

Configuration of the Bedrock Surface of the District of Columbia and Vicinity

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Configuration of the Bedrock Surface of the District of Columbia and Vicinity

By N. H. DARTON

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*This report embodies subsurface data
of interest to engineers and builders
compiled from 1890 to 1940*



UNITED STATES DEPARTMENT OF THE INTERIOR

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PREFACE

By ALICE S. ALLEN

The preparation of this report is the work of a geologist, and the subject of the paper—the position of the contact between the crystalline rocks and the sedimentary formations of the Coastal Plain deposits—is essentially one of interest to geologists. However, much of the source material was contributed by engineers, and it is believed that engineers may constitute the majority of readers of the published volume because of their interest in subsurface conditions arising from the volume of present-day construction in the Washington area. Therefore a brief account of the background of the investigations that culminated in the preparation of this report may be of interest.

Although the report is only now appearing in print, the manuscript was completed by the author in 1940. Publication of scientific reports was interrupted during the war years and in the interval that followed many buildings in Washington, as well as Government agencies, changed names. Because much of the subsurface data used in the manuscript consists of foundation explorations for buildings, there are many references to names and locations of buildings. The editors have tried to harmonize the references to such names with present usage. None of the additional subsurface information that has become available since the author completed his manuscript, however, has been added. The Geological Survey is continuing to accumulate records of subsurface data and will welcome contribution of boring records for use in future investigations.

The span of time during which the author accumulated the data for this paper approximates half a century, paralleling his unusually long term of service on the Geological Survey. Mr. Darton came to Washington in 1886 to start his geological career on the Survey. The association continued until and even beyond his retirement in 1936 except for a 3-year period of work with the Bureau of Mines. His formal retirement caused little change in his professional interests, and he continued to study local geology and to write papers until his death in 1948. Viewing the author's career in its entirety, for his record was unique among geologists for breadth of geologic interest and amount of geologic and topographic mapping throughout the United States, the geologic work in the Washington area forms a small part of his total accomplishments. His bibliography, however, shows that his interest in local geology was a continuing one. His field notebooks show that, at least as early as 1889, he was mapping geologic formations of the Coastal Plain in and around Washington. In 1891 Darton and others prepared a guidebook to the geology of Washington and vicinity for the International Geological Congress meeting. The U. S. Geological Survey Atlas folio on the Washington area, which was published in 1901, was the work of Darton and of Arthur Keith who collaborated in the mapping of the crystalline rocks. Although most of Darton's subsequent field assignments were in the western and southwestern parts of the country, his home remained in Washington. Apparently he collected, from time to time, records

of borings and wells, and made notes on observations of subsurface units temporarily exposed during excavation for buildings, and other structures. One of his latest publications is a geologic map of "Sedimentary formations of Washington, District of Columbia, and vicinity," which is a revision of the old Washington folio map, using a modern topographic map as a base.

The preparation of the manuscript for Professional Paper 217 might be considered a byproduct of the author's geologic mapping activities in the Washington area. Its peculiar value lies in the continuity of record over a period of nearly half a century, and in the fact that the geologic interpretations of the subsurface data were made by a geologist thoroughly familiar with local formations and their relation to the Coastal Plain geologic province.

CONFIGURATION OF THE BEDROCK SURFACE OF THE DISTRICT OF COLUMBIA AND VICINITY

By N. H. DARTON

ABSTRACT

A bedrock floor of granite, gneiss, schist, and other crystalline rocks underlies the District of Columbia region. It is at or near the surface in the western part and descends gradually eastward below the wedge-shaped mass of overlying sedimentary formations of the Coastal Plain. Much of Washington is built across this overlap of unconsolidated material on crystalline rock. In the valley of Rock Creek and in the rolling lands to the west the crystalline rocks crop out, but east of Rock Creek the bedrock surface slopes steadily southeastward, and in the eastern part of the city it lies several hundred feet below the surface. The position of the bedrock is a matter of great interest in planning foundations for governmental and other large buildings, and the relations of the basal gravels of the Coastal Plain sediments are important because they contain water supplies, which have been utilized commercially for condensing and other purposes.

Data as to bedrock configuration are difficult to obtain because in drilling wells and sinking boreholes the materials are not always identified accurately. At the outcrop, and to some extent underground, much of the bedrock is decayed to a micaceous sand that is not everywhere easy to distinguish from sedimentary material. Data from nearby holes help in verification from one to the other. The bedrock surface, described in this report and shown on the maps and sections, is the geologic contact between the bedrock formations and overlying unconsolidated materials of younger sedimentary formations. This surface rarely coincides with the top of hard rock due to the weathering of the bedrock formations to irregular depths.

Although the southeasterly slope of the bedrock is in general very regular at a rate of 100-150 feet to the mile, there are local variations in direction and amount. Where data are closely spaced they reveal low mounds and ridges and shallow valleys which had been developed as surface features on the old pre-Cretaceous rocks upon which the beds of the Potomac group were deposited. Possibly also some faulting or even flexing has taken place, which would cause irregularities in the bedrock floor. These local irregularities are described in as much detail as data permit and are illustrated by a number of maps and sections.

The boreholes that afford a basis for the altitude lines in the maps and diagrams are about 600 in number, but not all of them were correctly interpreted by the drillers as to materials penetrated or identity of bedrock.

INTRODUCTION

The District of Columbia region is underlain by gneiss or gneissic granite and schist, usually called "bedrock", which is at or near the surface in the western part of Washington but to the east slopes gently under an eastward-thickening wedge of sands and clays of the Coastal Plain succession. At the east corner of the District this bedrock surface is about 700 feet below sea level. Its position underground has been determined by borings at many places, and though the borings are irregularly spaced and not all of the records are reliable,

they have afforded a basis for the construction of maps showing configuration and depth. (See pls. 1 and 2.)

Plate 1, which shows the configuration by 50-foot contour lines, is similar to a map of the region published in 1901,¹ but modified by later data. Most of the material used in this report is listed in the tables on pages 35-39.

Knowledge of the configuration of the bedrock surface in the Washington area is of great practical importance in connection with foundations for heavy buildings, especially in the western part of the city; in its relation to local water supply throughout the area; and in its bearing on the structural geology and geologic history of the region.

SOURCES OF INFORMATION

The collection of data for this report has been in progress for many years, and some of the earlier data have already been published.²

Many detailed plats of test boreholes, with records and other data, were obtained from the office of the supervising Architect of the Treasury, Procurement Division; the office of Public Buildings and Grounds; the Corps of Engineers, United States Army; and the engineering departments of the District of Columbia.³ Included are the sites of the Washington Monument, Jefferson Memorial, Lincoln Memorial, Arlington Memorial Bridge, the buildings of the Post Office Department, Interior Department, Commerce Department, Labor Department, Interstate Commerce Commission, and Bureau of Engraving and Printing, the Pentagon Building, Munitions Building, Archives Building, Apex Building, and others. Several hundred boreholes at these localities reached bedrock and afforded data as to its altitude and configuration. Subsurface data were also supplied for numerous sites in which bedrock was not reached, such as the Government Printing Office and some other buildings with deep-seated foundations. In addition to borehole records supplied by Government agencies, subsurface information was contributed also

¹ Darton, N. H., and Keith, Arthur, U. S. Geol. Survey Geol. Atlas, Washington, D. C.-Md.-Va. folio (No. 70), 1901.

² Darton, N. H., Artesian-well prospects in the Atlantic Coastal Plain region: U. S. Geol. Survey Bull. 138, pp. 155-161, 1896. Darton, N. H., and Keith, Arthur, op. cit.

³ In acknowledging the sources of boring data, the Government agencies are identified by the names in use at the time the records were made available for this study. The present equivalents of the offices of the Supervising Architect of the Treasury and Public Buildings and Grounds are the Public Buildings Service and National Capital Parks Service.

by well drilling companies and by owners of private buildings.

Much of the canvassing for data was done by me up to 1940. Samuel Sanford obtained a few data in Maryland in 1905, and in later years R. C. Cady⁴ and D. J. Cederstrom, of the United States Geological Survey, collected information concerning some boreholes in Virginia.

ALTITUDE DATUMS

The contour lines indicating bedrock surface on the map, plate 1, are based on the "mean sea-level" datum established by the Coast and Geodetic Survey according to adjustments of leveling prior to 1929. The general adjustment of 1929 raised the datum plane 0.141 foot, but this has been ignored because it would not affect the position of contour lines of surface or bedrock on the present scale of the map. On the detailed maps of parts of the District of Columbia and on the figures and smaller plates the datum is the one used on the original plat of the boreholes. The datum used by the Engineer Department of the District of Columbia is 0.846 foot above mean sea level (prior to 1929), and that used by the Corps of Engineers, United States Army, is mean low tide, which is 1.264 feet below mean sea level (prior to 1929). These slight differences in datum are insignificant in view of the natural irregularity of the original bedrock surface and the entirely

gradational relation between sound rock, and rock that has been thoroughly disintegrated by weathering processes.

Figure 1 shows the different datums and also the altitude of the bronze-plate bench mark in the Capitol Building, which is regarded as a standard datum marker.

Most of the altitudes of bedrock shown on plate 1 have been deduced by subtracting the depth reported by the driller from known altitude of the ground surface at nearby points. The altitudes in Washington are based chiefly on figures given by District of Columbia or Army Engineers. As some of the holes are slightly higher or lower in relation to sea level than is indicated by such an approximation, the figure given on the map and in the tables for altitude of bedrock surface at some holes may be subject to a correction of a foot or two. In wells outside of Washington the altitude is taken from contour lines on the Geological Survey base map. In some places the term "sea level" is used in a general sense, or with reference to "mean sea level" on the Geological Survey base map.

GENERAL GEOLOGIC RELATIONS

BEDROCK

The bedrock that underlies the District of Columbia region is made up of crystalline rocks, principally granite, granite gneiss, schist, and diorite. Their geologic age has been considered to be pre-Cambrian (the oldest of the geologic ages), but no evidence has been cited to justify a positive age assignment. Most important for the purpose of this report is the fact that the crystalline rocks are much older geologically than any other geologic formations in the region, and their physical properties contrast sharply with those of the generally unconsolidated sedimentary formations found in the eastern part of the District. Where the crystalline rocks have not been affected by weathering processes, they are hard and either massive or slabby.

The granite gneiss is described by Keith⁵ as composed mainly of quartz, feldspars (orthoclase and plagioclase), and micas (muscovite and biotite), with small amounts of garnet, chlorite, hornblende, tourmaline, and pyrite. In places the rock contains scattered segregations or "eyes" of quartz and other minerals. The rock is gray on fresh exposures, and its generally slabby character causes it to break more easily parallel to the gneissic banding. Much of this rock could be termed "mica schist" where the mica content imparts a tendency to cleave parallel to the orientation of the mica flakes. The granite gneiss, including the schistose phases, is the most widespread of the crystalline rock types in the District. Quartz veins of varying widths are common throughout the gneiss and schist. Because quartz is resistant to disintegration by

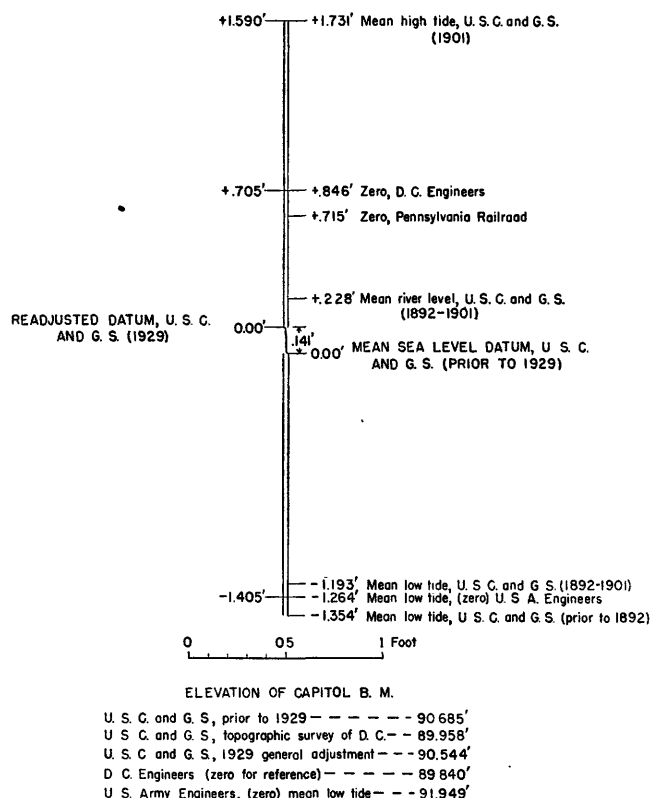


FIGURE 1.—Diagram showing different datum planes used in the Washington area.

