PLATE 3

Wild Rice

The Leipsic River, which forms one boundary of the Pollack Site, is fed by several lower order and ephemeral streams, such as Alston Branch, which forms another boundary (Figure 2, Plates 1 and 2). The inland half of the river presently consists of fresh water. At approximately 1050 B.C., a marine transgression drowned the Leipsic River and the mouth of Alston Branch creating an estuary and tidal river valley in the remaining portion of the river (Custer, Riley, and Mellin 1994: Appendix I). The mix of varied environments would have made this location a rich resource locale and an attractive setting for prehistoric populations.

In the vicinity of the Leipsic River are marshy wetlands containing a mixture of wild grasses and other plant species. The wetland zone surrounding the Pollack Site, identified by Daiber et al. (1976) as the Transition Marsh, contains plant species such as saltmarsh cordgrass, big cordgrass, giant reed grass, cattail, wild rice (Plate 3), marsh mallow, and numerous others. The varied composition of the Transition Marsh offers excellent conditions for wildlife food stocks, shelter, and nesting (Daiber et al. 1976). Approximately one mile east of the Pollack Site, the Transition Marsh grades into the Cordgrass Marsh Zone. Salt-marsh cordgrass is the dominant species and creates a prime habitat for a wide range

PLATE 4

Amaranth (Pigweed) Growing in Well-Drained Soil

of migratory birds, waterfowl, and fur-bearing animals (Daiber et al. 1976). The gently rolling landscape, well-drained soils, accessibility to fresh water, and the rich diversity of the local environment would have made the Pollack Site ideal for habitation throughout prehistory.

Soils in the area of the Pollack Site consist largely of Sassafras sandy loams which are well drained (Matthews and Ireland 1971). These soils, which were under cultivation at the Pollack Site at the time of the Phase III excavations, would have supported mixed hardwoods, primarily oak and hickory, during the time of prehistoric occupation (Custer 1986a, 1989:46-51; Riley et al. 1994: Appendix III). In bluff areas adjacent to the drainage, a narrow strip of Sassafrass-Evesboro soils is present. These soils are well drained to excessively well drained and very susceptible to erosion. Weed plants with edible seeds, such as Amaranth are found in these areas (Plate 4). Soil profiles from Phase II excavations (Grettler, Seidel, and Kraft 1994) show a plow zone varying in depth from 20 centimeters to 50 centimeters. The varying, undulating character of the subsoil suggests that the prehistoric land surface may have been slightly rolling, and that erosion and redeposition caused by deforestation and modern agriculture has had a moderate leveling effect upon the original surface contours.

Paleoenvironments

Comprehensive discussions of climatic and paleoenvironmental changes on the Delmarva Peninsula are contained in numerous sources (Custer 1984:30-37, 44-48, 62-64, 89-93, 154; 1986a; 1989:38-55; Kellogg and Custer 1994) and only a summary will be presented here. Climatic changes have taken place in the Middle Atlantic region over the 12,000-year period of human prehistory. These changes would have affected the growth, decline, and varieties of floral and faunal communities available in a given environmental zone during particular times. These effects would, in turn, have had an influence on human adaptation strategies.

A wide range of environmental studies, including climatology, pedology, hydrology, and fossil pollen analysis, have provided useful data for reconstructing past environments of the Delmarva Peninsula (Custer 1989). Models created from these studies can be applied to further understand prehistoric adaptations. The current geological period, the Quaternary Period, is divided into two epochs (Figure 6), the Pleistocene Epoch (16,000,000 B.P. - 10,000 B.P.) and the Holocene Epoch (10,000 B.P. - present). Studies have shown that within these epochs there are periods of climatic change which have had an impact on the settlement and subsistence strategies of prehistoric groups. Based on their analysis of fossil pollen data, Wendland and Bryson (1974) have developed an "episodic model" to explain discrepancies in the global geologic-botanic record. This model suggests that discrepancies in the pollen sequences may be a reflection of abrupt disturbances that changed relatively stable climates. Five environmental episodes have been postulated for the time between 15,000 B.C. and A.D. 1600 (Figure 6).

