Figs. 11 to 14 illustrates a striking change in surface morphology eastward from the elongate dark area, Hellespontus, into the large circular bright area, Hellas. In Figs. 11 and 12, Hellespontus and the intervening scarped and ridged transition zone to Hellas display abundant craters of good size, but in Figs. 12 and 14 the floor of Hellas is seen to be virtually devoid of discernible craters, except within a narrow marginal zone where they are faintly visible. Small craters disappear even earlier, being unrecognizable in the transition zone and on the near edge of Hellespontus, even in high resolution photos (Fig. 13).

Various considerations suggest that this disappearance of craters is not the result of an atmospheric haze or fog hanging over the Hellas area, but rather the product of some difference in processes acting, or materials present (or both), which results in abnormally rapid obscuration of craters on the floor of Hellas. The transition area between Hellespontus and Hellas with its short en echelon scarps and ridges constitutes the most distinct structural border yet seen between a light and dark area on Mars.

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2. Longitude measured eastward on Mars from the standard ephemeris zero meridian. Ephemeris longitude is measured westward from this meridian.
3. We acknowledge the support and encouragement of the National Aeronautics and Space Administration. We also thank the Mariner Mars '69 project manager, H. M. Schurmeier, and his staff at the Jet Propulsion Laboratory, California Institute of Technology, without whose skill, expert knowledge, and devoted labor Mariner 7 could not have succeeded.

11 August 1969

Glacial Age Marsh, Lafayette Park, Washington, D.C.

Abstract. *Organic sediments beneath historic Lafayette Park mark the site of a freshwater marsh which bordered the Potomac River when it was 15 meters above its present level. Plant microfossils and ice-rafted boulders indicate a climate much colder than now. The carbon-14 age of more than 45,000 years and palynological studies suggest an early Wisconsin age.*

In 1964 workmen uncovered a peat deposit while excavating for a foundation of the new U.S. Court of Claims building adjacent to the Dolly Madison House on the northeastern corner of Lafayette Park, just north of the White House (Fig. 1). The peat lies about 3 m below street level, is 1 m thick, and consists of a brown compacted mass of plant remains. Below the peat layer is 4.3 m of dark gray organic silt and sand containing occasional subangular boulders, one of which was reported to be more than 2 m long. Below these sediments test borings revealed 23.6 m of silt, sand, and gravel extending down to bedrock, which at this locality is 13.7 m below sea level.

The peat was best exposed in the northwest corner of the excavation, just below the foundation of the Dolly Madison House. I found it again in 1967 at the same horizon in an excavation just east of the Court of Claims building. However, the deposit is small, as indicated by the fact that I did not find it in a test pit 20 m deep dug in 1966 at the north end of Lafayette Park, or in other nearby building excavations.

The upper part of the peat is finely laminated and contains recognizable remains of sedges and other marsh plants, including numerous seeds of *Cyperus* similar to those of *C. aristatus*. The lower part is massive and silty, and, except for pieces of wood, contains no megascopic remains. A sample of the upper peat (sample W-1542) yielded a radiocarbon age greater than 45,000 years (*1*).

The organic sediments below the peat contain no shells or other megafossils except occasional pieces of wood, which appear to be mainly alder. These sediments also contain subangular boulders, which average about 25 to 50 cm in diameter. The boulders, mostly quartzite and other rocks not native to the area, were apparently rafted downstream by river ice at a time when Washington's climate was much colder and when the Potomac River was 10 to 15 m higher than it is at present.

Microscopic examination of the peat and underlying silt and sand from the Court of Claims excavation and other excavations near the park revealed pollen grains and, in places, freshwater diatoms and sponge spicules.

These microfossils are most numerous in the locality of the Court of Claims; here they are most abundant in the peat, decrease in number downward, and become very scarce in the lower sands. The most frequent microfossils found in the sediments exposed in the Court of Claims excavation are pollen grains, mostly from pine, spruce, and fir, and a few from deciduous hardwood trees such as oak. This pollen assemblage and the low percentages of nonarboreal pollen grains and spores indicate that dense coniferous forests covered the Washington area during most of the time involved.

Darton (*2*) and others thought, on the basis of lithology, that Cretaceous beds underlay the Pleistocene deposits at this locality. However, pollen grains in samples that I obtained from the bottom of the test pit in Lafayette Park and from borings in the vicinity indicate that all the sediments below Lafayette Park are of Pleistocene age and that they were deposited during two warm and two cold periods (Fig. 2). The warm periods, represented in Fig. 2 by zones *Y* and *S*, are inferred from the presence at these levels of pollen grains which show that deciduous forests, indicative of warm climatic conditions, covered the Washington area during the time involved. The cold periods, represented by zones *I* and *WA–WD*, are inferred from the pollen grains at these horizons, which show the former presence of boreal coniferous forests.