⁴ Cady, R. C., Ground-water resources of northern Virginia: Virginia Geol. Survey Bull. 50, 200 pp., 1938.

⁵ Darton, N. H., and Keith, Arthur, op. cit.

weathering, large fragments of quartz may be encountered at shallow depths where the enclosing rocks are thoroughly disintegrated to a sandy soil.

A large body of diorite underlies Georgetown and extends northward to the District line. Where freshly exposed, the diorite is a hard, massive rock of dark gray color due to its hornblende content, which increases near contacts with other rock types. Fresh exposures are uncommon and the soil which forms on the weathered diorite is characteristically brownish-red.

Various younger intrusive bodies of granite have been identified among the crystalline rocks. A granite with conspicuous biotite flakes extends along the west side of Rock Creek Valley, notably in the valley of Broad Branch where it has been quarried. Small lenticular bodies of soapstone and talc schist, which are the metamorphic representatives of ultra-basic igneous rock types, have been identified in this general region. Because the crystalline rocks are so generally altered by weathering, the various rock types are not easily identified and the present geologic picture of the crystalline bedrock is incomplete.

The crystalline rocks are traversed by breaks or cracks, called joints, which are especially conspicuous in quarries and ledge exposures but which extend far underground. The joint system consists of two or more sets of parallel fractures. The weathering of the rocks has been facilitated by the existence of these fractures which permitted the entrance of water into the rock mass.

The crystalline rocks lie at the surface in the northwest part of the area. Their outcrop forms an irregular northeast-trending belt roughly parallel to the northwest boundary of the District (see pl. 1). For long periods during geologic time these rocks have been exposed to weathering and in places they are disintegrated to depths as great as 50 feet. In records of many borings these weathered crystalline rocks have been identified as "rotten rock". Natural exposures of sound rock are generally limited to the Potomac River valley and its tributaries within the outcrop belt. The cutting of these valleys below the general land surface

has removed the weathered material and the original character of the various crystalline rock types can best be observed in the Potomac gorge near Chain Bridge and along Rock Creek.

SEDIMENTARY FORMATIONS

Several unconsolidated sedimentary formations overlie the crystalline bedrock in the District of Columbia area.⁶ Their general relations are shown in figure 2, and they are described briefly below in order from oldest to youngest.

Potomac group.—The oldest of the unconsolidated sedimentary formations in this area are of Lower Cretaceous age and belong to the geologic unit known as the Potomac group. These sediments overlie the bedrock floor in a wedge-shaped mass that thickens rapidly eastward to nearly 1,000 feet. The sediments are varied in texture and color; sand and clay predominate, in places occurring in separate lenses, but more generally mixed in varying proportions. The basal beds, which are exposed at the surface in the western part of the area, are generally drab gray and coarse, including gravel and arkose (coarse sand containing feldspar) derived from the disintegration of the old crystalline rocks. The basal beds generally yield artesian water. The upper beds, which underlie the eastern part of the area, include clays of a variety of colors, chiefly pink, red, gray, and buff, and interbedded lenses of light-colored sand much of which is cross-bedded. Local concentrations of iron oxide have cemented the sands into discontinuous black bands that are generally less than an inch thick and very hard. The Potomac group is the most extensive of the sedimentary units in the Washington area. Sediments of the Potomac group are naturally exposed on valley slopes in a broad belt that includes all but the northwestern edge of the District of Columbia.⁷ Except in the northeastern part, the exposures are discontinuous

⁶ Darton, N. H., (Map of) Sedimentary formations of Washington, D. C., and vicinity, U. S. Geol. Survey, 1946.

⁷ Darton, N. H., Sedimentary formations of Washington, D. C., and vicinity, U. S. Geol. Survey, 1946.

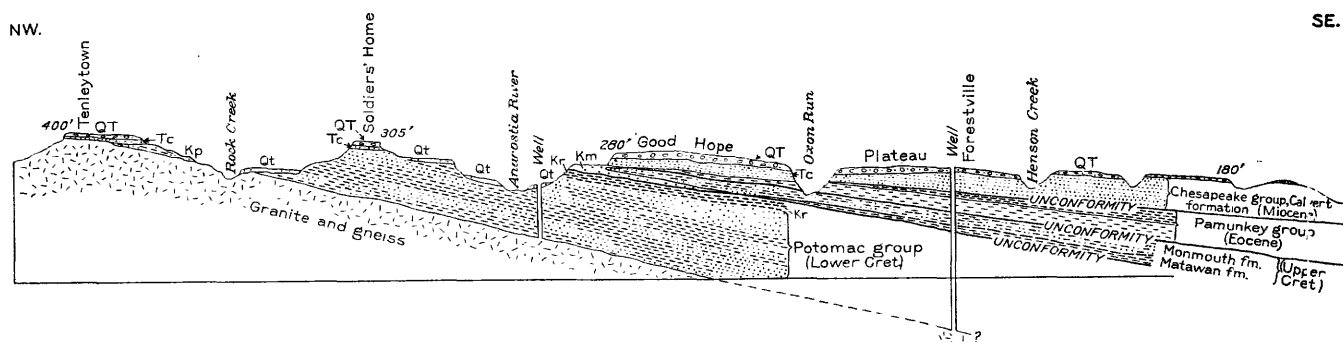


FIGURE 2.—Geologic section across the District of Columbia area, showing the succession and general relations of the principal sedimentary formations. Kp, Potomac group (Lower Cretaceous); Kr, Raritan formation (Upper Cretaceous); Km, Magothy formation (Upper Cretaceous); Tc, Calvert formation of Chesapeake group (Miocene); QT, upland gravels (Pleistocene and Pliocene?); Qt, terrace deposits (Pleistocene).

because younger gravel deposits cap the Potomac group in the higher interstream areas, and the valleys have been partially filled with terrace deposits and alluvium associated with the main streams.

Upper Cretaceous and Tertiary formations.—Overlying the Lower Cretaceous Potomac group are the Upper Cretaceous Raritan, Magothy, and Monmouth formations, the Eocene Pamunkey group, and the Miocene Chesapeake group which is represented in this area by the Calvert formation. These formations are sedimentary sands and clays, generally unconsolidated except for concretions and thin bands that have been cemented by local deposition of iron oxide. All these formations crop out east of the Anacostia River, and their areal distribution is shown on the geologic map of the sedimentary formations of Washington, D. C., and vicinity, previously mentioned. The Calvert formation overlaps older units and it is the only one of these formations that has been recognized west of the Anacostia River. The Calvert is made up of very fine sand mixed with clay. Where fresh it is dark gray to olive green and compact; weathered outcrops are soft gray and buff sands. Outliers of the Calvert formation, either overlying the Potomac group or resting directly on crystalline rocks, are found at Soldiers' Home, Tenleytown, and even farther west in Virginia.

Upland gravels.—The old high plain of the District of Columbia area was formerly mantled by a sheet of gravel, sand, and orange loam of probable Pliocene (Tertiary) and Pleistocene (Quaternary) age. These deposits, now 20 to 30 feet thick, constitute a wide, gently sloping plateau southeast of the District, but within the District they have been mostly worn away by erosion. Remnants remain at Reno Reservoir, which is the highest point in the District, and at Mount Alto, Soldiers' Home, and Good Hope Hill.

Terrace deposits.—Most of the older part of the city of Washington is built on a succession of terraces that descend from the old high plateau to the flats along the Potomac and Anacostia Rivers. The highest terraces are the oldest. These terraces are formed chiefly of gravel, sand, and loam of Pleistocene age and are 15 to 40 feet thick. In most of them the basal part is a mixture of sand, pebbles, and boulders. Terrace deposits underlie the Mount Pleasant area, Capitol Hill, and much of downtown Washington.

Alluvium and artificial fill.—The low lands along the Potomac River and its tributaries are mainly deposits of sand and clay laid down by the streams in Recent time. They contain a preponderance of fine-grained material and mostly slope down to and below tide-water level. The thickness may be as much as 25 feet. In the lower parts more or less additional sediment is brought down by every freshet. The most extensive areas regarded as alluvium are the lowest parts of Washington as far west as the mouth of Rock Creek

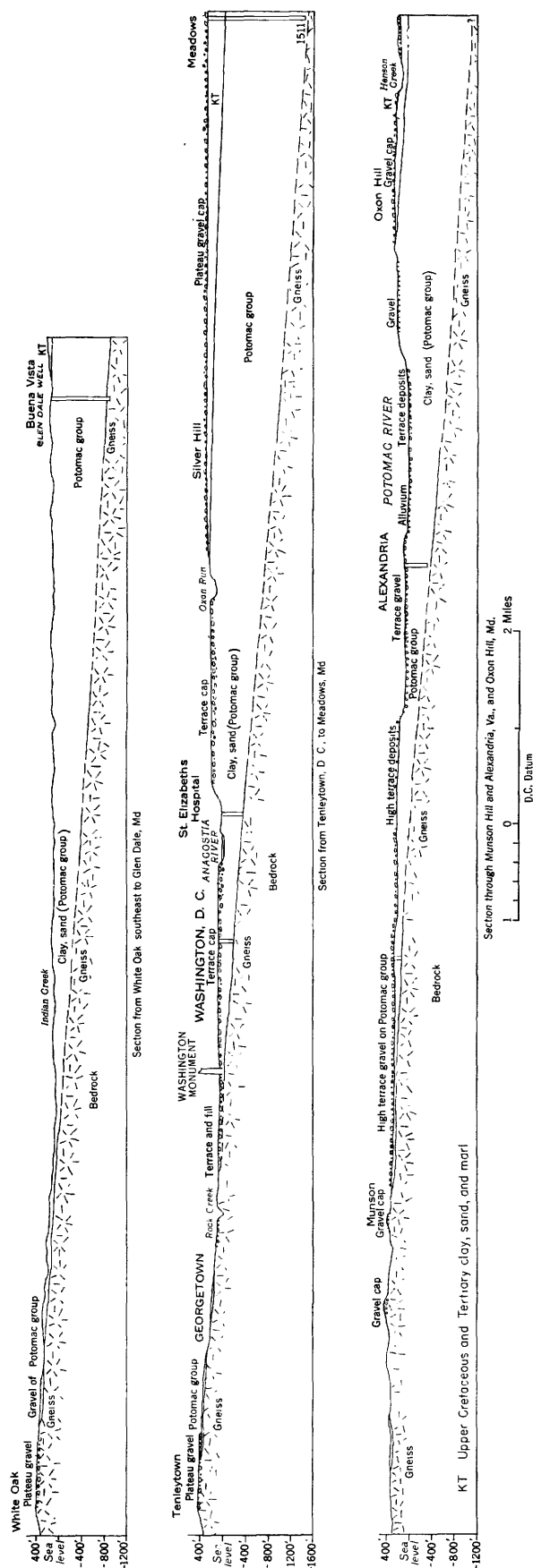


FIGURE 3.—Sections across the Coastal Plain-Piedmont overlap in Maryland, District of Columbia, and Virginia, showing relations of bedrock floor.

and the flats on both sides of the Potomac and Anacostia Rivers. Some of the lands bordering the rivers are the result of artificial filling by man. The tidal flats along the Potomac and Anacostia Rivers, the wide area of the National Airport, and the lower parts of Potomac Park were reclaimed by filling.