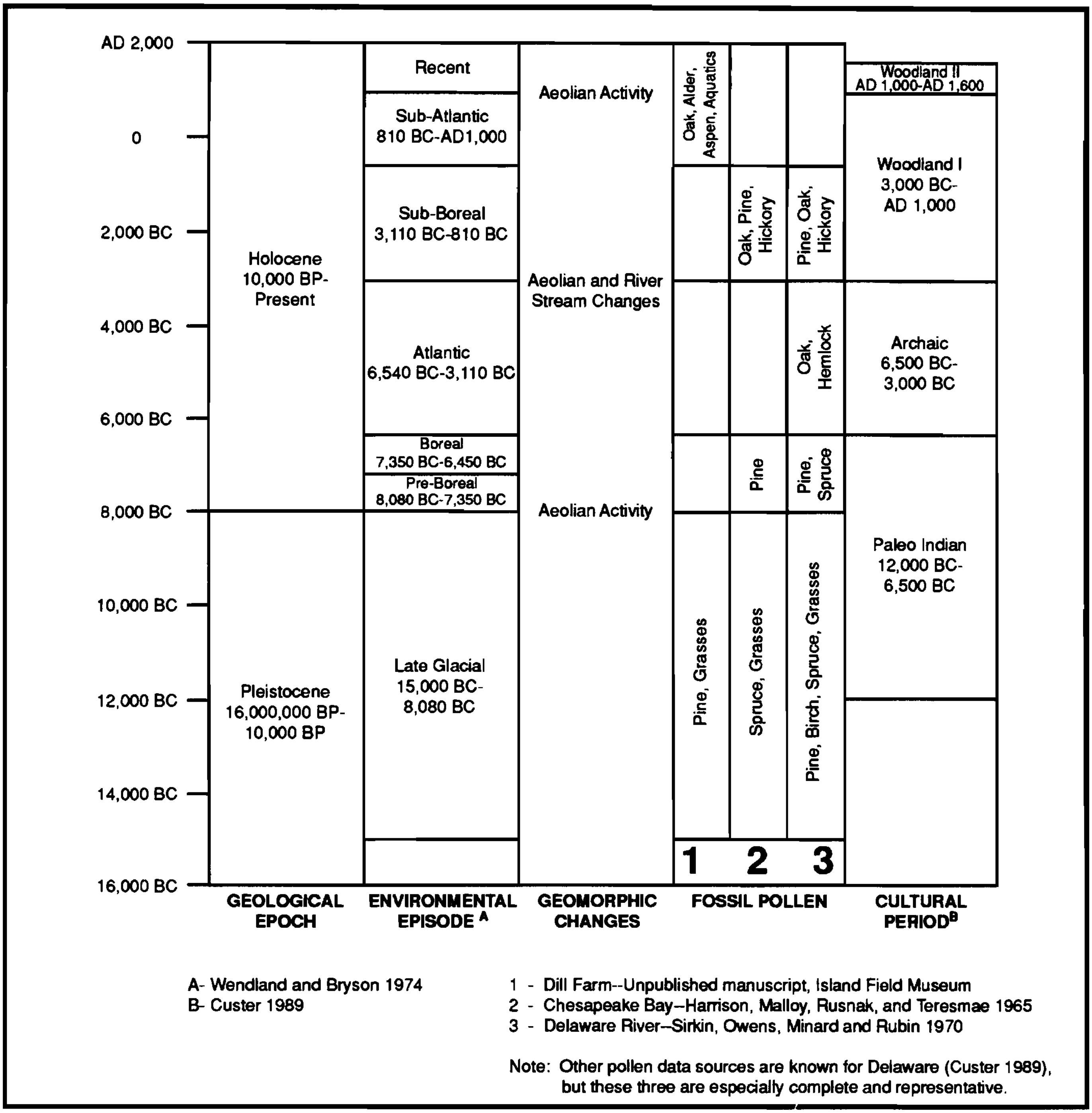
Studies of regional landscape modification have also identified periods of change in the environment. Two geomorphic processes have been linked to climatic changes (Knox 1983; Curry 1978, 1980; Curry and Custer 1982; Custer 1989). These processes are aeolian erosion and deposition of soils, and changes in river and stream systems (Figure 6). Deposition of aeolian, or windblown, soils indicate degrees of denudation of vegetation (Curry 1980; Curry and Custer 1982; Custer 1989). Three significant occurrences have been dated to the period of transition between the Pleistocene and Holocene epochs (Foss et al. 1978), the middle Holocene (Curry 1980), and the late Holocene (Custer and Watson 1985).