This evidence and recent excavations just north of Lafayette Park (Fig. 1) show that the Pleistocene deposits abut against a buried cliff, in places more than 20 m high, cut in lignitic Cretaceous beds and weathered Pleistocene gravels. This cliff, which roughly parallels H and Eye Streets, extends eastward from Washington Circle, 1 km west of the White House, to Judiciary Square, 1.5 km east of the White House. The cliff, which marks a former shoreline of

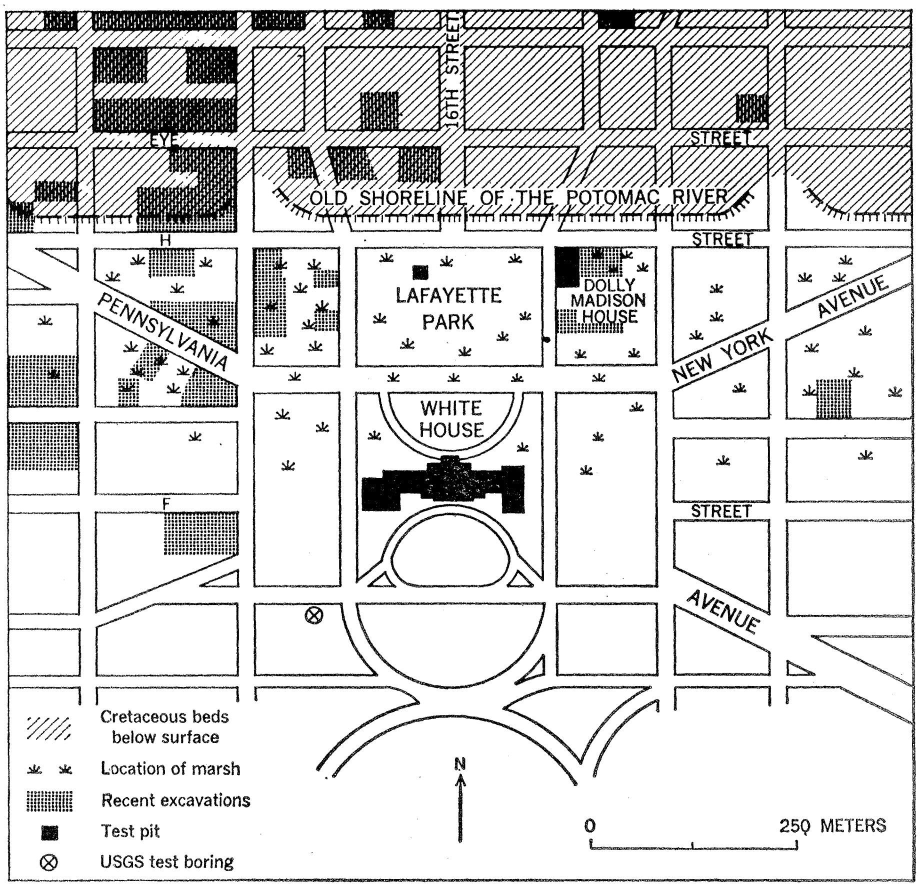

Fig. 1 (top left). Map of the Lafayette Park area, Washington, D.C., showing location of an old Pleistocene shoreline and a glacial age marsh.