BEDROCK CONTACTS GENERAL RELATIONS

In most drilling operations and excavations to reach bedrock in the District of Columbia region, the overlying materials are found to be the gravel, sand, and arkose of the Potomac group near the western margin of its outcrop area; the various river-terrace deposits; the alluvium in the lower lands along Potomac River; wash on slopes; and extensive fill by man, notably in the low areas formerly occupied by tide marsh.

Under most of the city of Washington and area to the east the bedrock is immediately overlain by gravel, sand, and in some places clay, of the lower part of the Potomac group, as shown in figure 3. To the west, however, where the bedrock floor rises to sea level and above, the Potomac deposits were deeply trenched and widely removed by erosion in later Cretaceous, Tertiary, and Quaternary times, and in consequence the bared rock surface in some areas is overlain by sediments younger than those of the Potomac group, as shown in figure 4 and plates 5 and 6.

The general slope of the bedrock surface beneath the sediments is between 100 feet and 150 feet per mile toward the southeast, as shown by the subsurface contours on plate 1, but the rate varies locally. Although the generalized picture shows an evenly sloping plane surface, closely spaced borings at individual building sites reveal irregularities in the surface where detailed

information is available. Such irregularities are the product of the events that comprise the geologic history of this area. The eroded surface of the bedrock formations was irregular at the time the earliest sediments of the Coastal Plain were deposited. Erosion in more recent geologic time was responsible for additional irregularity as, for example, the removal of the sedimentary formations of the Coastal Plain sequence by an ancestral Potomac River above the present site of the Tidal Basin.

Owing to the low rate of the eastward slope of the formations of the Potomac group, the basal contact with the crystalline rocks ascends very gradually the interstream ridges to the west. Exposures of the lower deposits of the group extend eastward on a low grade down the valleys leading out of the Piedmont region. Many small outliers are left on the gneiss highlands to the west.

The boundaries given on plates 1 and 2 are based on detailed mapping of geologic contacts. The contact of the Potomac deposits with the bedrock was readily located at most points, but during Pleistocene time there was much terracing at different altitudes along the overlap zone of the Potomac basal beds. As a result some of the terrace deposits seem to be indistinguishable from the much older gravels and sands of the Potomac group that they overlap. This is especially true where the terrace materials were derived from nearby Potomac beds. Where arkosic materials exist the deposits have been readily classed as Potomac, especially if they lie on a floor with pronounced slope to the east. Ordinarily the gravel of the Potomac group contains more vein quartz and fewer quartzite pebbles and boulders and is finer-grained than the terrace deposits.

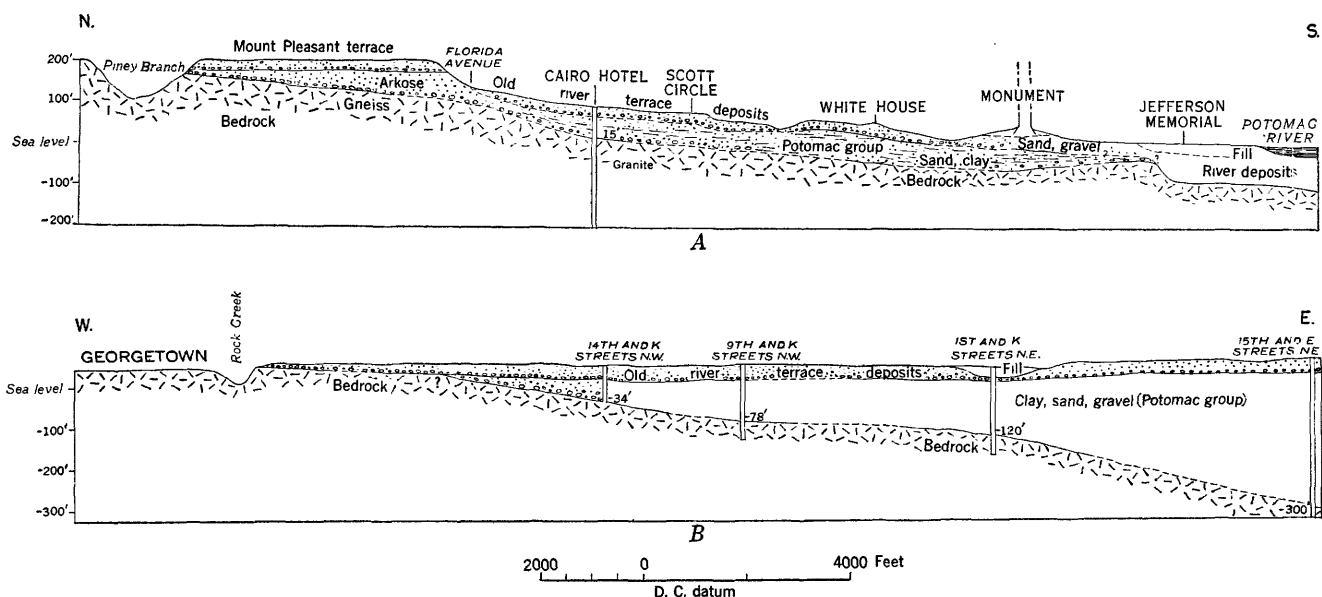


FIGURE 4.—Sections through Washington showing relations of bedrock and overlying formations. A, North to south along Sixteenth Street; B, West to east from Georgetown to Fifteenth and E Streets NE.

TENLEYTOWN RIDGE

On the Tenleytown ridge west of Rock Creek, which is followed by Wisconsin Avenue, an extensive outlier of arkose (feldspathic sand) and gravel of the Potomac group lies on the floor of crystalline rocks. This floor slopes from an altitude of 350 feet on Wisconsin Avenue near Quebec Street and on Massachusetts Avenue near Forty-second Street, to 240 feet on Thirty-ninth Street just north of T Street and to 210 feet a short distance south of the United States Naval Observatory. Small outliers cap the high summit near Fortieth and U Streets, the ridge on Foxhall Road north of W Street, the hill at the Bureau of Standards, and other high summits near Military Road, notably at Fort De Russey and knolls north and south.

Much of the material of the Potomac group in this area is gravel, as shown in plate 3, A, but in places this grades into or is overlain by arkosic gravelly sand, distinctively Potomac. The Potomac group is overlain and overlapped by the fine-grained buff sand of the Calvert formation (Miocene), which in turn is capped by the orange loam gravel of the high plateau (Pliocene? and Pleistocene) that forms the smooth surface of the ridge to its abrupt termination at an altitude of 410 feet at Tenleytown. The principal relations are shown in figure 5. Some of the finest exposures of this

local variation of rate and many small irregularities of contour. The Potomac group on the Tenleytown ridge may be 40 feet thick near Calvert Street and the Naval Observatory, but it thins to the north and disappears in the northwestern part of Cleveland Park. On Ordway Street near the line of Thirty-first Street the basal material is a thick bed of coarse gravel.

BRIGHTWOOD TO SILVER SPRING

On the ridge extending north from Brightwood to Silver Spring the Potomac deposits lying on the granite-gneiss floor are thin and mainly of interest as a source of water supply for shallow wells. Many basal contacts with bedrock have been exposed, but at some places there is doubt as to the identity of the beds called Potomac, owing to the presence of terrace deposits. Near the District line and farther north near Silver Spring, the highest ridge is capped by gravel that is believed to represent the old high plateau (Pliocene? and Pleistocene), which here attains an altitude of 350 feet. Much of the Potomac in this region is gravel without special character, but in places it grades into or is overlain by feldspathic sand, and it also grades into sandy clay. The plane of contact with the bedrock slopes southeastward with apparent regularity from the altitude of 350 feet south of Silver Spring to 300 feet near

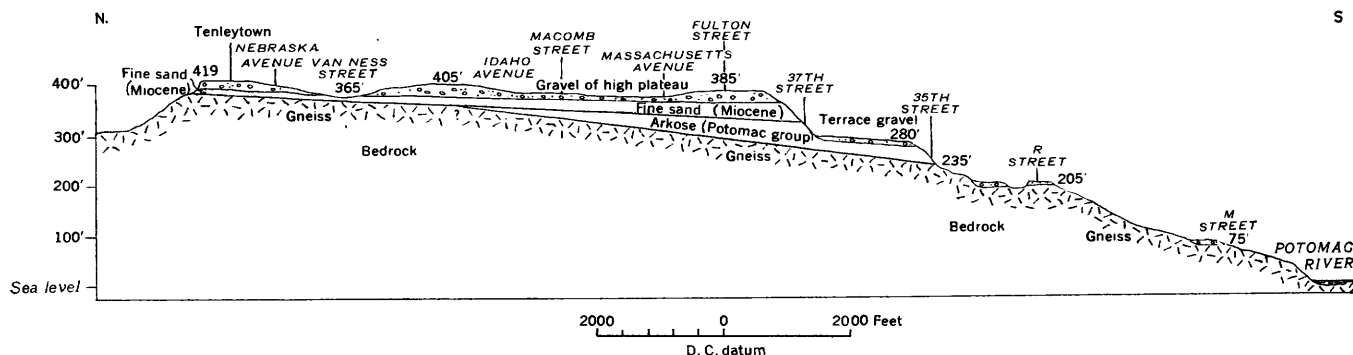


FIGURE 5.—Section along Wisconsin Avenue from Tenleytown to Potomac River.

succession formerly were to be seen in cuts on Wisconsin Avenue, Tunlaw Road, and Calvert Street, all on the ridge now occupied by Mount Alto Hospital, part of which is shown in plate 3, B. There were other good exposures of the Potomac gravel and arkose in the higher parts of Cleveland Park; at the north end of the ridge on Foxhall Road near an altitude of 340 feet; on Woodley Road; on Fortieth Street just south of Calvert Street; on the Naval Observatory ridge and in the ridge followed by Wisconsin Avenue, notably on the west side of Wisconsin Avenue just north of Hall Place; and in cuts on Thirty-seventh Street near U Street, Whitehaven Parkway at Thirty-fifth Place, and along the small stream west of the Naval Observatory. At most of these places the contact of gravel on the gneiss was visible. This contact slopes down to the southeast at a rate of about 100 feet to the mile, with

Walter Reed Hospital, to 250 feet near Takoma Park railroad station, and to 200 feet in the valley half a mile east of Brightwood, a rate that continues far to the east.

TAKOMA PARK TO PAINT BRANCH

From Takoma Park eastward to Paint Branch the western part of the Potomac deposit forms a gently eastward-sloping upland that is deeply trenched by valleys. The gravel, the sand, and locally the clay lie on a nearly plane surface of the bedrock, which slopes eastward at a uniform rate. This surface is not a perfect plain however, but presents low mounds and shallow valleys. Near Lewiston, it has an altitude of 220 feet; it goes under the surface at Paint Branch at an altitude of about 90 feet; and at Branchville it is about 100 feet below sea level.