Changes in river and stream systems during the Holocene Epoch have been noted in the Middle Atlantic region (Curry and Custer 1982), and especially in central Delaware (Custer and Griffith 1984). Research on changes in waterway systems in other parts of North America and the Eastern Woodlands have been attributed to responses to storm and flood activities (Knox 1983). These activities have also been suggested as being responsible for changes in river and stream systems on the Delmarva Peninsula (Custer 1989). The various studies show that past environmental transitions coincide with one another and also with the cultural time periods of the Delmarva Peninsula (Figure 6). To fully understand the impact of these changes on prehistoric settlement and subsistence patterns, these environmental changes must be regarded in a spatial and temporal context.

The Pleistocene Epoch is characterized by the onset of cold conditions with recurring episodes of continental glaciation. The last glaciation consisted of a large ice sheet, the Laurentide, which covered most of the northeastern portion of the North American continent. The retreat of this ice sheet had a major influence on the climatic conditions of Delaware during the past 14,000 years. By ca. 12,000 B.C., the Laurentide ice sheet had retreated to just north of the headwaters of the Delaware River

FIGURE 6

Environmental Changes and Climatic Episodes



(Ogden 1977). During this later portion of the Pleistocene, or Late Glacial episode, the Delmarva Peninsula would have been subjected to extensive frontal activity caused by the mixture of the cold air associated with the ice sheet and warm air from the south (Carbone 1976). This climate would have resulted in cloudy, wet, and cold-weather conditions on the Delmarva Peninsula.

After ca. 8500 B.C., the melting of the Laurentide ice sheet shifted air mass activities and increased moisture content in the atmosphere. The increase in moisture combined with the cold air of the diminishing ice sheet resulted in precipitation levels higher than those of the present (Carbone 1976). Other parts of the Middle Atlantic are thought to have once resembled tundra-like settings (Carbone 1976; Bernabo and Webb 1977), while in areas further south, the late Pleistocene was characterized by a mosaic of vegetational settings (Whitehead 1965; Brown and Cleland 1968; Custer 1989). Pollen data dating to this time from the Coastal Plain indicates that the Delmarva Peninsula probably contained grassland settings within a broader coniferous matrix (Figure 6). These grassland environments would have supported cold-weather megafauna and moose. Grassland areas would have been located in the low relief floodplains of the Delaware and Susquehanna rivers, which have since been inundated and buried by post-Pleistocene sea-level rise. High velocity winds generated by these open grasslands would have created aeolian transport and deposition at the interface of the broad coniferous forest stands. As the ice sheet retreated further north, its effects on the climate of the Delmarva Peninsula lessened.

Transition between the Pleistocene and the Holocene begins after 8000 B.C., during the Pre-Boreal and Boreal environmental episodes, when the ice sheet retreated north into Canada and temperatures increased due to solar warmth (Kellogg and Custer 1994). This transition between the end of the Pleistocene and the beginning of the Holocene is characterized by marked changes in floral environmental settings with the major effect being a reduction of open grassland environments and a spread of boreal woodland settings. The pollen data of this time from the Delmarva Peninsula reflect a replacement of spruce with pine. The reduction of grassland and forest interface settings lowered the carrying capacity for browsing and grazing species. As a result, poorly-drained swampy areas would have been focal points for animal populations including deer, elk, and moose.