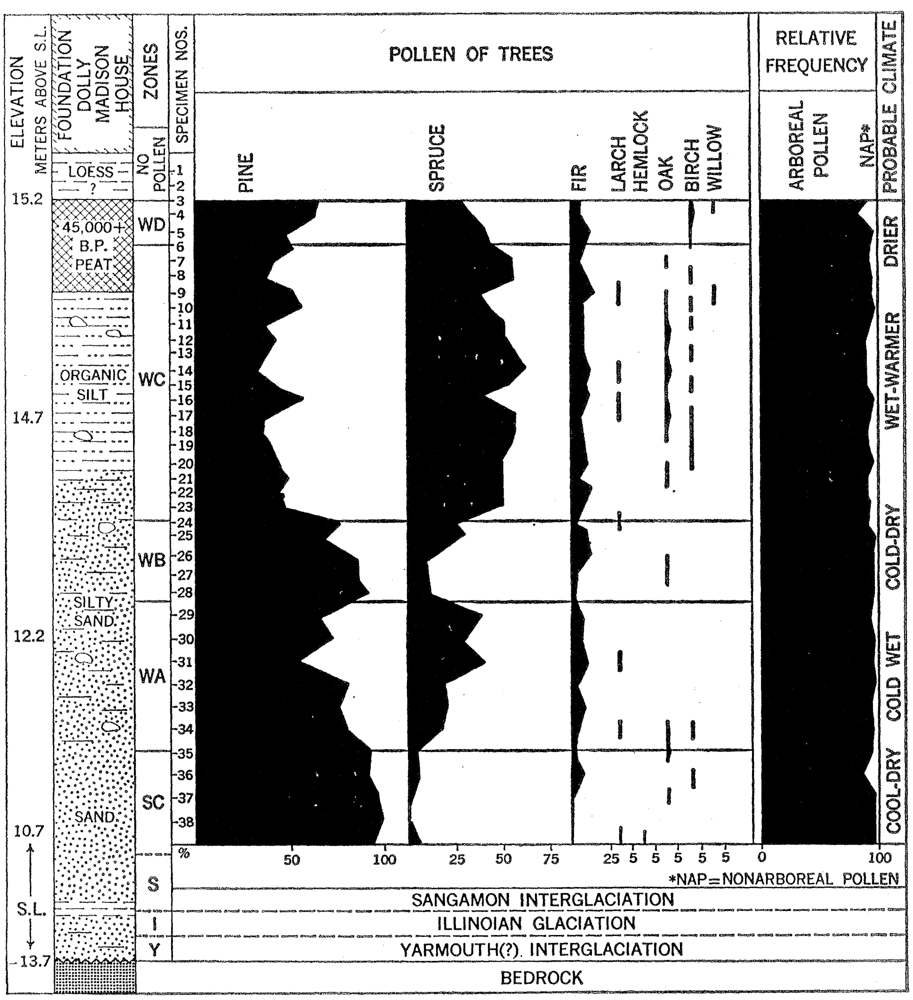

Fig. 2 (bottom left). Pollen diagram from Pleistocene sediments, exposed in the excavation for the U.S. Court of Claims building, Lafayette Park, Washington, D.C.

the Potomac River, was the result of downcutting by the river, probably during middle Pleistocene time, since it is much older than the Pleistocene deposits just to the south.

The results of my pollen study of these sediments exposed in the Court of Claims excavation are shown in Fig. 2. I have arbitrarily divided the pollen diagram into five pollen zones for reference and regional correlation.

The lowest zone exposed is zone *SC*, which is characterized by an abundance of pine pollen grains, many of which are small forms, similar in size to those from the northern scrub pine, *Pinus banksiana.* Although pine may be overrepresented in this zone as a result of distant transport, clumps of pine pollen grains indicate that the trees from which these grains came must have lived nearby.

This zone is equivalent in position and character to the pine zone above the Walker Interglacial Cypress Swamp (*3*), which underlies L Street, three blocks northwest of Lafayette Park. The zone marks the transition from the oak-hickory forests of interglacial time to the boreal coniferous forests of the following cold or glacial period. The pollen record seems to indicate that, during this transitional period, climatic or other conditions were unfavorable for hemlock and spruce, as well as for the deciduous hardwoods.

The next zone, zone *WA*, represents a period during which the area was invaded by boreal coniferous forest; the zone is characterized by a marked rise in spruce and a decline in the number of pine pollen grains. This interval was apparently of relatively short duration, as was the following interval, represented by zone *WB*, in which pine pollen again reaches high percentages.

Zone *WC* is the main spruce zone in the section and is marked by a series of spruce pollen maxima. The small number of oak pollen grains occurring in this zone may have been transported either from a distance or from a few relic oak trees in the vicinity.

Zone *WD* shows an increase in pine and a decrease in spruce pollen grains. The few birch and willow pollen grains in this upper zone suggest more open conditions.

The relative percentages of non-arboreal pollen grains do not show any significant fluctuations throughout the section exposed in the Court of Claims excavation. Pollen grains from aquatic plants are in general more abundant in the lower horizons and decrease in number upward. Those from sedge and alder reach their highest percentages in the peat. These grains undoubtedly came from plants living along the banks of the river, as indicated by the associated megafossils, and they reflect the gradual decrease in the water level and the establishment of marsh plants which led to the formation of the peat.