A. GRAVEL OF POTOMAC GROUP ON GNEISS.

North side of Harvard Street, 200 yards east of entrance to Zoological Park, 1928. Looking north.



B. PLATEAU GRAVEL (PLIOCENE?) ON CALVERT FORMATION (MIOCENE).

Arkose of Potomac group just below. Tunlaw Road north of Calvert Street, on line of 38th Street 1894



TERRACE DEPOSIT OF CAPITOL HILL.

About 250 yards south of the Capitol. Top of terrace is 80 feet above sea level. Geologist stands on the underlying Potomac group.



A. TERRACE GRAVEL AND LOAM ON GNEISS.

N Street near 24th Street, NW. Much of the older part of the city is built on the river terrace deposits. To the east these deposits lie on sand and clay of the Potomac group.



B. TERRACE DEPOSIT CAPPING ARKOSE NEAR BASE OF POTOMAC GROUP.

Cut on east side of 16th Street at Meridian Hill Park, 1900. Later concealed by wall. Top of terrace is 205 feet above sea level.



A. FAULT ON EASTERN EDGE OF ZOOLOGICAL PARK.

Adams Mill Road near Clydesdale Place, 1925. Looking northwest. Fault is between gneiss and terrace gravel.



B. FAULT IN REAR OF CALVERT STREET NEAR ZOOLOGICAL PARK.

Terrace gravel and loam on gneiss, 1901. Looking north. East side had dropped about 2 feet.

In the western part of the city of Washington the surface is a succession of sloping terraces at different altitudes, ranging from the Mount Pleasant terrace (altitude about 200 feet) to the lower terraces in downtown Washington (altitude 100 feet and less). The relations are shown in figures 4 and 5. The basal relations of the conspicuous terrace deposits on which the Capitol is built at an altitude of 80 feet is shown in plate 4; the basal contact of the Mount Pleasant terrace deposits is shown in plate 5, *B*.

In most of the areas from 30 to 100 feet above sea level west of Twentieth Street the Potomac group is absent and the bedrock is overlain by terrace deposits. The western edge of the Potomac group in this part of the city, as determined from scattered data, is shown on plate 1 by a broken line. Many street cuts and excavations from Constitution Avenue to T Street have revealed terrace deposits lying immediately on the gneiss. (See pl. 5, A.) Contacts were exposed in cuts west of the corner of Nineteenth Street and Jefferson Place (between M and N Streets); at 1210 Twentieth Street; on M Street between Twentieth and Twenty-first; at Twenty-first and O Streets; at Twenty-first and P Streets; and at the intersection of Twenty-first Street, Massachusetts Avenue, and Q Streets, where a 2-foot bed of gray sand lies on the gneiss. At 2107 Pennsylvania Avenue, 12-foot pits reached bedrock ("decayed gabbro") under terrace gravel.

SW.

ROCK DECAY

DEFORMATION

Doubtless the bedrock floor under the formations of the Coastal Plain has been flexed and broken to some extent at different geologic times, but evidence as to the course and amount of such flexures and faults is difficult to obtain. Since the widespread leveling of the land in early Cretaceous time the region as a whole has been uplifted and depressed many times. The general trend of these movements has been along northeast-southwest axes, but there probably has been much local variation in trend and amount.

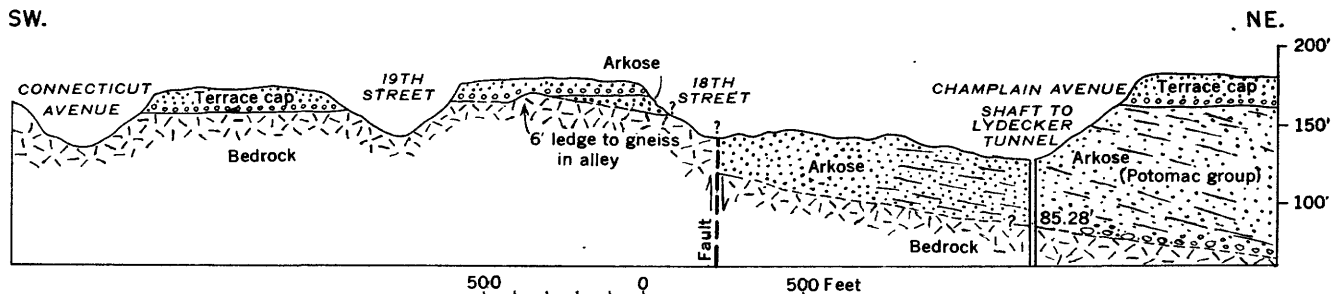


FIGURE 6.—Section across fault at Eighteenth and California Streets NW., looking north.

At the beginning of Potomac deposition, some old fault scarps may have remained, causing local breaks in the bedrock, which now appears to slope regularly eastward. Erosion also produced many local ridges and valleys. The uplifts and submergences of the Coastal Plain in later Cretaceous, Tertiary, and Pleistocene times must have been attended by flexing and faulting, which would affect the position of the bedrock surface, but few such features are revealed. A few faults in bedrock and overlying strata have been observed in the western part of Washington, but the displacement is small and apparently the faults are rather short. Along one fault exposed in a trench on Eighteenth Street near California Street, where arkose of the Potomac group rested on gneiss, there was a drop of 40 feet or more on the east side. (See fig. 6.)

A fault, probably local, in the terrace deposit on Adams Mill Road (see pl. 6, A) has a throw of about 8 feet. Another small fault was formerly exposed in the north side of the alley just north of Calvert Street. (See pl. 6, B.) These exposed faults suggest that others may be present under covered areas.

DISTRICT OF COLUMBIA NORTHWEST WASHINGTON* GENERAL GEOLOGIC SETTING

In the northwest section of Washington, crystalline rocks are exposed at the surface in approximately the western half. The rocks are difficult to identify in most of the area due to deep weathering and soil cover, but they are well exposed in the Potomac River gorge above Georgetown, and along Rock Creek. In the high area including Cleveland Park, Tenleytown, and American University is a large outlier of sedimentary formations which are entirely surrounded by, and underlain by, crystalline bedrock. East of Rock Creek and the Walter Reed Hospital grounds a practically continuous cover of sedimentary formations overlies the bedrock. The greatest variety of foundation conditions are found in the northwest section of the city. The table of borehole data at the end of this report lists the bedrock altitude at many locations, and the subsurface conditions at several building sites in the northwest section are described below.

APEX BUILDING

The site for the Apex Building between Sixth and Seventh Streets, Pennsylvania Avenue and Constitution Avenue, now occupied by the Federal Trade Commission, was explored by six holes about 70 feet deep, with their bottom from 58 to 62 feet below datum. None of the borings reached bedrock, which here lies between 105 and 115 feet below datum. The materials penetrated were clay (15 to 25 feet) containing vivianite grains of bright green color, and clay and sand (50

to 60 feet) including some thin lenticular bodies of gravel. All these probably are river-terrace deposits. No Potomac strata were recognized but it is likely that some of the older strata lie deeper on the bedrock floor, though no suggestion can be made as to their limits. The borings were made by the George Drilling Co., and the records were furnished by the Procurement Division of the Treasury Department.

NATIONAL ARCHIVES BUILDING

Nineteen test borings were made by Battle Bros. at the site of the Archives Building between Seventh and Ninth Streets and Pennsylvania and Constitution Avenues. Nine of them, from 90 to 120 feet deep, penetrated bedrock to a depth of 5 feet. The other 10 were sunk to a uniform altitude of -60 feet (D. C. datum) and ended in sand, clay, or gravel. The location of the boreholes and the altitude of the bedrock surface are shown on plate 7, which gives also an interpretation of the bedrock configuration by 5-foot contour lines. Data from a 628-foot boring made many years ago in the old Center Market on Seventh Street near the corner of Constitution Avenue are added.

As shown in the two cross sections (pl. 7), considerable diversity of materials was revealed by the holes, but fine sands and clays predominated. The upper materials were fill and river deposits, but the deeper holes penetrated compact sands and gravels, most likely of Potomac age. Hole 4, in the northeast corner of the site, entered fine, compact sand at a depth of 43 feet and continued in this material to a basal bed of sand, gravel, and boulders 6 feet thick lying on bedrock at 103 feet below sea level. A similar succession was found in hole 7 in the center of the area. In hole 15, near the southwest corner of the site, the sand and gravel was underlain by 35 feet of sand and some clay, all fine and compact, on bedrock at -74.2 feet. In hole 16 the fine compact sand extends from -38 feet to bedrock at -78 feet. Hole 17 had 30 feet of soft blue clay in its upper part, with fine sand and gravel and fine sand (all compact) for the next 34 feet. In hole 18 clay and sand extended from the surface to a depth of 30 feet below which were 3 feet of sand and gravel, 6 feet of soft sandy silt, and 42 feet of compact sand and clay and sand, to bedrock at -77½ feet. Hole 19 penetrated 40 feet of fill, clay, sandy silt, and thin deposits of gravel, underlain by 54 feet of very compact fine sand, on hard clay with some thin gravel streaks in the upper part, and reached bedrock at -86.8 feet. It seems probable that these compact sands and clays and the local basal gravel represent the lower part of the Potomac group.

INTERNAL REVENUE BUREAU BUILDING

In 1926 nine holes were bored into mica schist at the site of the Internal Revenue Bureau Building, between Tenth and Twelfth Streets, and Constitution Avenue

* See also table, pages 35-36.

and C Street, under direction of W. C. Lyon, of the Office of the Supervising Architect, Treasury Department. They showed that the bedrock surface is very smooth and nearly at an altitude of -60 feet (D. C. datum), declining to -64.7 feet in the southeast corner of the area. The materials penetrated are shown in three cross sections of plate 7.

OLD POST OFFICE BUILDING

The building now occupying the square between Eleventh, Twelfth, C, and D Streets, built in 1892, was occupied for many years by the City Post Office. The site was explored by eight boreholes, 20 to 30 feet deep, sunk in the bottom of an excavation about 15 feet deep. I was consulted as to the underground conditions and predicted bedrock about 70 feet below the surface. Explorations conducted by Bernard Green, Architect of the Library of Congress, revealed that in this area there was at a depth of 35 to 40 feet a deposit of sand with gravel and boulders so compact that piles could be driven into it only a foot or so. This stratum served as foundation for the old Post Office Building, the Evening Star Building, and the north extension of the Raleigh Hotel (E and Twelfth Streets). In the plats it has been referred to as "bedrock", but true bedrock lies considerably deeper. It extends some distance west of Twelfth Street and served as foundation for the Warner Building (formerly Earle) at Thirteenth and E Streets, and other buildings. On Eleventh Street its surface descends to -22 feet (D. C. datum) at the south end of the Post Office Building and to -30 feet at Pennsylvania Avenue. It rises to -21 feet at the north end of the Evening Star Building.