By 6500 B.C., the beginning of the Atlantic Episode, temperatures from solar radiation reached a maximum and the cold-weather floral species shifted and faunal species migrated out of the Middle Atlantic region to areas further north (Kellogg and Custer 1994). This early part of the Holocene is marked by a general warming trend and an increase in precipitation. Grasslands diminished and the coniferous woods were replaced by the expansion of dense mesic forests of oak, hemlock, and pine (Figure 6). Swampy areas were distributed among poorly-drained areas such as the floodplains and bay/basin settings. These environments supported faunal species similar to species found today, such as deer and turkey. The Atlantic Episode of the Holocene Epoch is characterized by the stabilization of a continental climate with distinct seasonal differences in air mass distribution patterns, temperature, and precipitation (Custer 1989).

After the Atlantic Episode, the climates and environments of the Delmarva Peninsula became very complex. The Atlantic Episode was followed by the Sub-Boreal Episode (3110 B.C. - 810 B.C.) which is characterized first by warm and dry conditions and later by increases in precipitation and cooler temperatures. The early part of the Sub-Boreal has been called the mid-postglacial xerothermic, a period of warm and dry climate, which seems to have had a significant impact on the distribution of plant and animal resources of the Delmarva Peninsula. Pollen samples dating from this time show a decline in hemlock and an increase in hickory species suggesting that mesic forests of hemlock and oak were replaced by xeric forests of species such as hickory. In addition, grassland settings seem to have once again become widespread on the Delmarva Peninsula. During the Sub-Boreal, estuarine resources changed. Although sea level was still rising, the rate of the rise had stabilized enough to support significant accumulations of estuarine resources.

By the Sub-Atlantic Episode, ca. 500 B.C., fluctuations in temperature and precipitation stabilized and conditions resembled those of the present. The variety of pollen data from the Delmarva Peninsula of this time indicate that environmental settings were able to support a wide range of mesophytic species.

These environments also supported a variety of animal species and the dominant game animals at this time were deer and turkey. After 500 B.C., the rate of sea-level change stabilized and distributions of estuarine resources continued to expand.

During Phase III excavations at the Leipsic Site (7K-C-194A), a large prehistoric site on the north side of the Leipsic River directly across from the Pollack Site (Figure 3), a detailed study of the geomorphology of the Leipsic River area was undertaken (Whallon 1989; Kellogg and Custer 1994; Custer, Riley, and Mellin 1994: Appendix I). In brief, several vibracore and hand-augured core samples were taken from various loci on the north and south shores of the Leipsic River and along Alston Branch. Sandy mud deposits at the base of many profiles indicate that a fluvial environment existed in this area during the early Holocene, and the absence of pollen in this horizon has been interpreted as representing a period of fluvial flooding. Basal peat deposits in cores from the south side of the river indicate a freshwater swamp/marsh environment.

Between approximately 3300 B.C. and 1300 B.C., a freshwater swamp/marsh environment is indicated by mud units overlying the sandy mud profiles from the north side of the river and a shift from peat to mud in profiles from the south side of the river. A decrease in the rate of sediment accumulation observed in the profiles suggests a decrease in organic productivity and, thus, a dry climate. Pollen from the north shore of the Leipsic River shows a predominance of "dry woody" (oak, pine, hickory) and "dry herbaceous" taxa (Whallon 1989).

