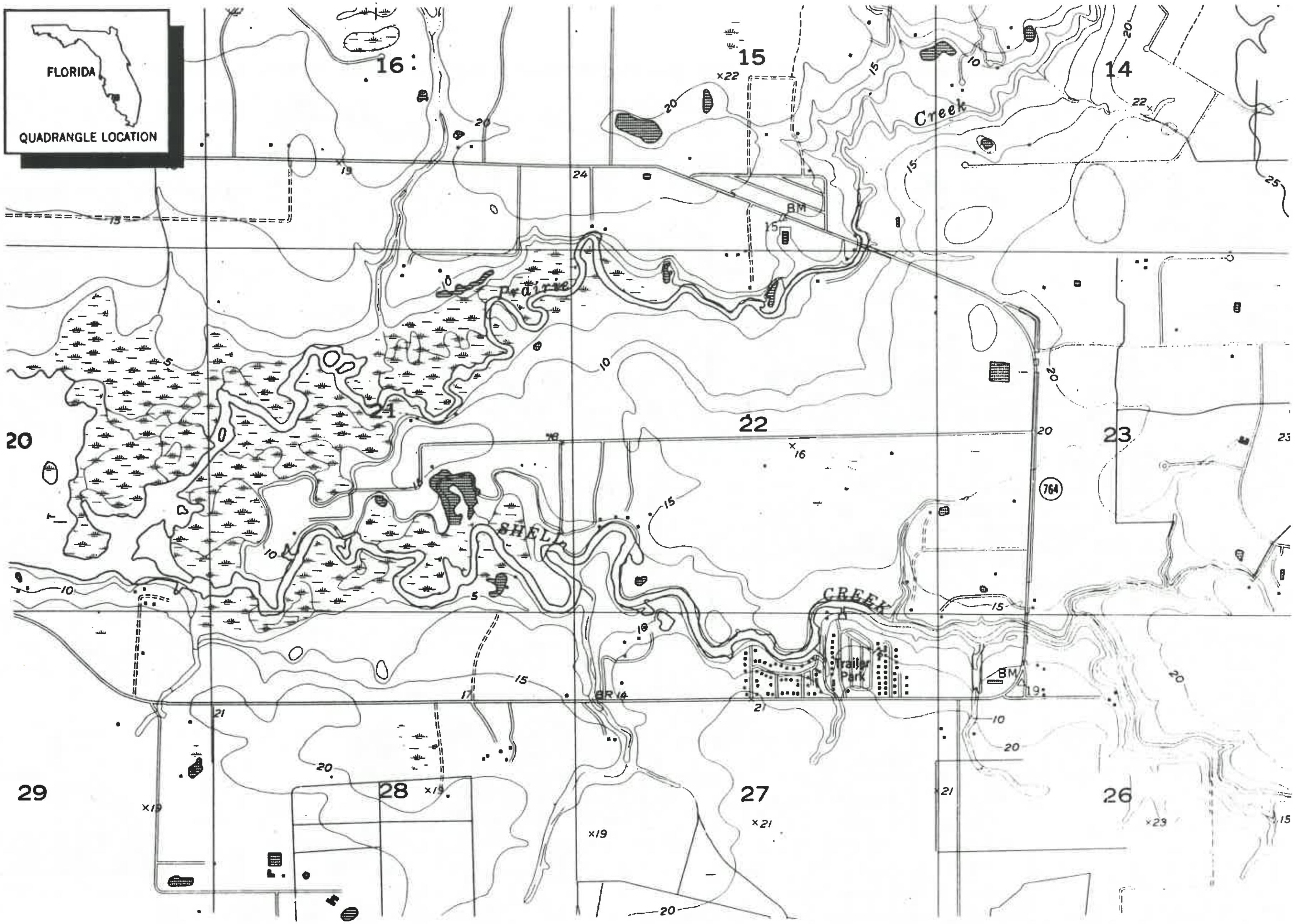

Figure 7. Portion of the Cleveland Quadrangle (Charlotte County) showing Shell Creek

Creek in Figure 7, the stream flows into a low, swampy flood plain as it merges with Prairie Creek entering from the north. Any fossiliferous strata here are likely covered by flood plain sands and vegetation. To the east, however, especially east of the trailer park (Figure 7), the stream is well-incised in slightly higher terrain. Elevation rises from about 5 feet at the stream edge up to nearly twenty feet immediately adjacent to the creek. The closely-spaced contour lines suggest reasonably steep banks, and as such, possible exposure of otherwise buried subsurface strata. As it turns out, Shell Creek does cut into shelly undifferentiated Plio-Pleistocene units in this area, and collecting along its banks may be carried out from a boat or canoe. In many cases, the bottoms of streams such as this may also contain pockets of vertebrate fossil material, derived from sediments the stream has cut through.

The examples given above represent a small portion of the terrain statewide. Some areas of Florida, such as the Everglades for example, offer little potential for the fossil collector regardless of how many maps one studies. As shown here, however, many other areas may be scouted for collecting sites using the accurate land form representation provided by the topographic quadrangle map.

A note about geology and the pitfalls of topographic maps:

It is important to remember that the local geology plays an important part in fossil occurrence. Fossiliferous strata is not always present at shallow enough depth to be intersected by surface features. There are, for instance, many areas in Florida with incised streams, roadcuts, canals, and karst features which *do not* cut into fossiliferous sediments. This is true for *most* of Florida. Successful fossil site locating requires combining a knowledge of local stratigraphy with the shape of the land surface. The ideal method would entail using a geological map to locate areas with known shallow fossiliferous strata, then overlaying the corresponding topographic maps to locate potential hunting sites. We can explore this technique in a future article.

Obtaining Topographic Maps for your area:

Many public and university libraries statewide have topographic maps available as reference materials. Topographic quadrangles may be purchased by mail from the U.S. Geological Survey at the following address:

Map Distribution Section
U.S. Geological Survey
Federal Center, Box 25286
Denver, CO 80225
phone (800) 872-6277
Price is $2.50 each.

Maps for your particular area may also be available at local sporting good stores, engineering or survey equipment stores, some marinas, and outdoors or trail shops. Information regarding local (Florida) distributors of U.S. Geological Survey maps may be obtained from the Florida Geological Survey librarian at (904) 488-9380.

Orders for Florida quadrangles as well as questions concerning the status of mapping, map reference libraries, and commercial dealers may also be directed to:

Florida Resources and Environmental
Analysis Center (FREAC)
Room 361, Bellamy Building
Attn. Jim Anderson or Peter Krafft
Florida State University
Tallahassee, FL 32306-4015
phone (904) 644-2007

Prices at FREAC are also $2.50 per map plus $4.00 shipping for orders up to $20, $6.00 for orders of $20-$40, or $8.00 shipping for orders in excess of $40. Pre-payment is not necessary, and FREAC will forward an invoice for your order.

The Index to Topographic Maps of Florida, which shows the names and coverage areas for 7.5 minute quadrangle maps in Florida, may be ordered free of charge from FREAC or from the U.S. Geological Survey.

References

Brown, R., 1988, Florida's Fossils, Guide to Location, Identification, and Enjoyment: Sarasota, The Pineapple Press, 208 p.

Yon, J.W., (Project Coordinator), 1972, Environmental Geology and Hydrology, Tallahassee Area, Florida: Florida Bureau of Geology Special Publication 16, p. 6.