In a letter of April 18, 1898, Bernard Green wrote me as follows regarding the Raleigh Hotel foundation: "The piles stopped at a depth of 37 feet (below curb) in hard material supposed to be rock, but a 4½-foot caisson revealed a bed of large rounded stones closely packed and imbedded solidly in fine sand. The stones were dislodged by the crowbar only with difficulty, and so I adopted that bottom as practically equivalent to solid rock for the purpose of the foundation." This gravel and sand deposit was reached by the piles in the south end of the Post Office excavation, as shown by borehole 3 (pl. 7), and was conspicuous in borehole 1, in the northwest corner of the site of the Internal Revenue Building, where it was penetrated from 26 to 39½ feet (17.5 to 31 feet below D. C. datum). It was underlain by nearly 29 feet of sand—gray above, greenish in the middle, and white below—which lies on mica schist at 59.7 feet below datum and was bored into for 8 feet. A short distance south of this borehole the gravel thins, and apparently it is entirely absent near Constitution Avenue at the site of the Internal Revenue Building, as shown in borehole 4. The bed probably is an old river deposit and occupies a channel, the middle of which extended from Tenth to Thirteenth Streets, near Pennsyl-

vania Avenue. So far as it goes it affords excellent foundations for such buildings as the Star, Raleigh, Harrington, and Warner. How much these buildings have settled since their erection appears not to have been observed. Doubtless they have all gone down a very small amount, for a slight compaction was to be expected of the 30-foot thickness of sand and other porous materials that extend to bedrock.

POST OFFICE DEPARTMENT BUILDING

About 20 test holes were bored at the site of the Post Office Department Building, Pennsylvania Avenue between Twelfth and Thirteenth Streets, in 1931 and 1932. Many of the holes went to bedrock or to "refusal."⁹ The borings were made by several companies and are not all in close accord as to details, but they indicate the configuration of the bedrock surface. One section on plate 7 shows some details in the Post Office Department site and is continued south through the site of the Interstate Commerce Commission Building, repeating records of holes 9 and 29, as given in the two west-east sections through the buildings of the Department of Labor and Interstate Commerce Commission. Some of the difference in names of materials recorded is due to different drillers.

A cross section from west to east across the center of the Post Office Department Building site, shown in plate 7, was condensed from a section made in the office of the Procurement Division in 1931. It shows hole 16 reaching bedrock at -58 feet, but according to a record by the Mott Core Drilling Co. at this place the gneiss was penetrated from -60.7 to -65.7 feet under a foot of "sandy shale." The overlying gravel bed, 25 feet thick, made very hard drilling.

LABOR DEPARTMENT AND INTERSTATE COMMERCE COMMISSION BUILDINGS

The strip of land occupied by the buildings of the Department of Labor and the Interstate Commerce Commission, along the north side of Constitution Avenue between Twelfth and Fourteenth Streets, was explored by holes from 60 to 82 feet deep bored by the Giles Drilling Co. in 1931. It was specified that all holes must penetrate bedrock for 3 feet, but as the penetration was made by a spoon no core could be obtained. The rock samples called "Potomac gneiss" were so soft that they "decomposed in water." At nearly all the holes the overlying material for a few feet consisted of cobbles, boulders, and compact sand, most of which showed considerable mica. Locally silt or clay lay on the gneiss. It is not known whether any of these sedimentary materials represent the Potomac group; at least the greater part appear to be river deposits. Two sections are shown on plate 7.

The holes show a valley in the bedrock surface just

⁹ The term "refusal" is used where the drill points or piles encounter a very hard material that is practically impenetrable. Ordinarily it is bedrock, but in some places it is a boulder or a stony layer.

east of the Department of Labor and a low ridge under the northwest corner of the Interstate Commerce Commission Building. The configuration of the bedrock surface presents considerable diversity, as shown by the 5-foot contours in plate 7.

Other holes bored in part of this area in 1932 and a blueprint of some of the old holes show some slight differences in character and limits of materials and of depth to bedrock, but these discrepancies appear not to be important.

COMMERCE DEPARTMENT BUILDING

Most of the boreholes made to test the underground conditions at the site of the building for the Department of Commerce, Fourteenth to Fifteenth Streets, E Street to Constitution Avenue, passed through 70 to 90 feet of unconsolidated sediment to the bedrock floor. Several records of holes are given in condensed form in the two cross sections shown in plate 7. It seems probable that the lower deposit of sand and clay with some gravel at the base is of Potomac age, at least in part, and that the overlying gravel, clay, and mud are deposits of the lowest terrace or of a deep part of the trough of the old Potomac River, which was excavated considerably below present sea level in this area. The artificial fill is no doubt correctly identified in the records, but apparently its lower limit is not indicated in every borehole. The blue clay at a depth of 20 feet contains numerous scattered grains of the green mineral vivianite, a characteristic feature in this general region.

AMERICAN NATIONAL RED CROSS BUILDINGS

On the block between Seventeenth, Eighteenth, D, and E Streets, test borings were made for the Memorial to the Women of the Civil War, commonly called the Red Cross Building, the World War Memorial Building, and the office buildings of the American National Red Cross. They are shown in figure 7.

Four holes drilled in March 1914 showed the following conditions under the main Red Cross Building, in the east end of the block:

Altitude of land surface and bedrock surface under Red Cross Building

No. of hole	Location	Land surface (feet)	Bedrock (feet)
1	Northwest corner.....	23.25	At -31.3.
2	Southwest corner.....	27	At -34.8.
3	Northeast corner.....	24.3	From -34.2 to -36.2.
4	Southeast corner.....	24.6	From -37 to -39.

The contours of bedrock surface show a low underground ridge with its axis under the northwestern part of the main Red Cross Building. A slight down-slope to the northwest may reach -40 feet near E Street. The "heavy gravel under blue clay" in holes 4 and 5 at the south end of the site of the Red Cross Office Building appears to be underlain by mica rock, which gave

"refusal" to boring at -23.5 in hole 4 and at -23 feet in hole 5. This appears to indicate the presence of an underground ridge 10 feet in height under the southwest corner of this block.

Constitution Hall, on the next square south, and the building of the Pan American Union beyond it are built on piles, and no data have been obtained as to the underlying bedrock surface.

INTERIOR DEPARTMENT BUILDING

A very complete exploration was made of the underground conditions at the site of the new building for the Department of the Interior on the two blocks extending from C to E, Eighteenth to Nineteenth Streets. (See pl. 8.) It consisted of 46 holes 50 to 70 feet deep most of which were extended into the gneiss bedrock, and several test pits. The gneiss is overlain by gravel and sand and a thick body of clay, as shown in the sections on plate 8. The exploration was done in 1935 under the direction of Mr. C. E. Darnall of the Office of the Supervising Architect of the Treasury, and I examined the samples obtained. The location of holes and the configuration of the bedrock surface are shown on the map and sections. (Pl. 8.) The principal contour line, at -30 feet, indicates some slight diversity of configuration, notably a narrow valley in the southeastern part of the area and small hills 5 to 7 feet higher than the valley bottom. In general the bedrock presents a remarkably smooth shelf cut on the gneiss surface in pre-Potomac time, for the lower part of the gravel and sand apparently represents the west edge of the Potomac group. Part of this gravel and sand was exposed in the excavation for footings and cellar, but its identity was not recognized with certainty. The wide shelf of bedrock appears to extend some distance to the south and west.

17TH STREET BETWEEN PENNSYLVANIA AVENUE AND H STREET

In December 1941, six holes were bored to and into bedrock at and north of the Court of Claims Building, in square 167, east of Seventeenth Street between Pennsylvania Avenue and H Street, to ascertain foundation conditions for a heavy building. A prediction that the bedrock was from 65 to 75 feet below the surface was closely verified by the results of the borings, given in figure 8.

The land surface slopes up from an altitude of 55 feet at the south to 67 feet at H Street. The main slope of the bedrock beneath is to the south, probably with local irregularities. The gravel and sand and clay penetrated undoubtedly constitute the edge of the Potomac group, as revealed in the deep excavation for the Hill Building, on the ridge at Seventeenth and I Streets. These are overlain by terrace deposits laid down by an earlier Potomac River. Of the total thickness of sediments penetrated by these holes, 60 to 65 feet deep,

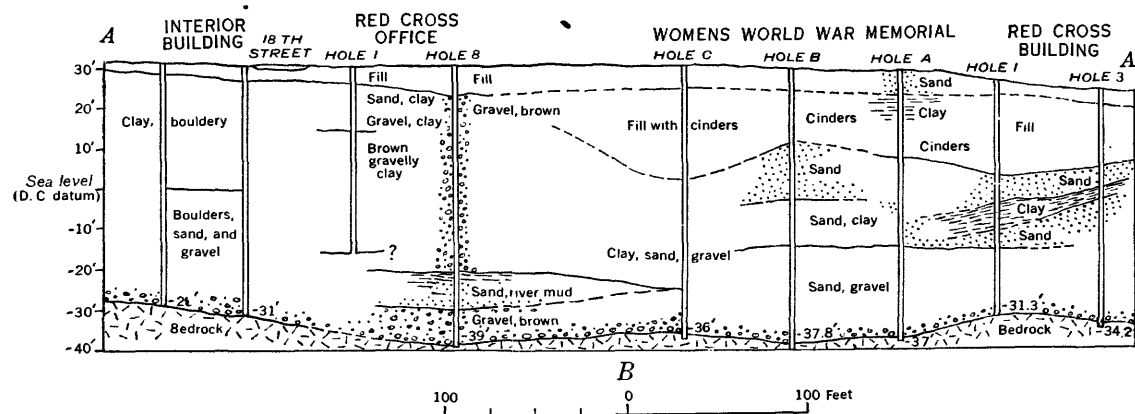
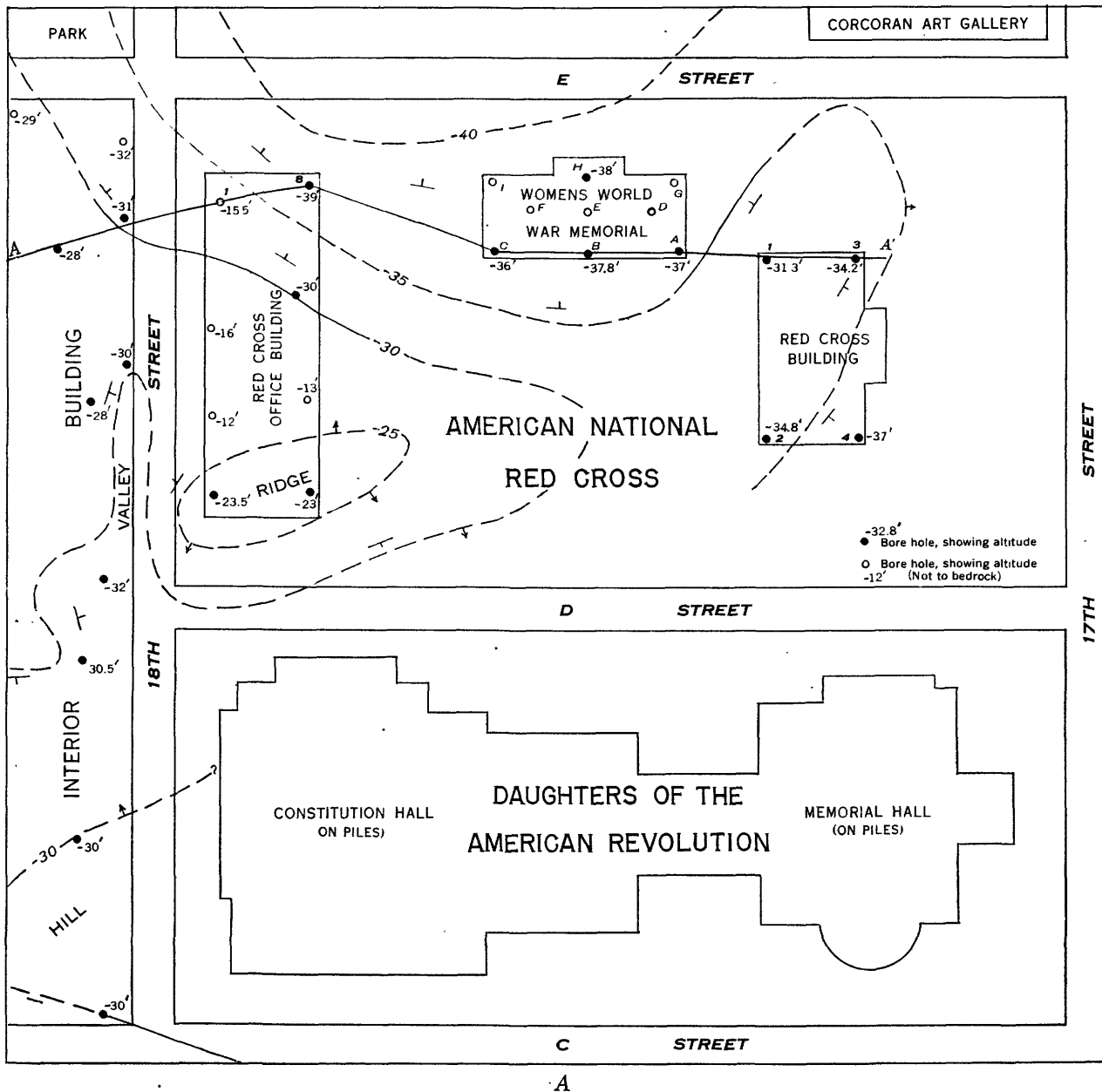


FIGURE 7.—Map and section showing configuration of bedrock surface and boreholes on the site of buildings of the American National Red Cross, between C and E, Seventeenth and Eighteenth Streets NW.