Between 1300 B.C. and A.D. 450, a swamp/marsh forested wetland existed in the Leipsic River Valley and this environment is represented in peat deposits present on both sides of the river. Both pollen and sediment accumulations increased during this time and the pollen data suggest that both wet-adapted species (wild rice, water lily, alder, birch, and ash) and dry-adapted species (grasses, ragweed, goldenrod, oak, and hickory) were supported by this environment (Whallon 1989:109-110). Wild rice and hickory would have been particularly good sources of edible resources for prehistoric peoples. The abundance of pollen and organic peat in this horizon may indicate a relatively wetter climate. Between A.D. 450 and A.D. 1450, pollen accumulation increased whereas the rate of sediment accumulation decreased (Whallon 1989:110). The disappearance of certain wet-adapted species (cattail, wild rice, birch, and willow) from the pollen record suggests a reduction in moisture, although a marshy wetland environment appears to have persisted through this time period.

After A.D. 1450, mud deposits were again present, and these deposits have been interpreted as representing a tidal incursion (Whallon 1989:111). This wet environment would have supported a renewal of wet-adapted species, and the pollen record shows a mixture of wet- and dry-adapted varieties. The modern environment consists of a swamp/marsh forested wetland seasonally flooded by fluvial action, and occasionally by tidal action. Vegetation includes a prevalence of green ash, red maple, and black gum, and variable amounts of black willow, American holly, oak, Atlantic white cedar, and Loblolly pine with occasional grasses and sedges (Whallon 1989:111).

Another series of cores was taken along Alston Branch. The environments represented in these cores are similar to those from the Leipsic River except that an estuarine environment developed in the area of the mouth of Alston Branch at its confluence with the Leipsic River in the later Holocene. These cores consist mainly of three sedimentary facies: sand and muddy sand, mud, and peat. Prior to 1050 B.C., this area was characterized by fluvial and tidal river channels which deposited the sand and muddy sand sediments. Plant pollen from this soil horizon was sparse for headwater areas of Alston Branch and consisted primarily of sedges, grasses, and shrubs as well as pokeberry and tuliptree. No pollen was present in this horizon closer to the mouth of Alston Branch.

At approximately A.D. 1050, the Leipsic River and mouth of Alston Branch were drowned by an estuary which created a tidal river valley and an estuarine open water environment at the confluence of Alston Branch and the Leipsic River just to the east of the Pollack Site. No mud horizon was present at the headwaters of Alston Branch, and no pollen was present in this mud horizon midway downstream. Further downstream, closer to the confluence of Alston Branch and the Leipsic River, pollen was present and consisted of wetland shrubs, pitch pine and elderberry. Pollen from mud and peat horizons at the confluence consisted of wetland sedges and herbs, water hemp, snapweed and marigold along with woody shrubs such as silky dogwood, southern arrowwood, and smooth alder. Finally, around 50 B.C. another estuary formed within a tidal river valley with extensive fringing marshes. Pollen from this mud horizon in the vicinity of the estuarine environment consisted of wetland sedges, smooth alder, and southern arrowwood.

In sum, data from the cores and pollen samples indicate that the general vicinity of the Pollack Site would have been a diverse and productive environment with many varied food sources for prehistoric populations. Local environments included sources of fresh water in the upstream sections of the Leipsic River and Alston Branch, as well as estuarine resources within a short distance east of the site. The accessibility to fresh water, especially during times of environmental stress, such as those which occurred in the middle Holocene, would have been especially important.

The geologic setting of the Pollack Site places it approximately 30 miles southeast of the nearest source of primary lithic materials for the manufacture of stone tools. These Delaware Chalcedony Complex jaspers, cherts, and chalcedonies would have been available in quarries at Iron Hill and Chestnut Hill, just south of Newark. The nearest sources of primary quartz would have been in the Piedmont of north and northwestern Delaware and southeastern Pennsylvania. However, a variety of secondary lithic resources (lithic resources that have been transported by natural agents from their places of formation) would have been available in gravel beds and point bars along stream valleys in the Low Coastal Plain (Custer and Galasso 1980). These cobbles, though of varying size and quality, would have been suitable for the manufacture of stone tools. In fact, in some respects secondary cobbles would be appealing to prehistoric groups settled in nearby base camps because they exist in an easily transportable form and often require little modification of that form to produce a working edge. Therefore, although primary lithic sources were not locally available near the Pollack Site, secondary sources were available and suitable to meet most lithic needs.