The peat accumulation was suddenly terminated by the deposition of overlying silt which destroyed the peat-forming plants. This silt layer, which forms the foundation of the Dolly Madison House, rests conformably on the peat and is here about 1 m thick. Because of its distinctive characteristics and distribution, I suggest that the silt is most likely a loess deposit resulting from wind action on the newly exposed flood plain of the Potomac River when the water level fell during the middle or later part of this glacial period.

The presence of sediments of probable glacial age above interglacial beds and 15 m above the present Potomac River estuary is surprising since it is generally believed that, because of glacial control, sea level was high during interglaciations and much lower during glaciations.

Cooke, who studied the Pleistocene terraces of the Atlantic Coastal Plain, correlated the terrace on which Lafayette Park and the White House are located with his 21-m Penholoway Terrace (*4*). He believed that this terrace was formed by marine or estuarian erosion as a result of falling sea level during the latter part of an interglacial period. In 1935 (*5*) he assigned this terrace, as well as the 43-m, 30-m, and the 13-m terraces also found in Washington, to the Sangamon Interglaciation; but in 1952 he reassigned these terraces tentatively to the Yarmouth Interglaciation.

Cooke placed the Pleistocene sediments, including the Walker Swamp deposit, which underlies these terraces, in the so-called Wicomico Formation. He assumed that the deposition of the Wicomico began during late Kansan Glaciation and continued during the Yarmouth Interglaciation when sea level rose and reached a maximum height of 43 m above its present stand.

Cooke based his correlations largely on geomorphological criteria and on the assumption that there had been little or no land movement along the southeastern seaboard during the Pleistocene. In recent years, however, several authors (*6*) have questioned the Pleistocene stability of the Chesapeake Bay area and the origin and correlation of the terraces. My palynological and geological investigations (*7*) of the terraces and terrace deposits in the District of Columbia and Maryland seem to support these doubts.

My studies indicate that the Lafayette Park terrace and the topmost part of the underlying fossiliferous sediments, such as those exposed in the U.S. Court of Claims excavation, are the result of continued aggrading by the Potomac River, probably during the early part of the Wisconsin Glaciation, and that the maximum height of relative sea level in late Pleistocene time occurred in this area during the early part of this glacial period and not during an interglacial period, as previously believed. I find no evidence that tidewater level in the vicinity of Washington ever reached a height greater than 20 m above the present level during the middle or late Pleistocene.

The Walker Interglacial Cypress Swamp north of Lafayette Park is of probable Sangamon age (*7*). It rests in a broad valley cut through the Pleistocene silts and basal gravels, which underlie Cooke's 30-m and 43-m terraces, and through Cretaceous sediments into bedrock to a depth of 4 m above sea level. This suggests a long period of erosion after the upper terraces had been formed and before the deposition of the sediments below the Walker Swamp, presumably during the Illinoian Glaciation (*8*). It thus appears that Cooke's upper terraces and the underlying Pleistocene sediments, which contain pollen grains indicating a cold climate up to a height of 26 m above sea level, probably date from the early Pleistocene and are certainly much older than the Walker Swamp deposits and the Lafayette Park terrace to the south.

The lower 13-m and 8-m terraces just south of the White House, which Cooke believed to be the result of estuarian erosion during the Yarmouth and Sangamon interglaciations, respectively, were most probably formed by nonestuarian stream erosion as a result of the lowering of sea level and some isostatic uplift (*9*) during the middle or upper Wisconsin Glaciation.

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24 April 1969

Venus: Mapping the Surface Reflectivity by Radar Interferometry

Abstract. *The surface reflectivity of Venus obtained by radar interferometry at a wavelength of 3.8 centimeters has been mapped for a region extending approximately from −80° to 0° in longitude (Carpenter's definition) and from −50° to +40° in latitude. The map is free from the twofold range-Doppler ambiguity because the interferometer fringe pattern makes possible the separation of two points of equal range and Doppler shift. The map presents many new features and clearly delineates features already observed. Most notably, the map shows large circular regions of significantly lower reflectivity than their surroundings.*

Radar reflections from the planet Venus have provided important evidence on the nature of its surface. The rotation rate (*1*) of the planet has been determined by measuring the frequency spread of the echo from a continuous wave transmission. Furthermore, precise delay measurements (*1*) have been used to determine the orbit and radius of the planet. Analysis of the frequency and delay spectra at various wavelengths indicates that the surface is somewhat smoother on the average than the lunar surface. However, cer-