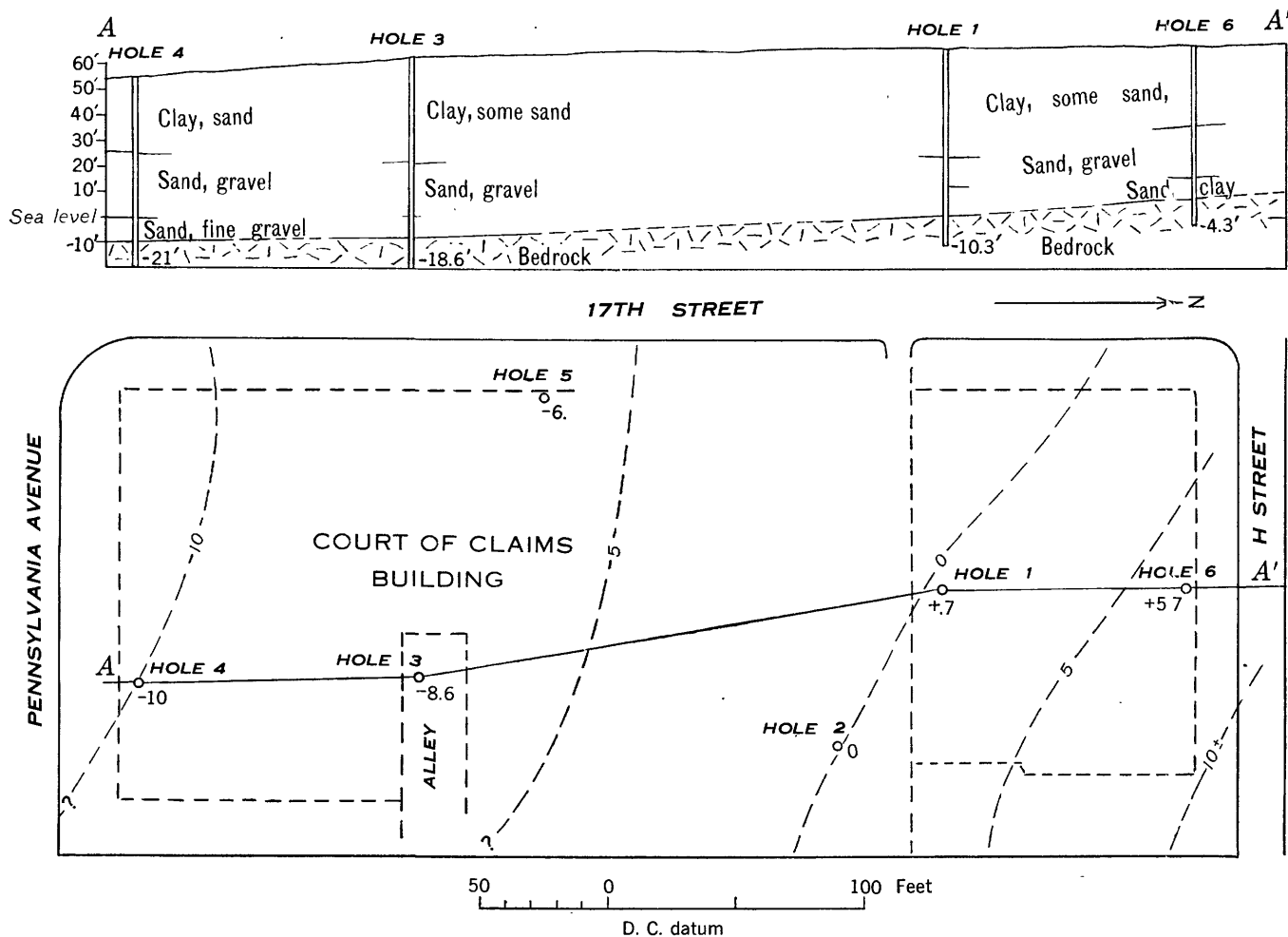


FIGURE 8.—Boreholes and configuration of bedrock surface on east side of Seventeenth Street between Pennsylvania Avenue and H Street NW. From data by Gilbert Brooks, 1941. Figures on the map indicate the position of bedrock in relation to sea level.

about half may be Potomac group trenched by the old valley of Potomac River to within 25 to 30 feet of the bedrock. How far south of Pennsylvania Avenue the Potomac group extends is not known.

Besides showing the position of the bedrock surface the holes afford data as to the character of the overlying deposits. Hole 6 reported considerable coarse sand and gravel from a depth of 32 to 53 feet, and hole 1 was in sand from a depth of 38 to 50 feet. Hole 3 penetrated a mixture of gravel and sand from a depth of 42 feet to bedrock 58 feet deep, and hole 4 from a depth of 32 feet to bedrock at a depth of 65 feet. The top of the bedrock was "soft" for the first foot in holes 1 and 4, for 3 feet in hole 5, and for 1½ feet in hole 6. The rock was penetrated 10 feet or more in all six holes.

19TH AND 20TH STREETS, CONSTITUTION AVENUE AND C STREET

Eight holes bored at the site of the buildings for the Public Health Service, later occupied by the Atomic Energy Commission, in square 128, between Nineteenth and Twentieth Streets, Constitution Avenue and C Street, penetrated gneiss at a depth of about 50 feet. The area is covered with fill 22 to 25 feet thick, lying

on terrace deposits composed of sand, gravel, muck, and clay. The terrace materials were deposited in a wide trench cut into the bedrock by an earlier Potomac River. Plate 8 shows the location of boreholes and altitude of bedrock, and the probable configuration of the bedrock surface is indicated by contour lines. The most noticeable feature is a shallow basin which may extend north to and beyond C Street and east under the southern edge of the Interior Department Building. The borehole data for this area were supplied by the drillers, Sprague & Henwood, of Scranton, Pa., through the Procurement Division of the Treasury Department.

20TH AND 21ST STREETS, C AND D STREETS

At the site of Temporary Building 4, on square 87E, between Twentieth and Twenty-first, C and D Streets NW., 7 test holes were bored in 1930, from 34 to 56 feet deep, all but 1 of them to bedrock. In 1940 14 holes were bored in the south half of this block to afford detail as to underground conditions for a proposed extension of the Federal Reserve Building; these holes were from 44 to 77 feet deep and penetrated the bedrock floor for a few feet. Cross sections showing most

of the features are included on plate 8. The data were furnished by the Corps of Engineers, United States Army. A notable feature in the east half of the block is the slope of the bedrock, which evidently marks the edge of a low ridge extending from the west.

FEDERAL RESERVE BOARD BUILDING

In 1935 12 test holes were bored at the site for the Federal Reserve Building, between Twentieth and Twenty-first Streets on Constitution Avenue; 11 of them penetrated the gneiss bedrock and indicated the configuration of its surface, as shown on plate 8. A

notable feature is a 20-foot valley in the center of the block. The relations of the boreholes are further shown in the cross sections on plate 8. Hole 6 passed through a bed of boulders from a depth of 37 feet to its bottom at a depth of 47 feet without reaching bedrock, which doubtless is not far below. This bed represents part of the filling of the buried valley.

NATIONAL ACADEMY OF SCIENCES

At the site of the National Academy of Sciences Building, between Twenty-first and Twenty-second Streets, Constitution Avenue and C Street, four test

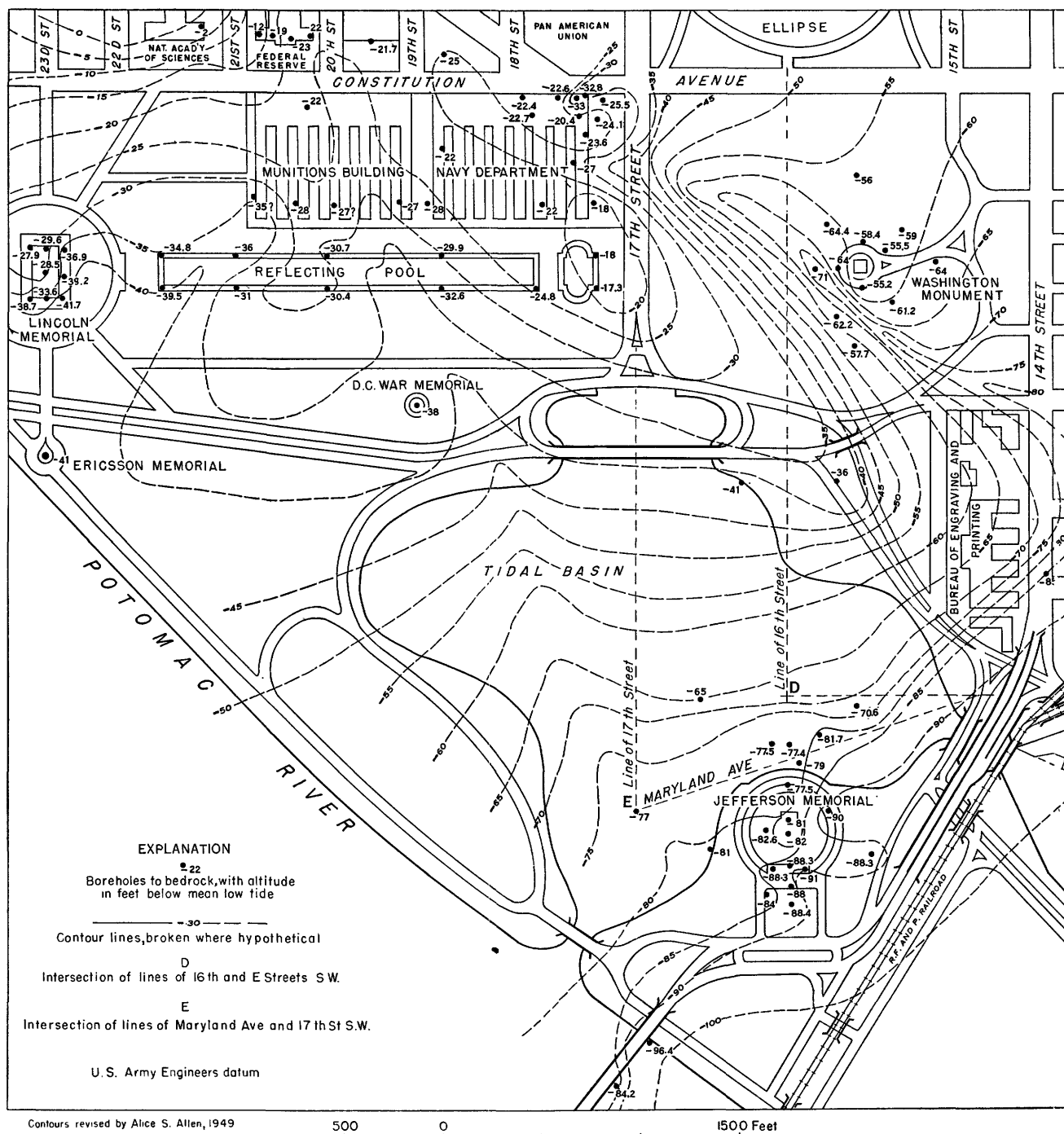


FIGURE 9.—Map of area south of Constitution Avenue and west of Fourteenth Street SW., showing configuration of bedrock surface.

borings were made in 1922 which penetrated bedrock from 6 to 18 feet. In every hole the upper part of the rock was found to be considerably decomposed. The overlying deposit was reported as clay and sand 6 to 28 feet thick, the thickest part being under the southeast corner of the building. The fill, mostly of sand, was 5 to 10 feet thick, the smallest amount being in the southeast corner. The location of the holes and elevation of bedrock are shown in plate 8. The bedrock surface slopes rather steeply to the southeast probably from an underground ridge extending from the northwest, as suggested by the broken contour lines in plate 8. This downward slope to the southeast and south

probably continues under Constitution Avenue from Twenty-third to Eighteenth Streets, as shown in figure 9.