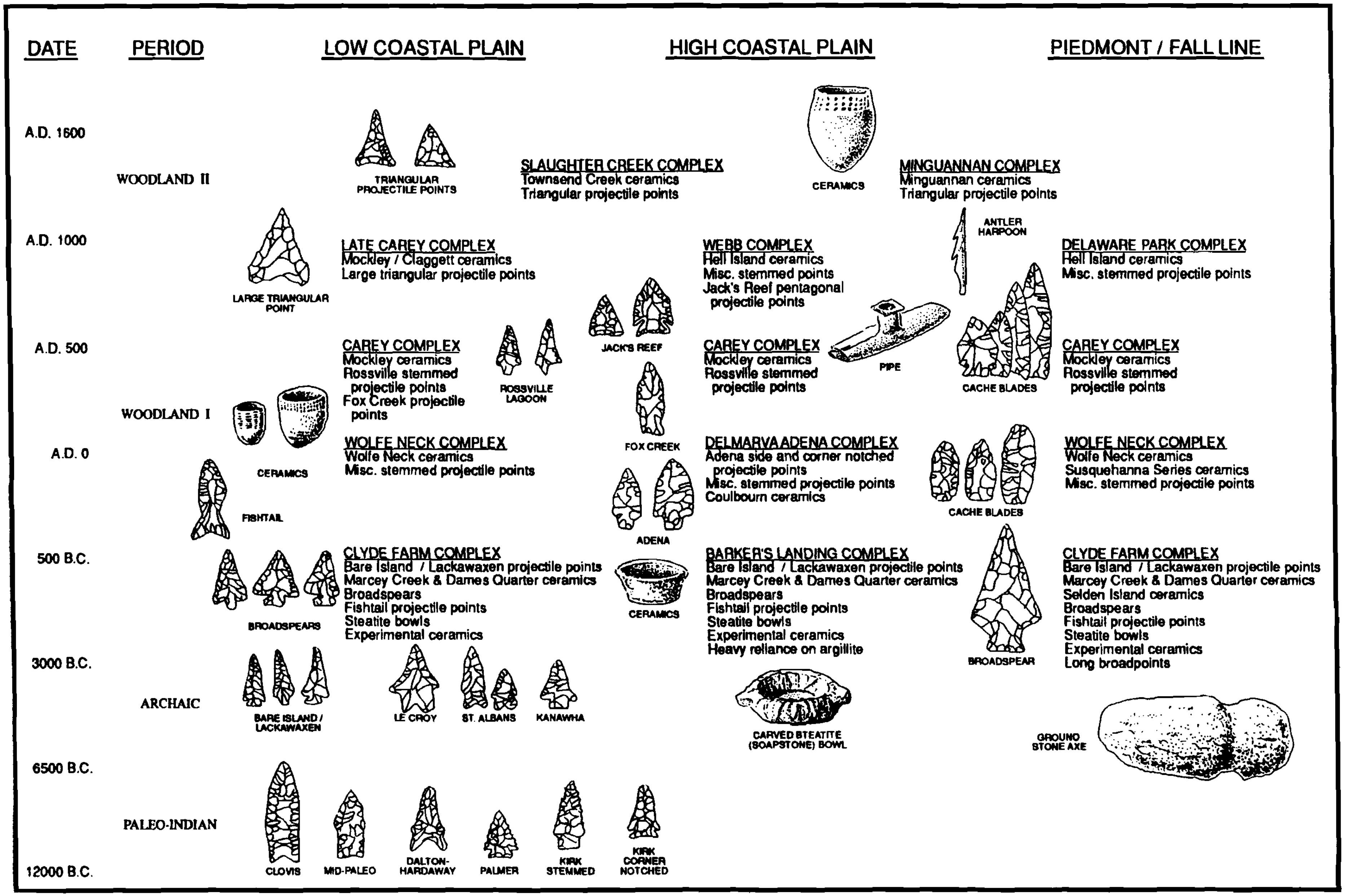
Regional Prehistory

This summary of the regional prehistory is abstracted from the work of Custer (1984, 1986a, 1986b, 1989). The prehistoric archaeological record of the Delaware Coastal Plain can be divided into four large blocks of time: The Paleo-Indian Period (ca. 12,000 B.C. - 6500 B.C.), the Archaic Period (6500 B.C. - 3000 B.C.), the Woodland I Period (3000 B.C. - A.D. 1000), and the Woodland II Period (A.D. 1000 - A.D. 1650). A fifth time period, the Contact Period may also be considered and spans from A.D. 1650 to A.D. 1750, the approximate date of the final Indian habitation of Delaware in anything resembling their pre-European Contact form. Each of these periods is described below and the attributes of particular cultural complexes are described and illustrated in Figure 7.

Paleo-Indian Period (12,000 B.C. - 6500 B.C.). The Paleo-Indian Period encompasses the time period of the final retreat of Pleistocene ice sheets from Eastern North America and establishment of more modern Holocene environments. The distinctive feature of the Paleo-Indian Period is an

FIGURE 7

Delaware Prehistoric Chronological Chart



adaptation to the cold, and alternately wet and dry conditions at the end of the Pleistocene and the beginning of the Holocene. This adaptation was primarily based on hunting and gathering with hunting providing a large portion of the diet. Hunted animals may have included now-extinct megafauna and moose. A mosaic of deciduous, boreal, and grassland environments would have provided a large number of productive habitats for these game animals in central Delaware and watering areas would have been particularly good hunting settings.

Tool kits of the people who lived at this time were oriented toward the procurement and processing of hunted animal resources. A preference for high quality lithic materials is noted in the stone tool kits and careful resharpening and maintenance of tools is common. A mobile lifestyle moving among the game attractive environments is hypothesized with the social organizations being based upon single and multiple family bands. Throughout the 5500 year time span of the period, the basic adaptation remains relatively constant with some modifications being seen as Holocene environments appeared at the end of the Paleo-Indian Period.

Numerous Paleo-Indian sites are noted for the Delaware Coastal Plain. Most of the sites are associated with poorly-drained swampy areas and include the Hughes Paleo-Indian Site Complex near Felton.

Archaic Period (6500 B.C. - 3000 B.C.). The Archaic Period is characterized by a series of adaptations to the newly emerged full Holocene environments. These environments differed from earlier ones and were dominated by mesic forests of oak and hemlock. A reduction in open grasslands in the face of warm and wet conditions caused the extinction of many of the grazing animals hunted during Paleo-Indian times; however, browsing species such as deer flourished. Sea-level rise is also associated with the beginning of the Holocene in Delaware. The major effect of the sea-level rise would have been to raise the local water table, which helped to create a number of large interior swamps. Adaptations changed from the hunting focus of the Paleo-Indian to a more generalized foraging pattern in which plant food resources played a more important role. Large swamp settings apparently supported large base camps, but none are known from the study area. A number of small procurement sites in favorable hunting and gathering locales, such as bay/basin features, are known from Delaware's Coastal Plain.

Tool kits were more generalized than earlier Paleo-Indian tool kits and showed a wider array of plant processing tools such as grinding stones, mortars, and pestles. A mobile lifestyle was probably common with a wide range of resources and settings utilized on a seasonal basis. A shifting band level organization which saw the waxing and waning of group size in relation to resource availability is evident. Known sites include large base camps such as the Clyde Farm Site in northern Delaware and smaller processing sites located at a variety of locations and environmental settings.