NAVY DEPARTMENT BUILDING

Part of the area on the south side of Constitution Avenue between Seventeenth and Twenty-first Streets has been explored by boreholes. Most of these holes reached bedrock, as shown in figure 9, which shows also the configuration of bedrock in the area extending past the Reflecting Pool, Washington Monument, Jefferson Memorial, and Highway Bridge. Cross sections in figure 10 show borehole data under the Navy Depart-

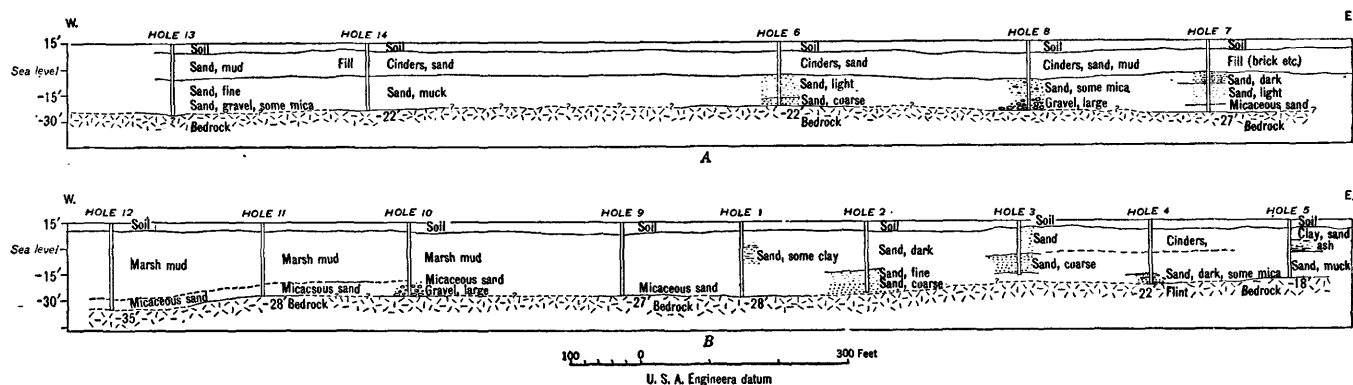


FIGURE 10.—Sections through boreholes at site of Munitions Building and Navy Department Building, 1918. A, 350 feet south of Constitution Avenue; B, 600 feet south of Constitution Avenue.

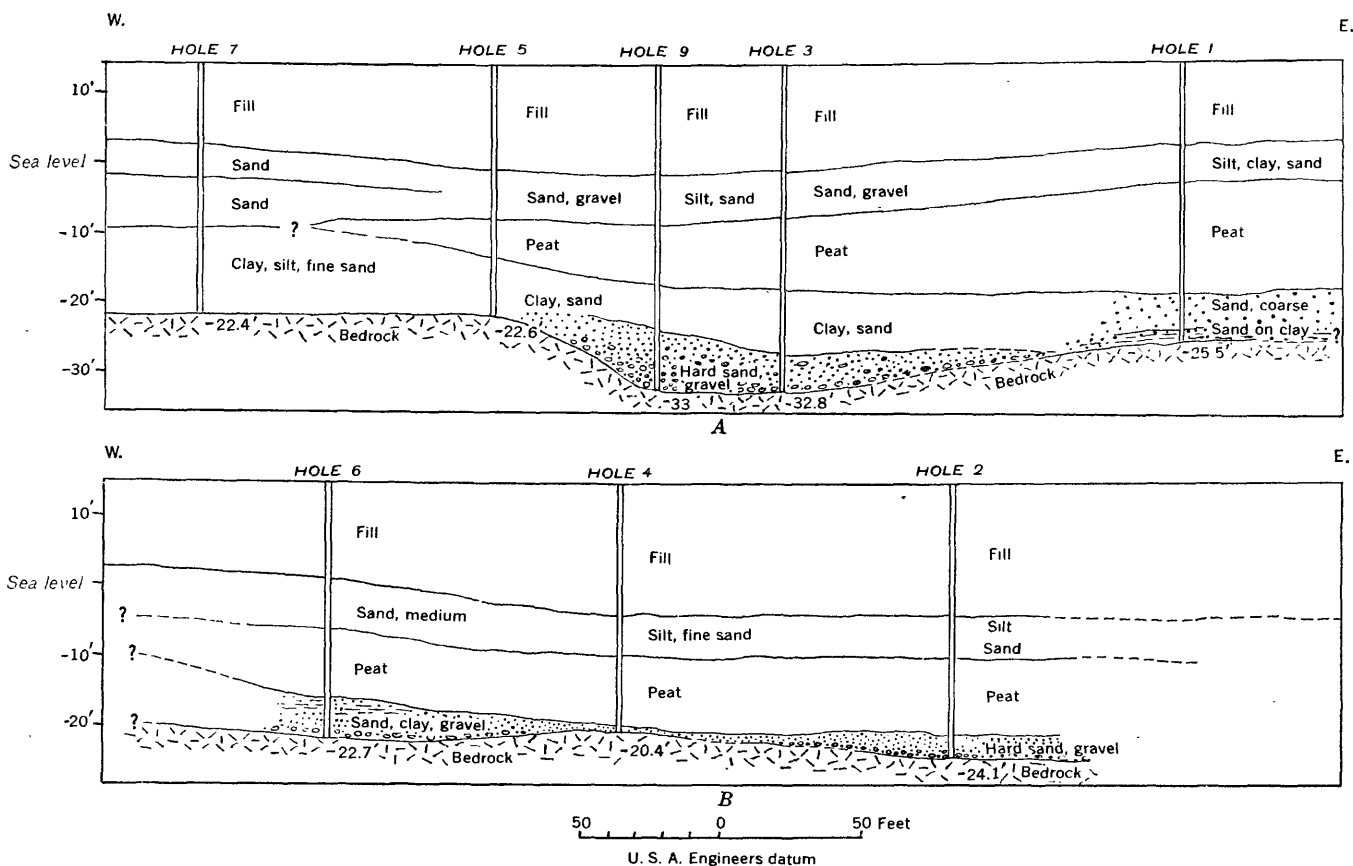


FIGURE 11.—Sections at northeast corner of Navy Department Building. B is about 75 feet south of A.

ment, at Eighteenth Street and Constitution Avenue, and the Munitions Building just to the west, and those in figure 11 represent a later series of holes bored in the northeast corner of the Navy Department area preliminary to repairs necessitated by serious subsidence.

The area west of Twenty-first Street between Constitution Avenue and Lincoln Memorial has not been explored, but it is evident that there is a general downgrade of the bedrock surface south from the Academy of Sciences, where it is near sea level, into the basin a short distance east of the Lincoln Memorial, where the altitude of bedrock is -41 feet. As shown in figure 9, the rock surface east of the longitude of Twenty-first Street forms a wide platform at an altitude of -22 to -32 feet. The bedrock at the east end of the Reflecting Pool and under the southeast corner of the Navy Department Building is higher than -20 feet, indicating an underground "ridge" of considerable prominence.

It seems probable that in all of this area, as well as in much of the area north of Constitution Avenue shown in plate 8, the Potomac group is absent or is represented by only a thin remnant of basal gravel and sand. Most if not all of the material revealed by excavations or borings appears to be a river deposit laid down after a wide trough had been excavated by an earlier Potomac River to a depth of more than 40 feet below present sea level.

STATE DEPARTMENT BUILDING

The building at Twenty-first and Virginia Avenue now occupied by the State Department was erected for the War Department in 1941. In the two squares between Twenty-first and Twenty-third, C and D Streets about 60 test holes and pits were sunk in the autumn of 1938, affording the data given in plate 8 and figure 12. The most marked feature is the rapid rise of bedrock near the line of Twenty-second Street from D to C Streets. Rock was revealed in a 4-foot cut at Twenty-second and C Streets and extended up Twenty-third Street to a point opposite the old Naval Hospital Building. East of Twenty-second Street, except in hole 38, the bedrock was not identified by core samples, but it is highly probable that where the drills showed "refusal" to drive they had reached the bedrock floor. In all the area where this floor lies 30 feet above sea level it is overlain by a body of blue clay believed to be a river deposit of Pleistocene age. The clay is more than 40 feet thick in places and thins out to the west against the upward slope of the rock floor. The mineral vivianite occurring in this clay in small amount is conspicuous by its bright-green color and glistening aspect. Above the blue clay is a terrace deposit of sand and gravel, which contains considerable clay in places and is overlain by a mantle of brown sandy clay averaging about 15 feet in thickness. Next above is a fill of

cinders, sand, and clay, which extends to the surface. The blue clay is part of an extensive deposit occupying a wide area in the lower western part of downtown Washington, and the vivianite is conspicuous throughout. The member of sand and gravel above this blue clay appears to lie on an irregular surface eroded by the running water of a predecessor of the Potomac River.

1ST STREET NEAR R STREET AND FLORIDA AVENUE

A 122-foot hole at 1620 First Street NW., near R Street and Florida Avenue, office of the Fairfax Farms Milk Co., penetrated rotten rock at a depth of 42 to 46 feet below sea level.

Hole at 1620 1st Street NW

	Feet
Clay, yellow, brown, and blue	0-41
Sand with some water	41-74
Clay, blue	74-92
Sand with water	92-101
Clay, blue	101-109
Water sand	109-118
Rotten rock	118-122

4TH STREET AND PENNSYLVANIA AVENUE

A test hole drilled at the corner of Fourth Street and Pennsylvania Avenue, at the site of the proposed Municipal Center, had the following record:

Borehole at 4th Street and Pennsylvania Avenue NW

	Feet
Clay, yellow sandy	0-21
Clay, yellow, with gravel	21-41
Clay, gray with bits of black wood and gravel	41-54
Clay, sandy, yellow	54-62
Sand, gray, water	62-74
Clay, gray, light on dark, with some gravel and black wood	74-103
Clay, sandy, gray	103-107
Sand and gravel, blue-gray, water	107-115
Clay, sandy, greenish blue, some gravel	115-137
Sand, coarse, water	137-145
Clay, sandy, with gravel near base	145-157
Clay, gray, with gravel and wood	157-174
Clay, greenish blue and "rotten rock"	174-176
Rotten rock	176-179

The altitude of the land surface at this place is about 20 feet, and the surface of the bedrock probably is at a depth of 174 feet, or 154 feet below sea level.