Woodland I Period (3000 B.C. - A.D. 1000). The Woodland I Period can be correlated with a dramatic change in local climates and environments that seem to be part of events occurring throughout the Middle Atlantic region. A period of shifting wet and dry climates lasts from ca. 3000 B.C. to 1000 B.C. and in some areas mesic forests were replaced by xeric forests of oak and hickory. Grasslands also again became common. Some interior streams dried up; however, the overall effect of the environmental change was an alteration of the environment, not a degradation. Continued sea-level rise and a reduction in its rate also made many areas of the Delaware River and Bay shore the locations of large brackish water marshes which are especially high in productivity. The major changes in environment and resource distributions caused a radical shift in adaptations for prehistoric groups. Important areas for settlements include the major river floodplains and estuarine swamp areas. Large base camps with fairly large numbers of people are evident in many settings in the Delaware Coastal Plain, such as the Barker's Landing, Coverdale, Hell Island, and Robbins Farm sites. These sites seem to have supported many more people than previous base camp sites and may have been occupied on a year-round basis. The overall tendency is toward a more sedentary lifestyle.

The tool kits show some minor variations as well as some major additions from previous Archaic tool kits. Plant processing tools become increasingly common and seem to indicate an intensive harvesting of wild plant foods that may have approached the efficiency of agriculture by the end of the Woodland I Period. Chipped stone tools changed little from the preceding Archaic Period; however, broad-blade, knife-like processing tools became more prevalent. The addition of stone, and then ceramic, containers is also seen. These items allowed the more efficient cooking of certain types of food and may also have functioned for storage of certain surplus plant foods. Storage pits and semi-subterranean houses are also known for the Delaware Coastal Plain during this period from numerous sites.

Social organizations also seem to have undergone radical changes during this period. With the onset of relatively sedentary lifestyles and intensified food production, which might have produced occasional surpluses, incipient ranked societies began to develop as indicated by the presence of 1) extensive trade and exchange in lithic materials for tools as well as non-utilitarian artifacts, 2) caching of special artifact forms and utilization of artifacts manufactured from exotic raw materials. The data from cemeteries of the Delmarva Adena Complex (ca. 500 B.C. to A.D. 0), such as the Frederica Adena Site and the St. Jones Adena Site (Thomas 1976), indicate that certain individuals had special status in these societies and the existence of a simple ranked social organization is hypothesized. Similar data from the Island Field Site show that these organizations lasted up until A.D. 1000, although they may not have always been present throughout all of the Woodland I Period. In any event, by the end of the Woodland I Period a relatively sedentary lifestyle is evident in Delaware's Coastal Plain. It should also be noted that the greatest number of archaeological sites in the project area date to the Woodland I Period and the Mid-Drainage Zone, within which most of the alignment is located, and is the focus of most of the important sites of this period.

Woodland II Period (A.D. 1000 - A.D. 1650). In many areas of the Middle Atlantic, the Woodland II Period is marked by the appearance of agriculture food production systems; however, in the Delaware Coastal Plain there are no clear indications of such a shift. Some of the settlements of the Woodland I Period, especially the large base camps, were also occupied during the Woodland II Period and very few changes in basic lifestyles and overall artifact assemblages are evident. Intensive plant utilization and hunting remained the major subsistence activities up to European Contact. There is some evidence, nonetheless, of an increasing reliance on plant foods and coastal resources throughout the Woodland II Period in the study area. Social organization changes are evidenced by a collapse of the trade and exchange networks and the end of the appearance of elaborate cemeteries.

Contact Period (A.D. 1650 - A.D. 1750). The Contact Period is an enigmatic period of the archaeological record of Delaware which begins with the arrival of the first substantial numbers of Europeans in Delaware. The time period is enigmatic because no Native American archaeological sites that clearly date to this period have yet been discovered in Delaware. A number of sites from the Contact Period are known in surrounding areas such as southeastern Pennsylvania, nonetheless. It seems clear that Native American groups of Delaware did not participate in much interaction with Europeans and were under the domination of the Susquehannock Indians of southern Lancaster County, Pennsylvania. The Contact Period ends with the virtual extinction of Native American lifeways in the Middle Atlantic area except for a few remnant groups.