JUDICIARY SQUARE

In February 1936 three groups of test holes were bored in Judiciary Square, between Fourth and Fifth, D and F Streets. They were on the site of court buildings and mostly about 40 feet deep. Holes 9 and 15 were deeper, and the drillers suggested that they reached bedrock at depths of 125 and 132 feet, respectively. It seems likely, however, that the holes were

BEDROCK SURFACE OF THE DISTRICT OF COLUMBIA

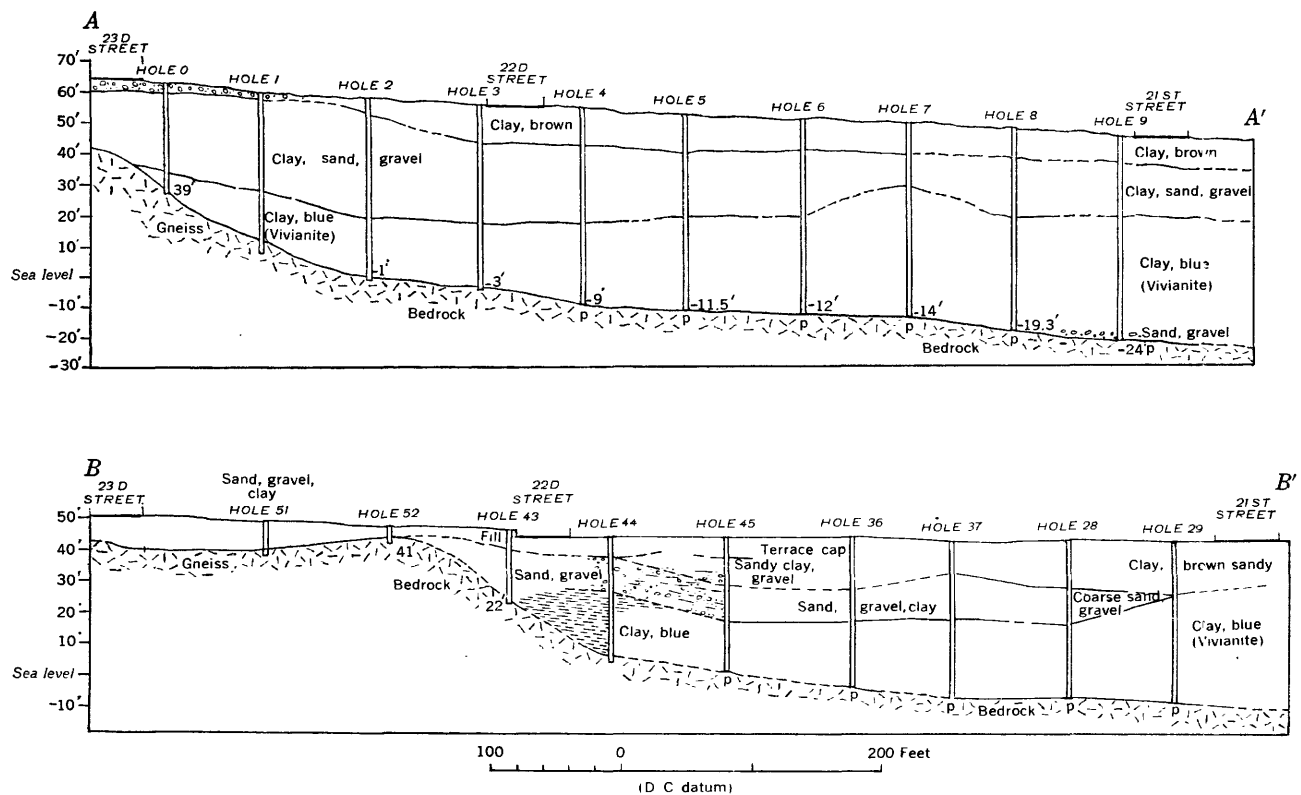
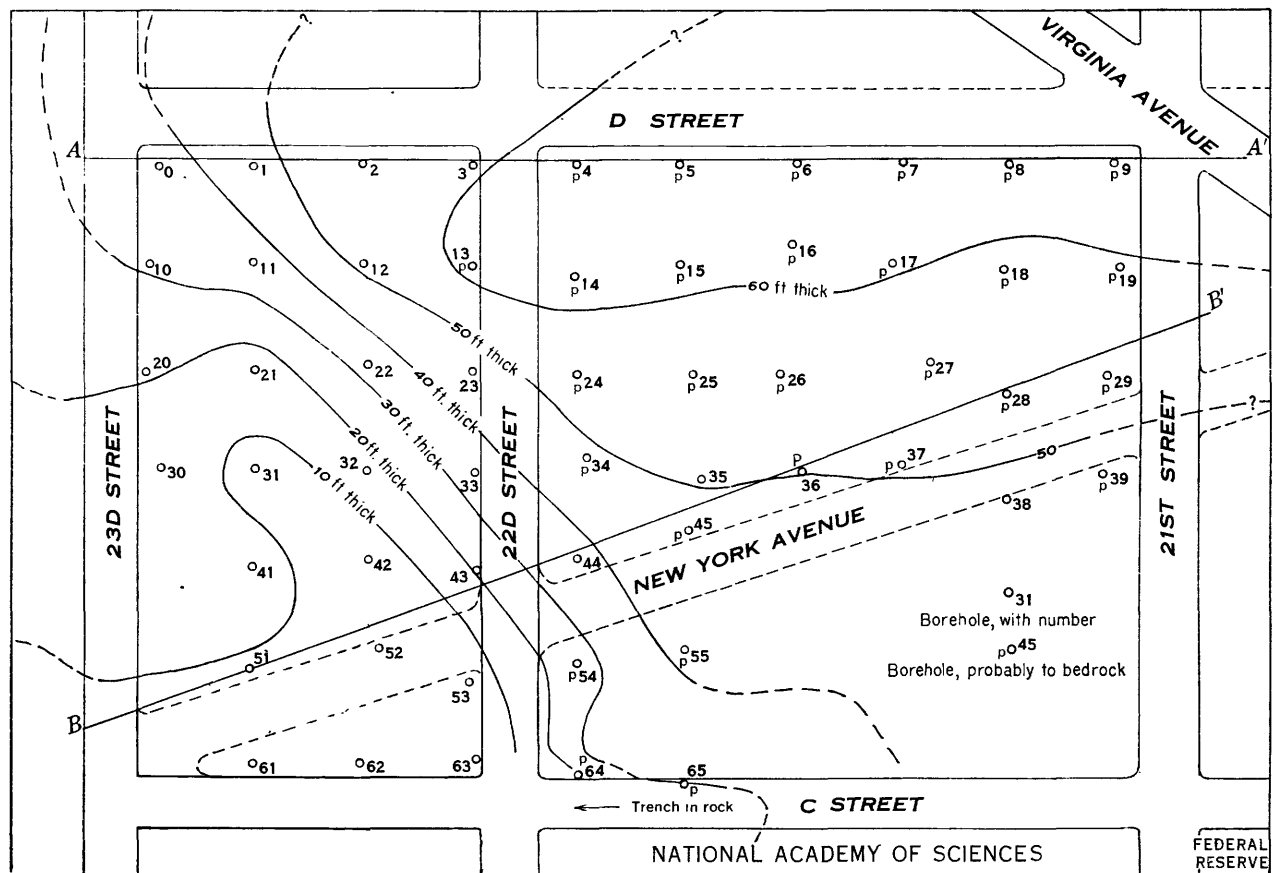


FIGURE 12.—Map and sections at site of State Department Building, between Twenty-first and Twenty-third, C and D Streets N.W., 1938. The 10-foot intervals on the map show the thickness of overburden beneath the natural ground surface; they are not contours.

discontinued about 50 feet above the bedrock. The records are as follows:

Borehole 9, near center of east side of Police Court

	<i>Feet</i>
Loam and clay.....	0-5
Sandy clay.....	5-14
Sand, coarse.....	14-47
Sand and gravel.....	47-60
Do.....	60-73
Sand and boulders.....	73-75
Blue clay, hard, greenish.....	75-85
Sand and clay, some gravel.....	85-95
Sand and clay, bluish.....	95-105
Sand, coarse, bluish, compact.....	105-115
Sand, greenish, very compact, some clay.....	115-125½

Borehole 15, near center of Juvenile Court

	<i>Feet</i>
Loam and clay.....	0-4
Sandy clay.....	4-12½
Sand, coarse, light colored.....	12½-53
Sand, coarse, and gravel.....	53-73
Sand, fine and gravel.....	72-83
Clay, sandy, hard, greenish blue.....	83-93
Clay, sandy, hard, bluish.....	93-103
Sandy, medium, bluish white.....	103-123
Sand, fine, white, wood.....	123-132

Much of this material is of Potomac age beginning at a depth of 75 feet in hole 9 and at 83 feet in hole 15, or even higher.

6TH AND 7TH STREETS, O STREET BETWEEN

A well on O Street between Sixth and Seventh Streets penetrated rock at a depth of 100 to 201 feet.

Record of lower part of well on O Street between 6th and 7th Streets NW.

	<i>Feet</i>
Soapstone.....	100-135
Talcoose slate.....	135-142
Hard soapstone.....	142-192
Gneiss and quartz.....	192-201

10TH STREET BETWEEN D AND E STREETS

A report on a well at the old building of the Washington Gas Light Co., 417 Tenth Street, in 1935, was as follows:

Record of well at 417 Tenth Street NW.

	<i>Feet</i>
Clay and gravel.....	0-8
Clay, blue, stiff.....	8-18
Clay, brown, sandy.....	18-29
Sand and gravel. Water supply.....	29-45
Clay, sandy, blue.....	45-56
Sand.....	56-61
Clay, blue, stiff.....	61-65
Sand and gravel.....	65-76
Clay, black, stiff.....	76-77

11TH AND E STREETS

A well at the Harrington Hotel, E Street between Eleventh and Twelfth Streets, had the following record:

Record of well in basement of Harrington Hotel

	<i>Feet</i>
Clay, blue.....	0-28
Gravel, coarse, and boulders.....	28-45
Clay, sandy, green.....	45-46
Sand, medium fine, grading down into coarse sand and gravel.....	46-57
Clay, blue, tough.....	57-72
Gravel, medium fine, yields 180 gallons a minute.....	72-83

11TH AND G STREETS

The record of the 97-foot hole at the northeast corner of Eleventh and G Streets, formerly Palais Royal, now Woodward & Lothrop North Building, gives sand and gravel at 20 to 40 feet on "crystalline formation," underlain at 80 feet by "gravel or disintegrated crystallines" extending to the bottom. This record might indicate that the bedrock was entered at 3 feet below sea level, but records of other nearby holes indicate that the bedrock here should be expected at about 70 feet below sea level.

14TH AND R STREETS

A borehole at the building of the Chesapeake & Potomac Telephone Co., at the northwest corner of Fourteenth and R Streets, revealed the following:

Borehole at northwest corner of 14th and R Streets NW.

	<i>Feet</i>
Clay, yellow on blue.....	0-21
Clay, brown sandy.....	21-27
Clay, yellow, grading down into bluish-green sandy clay with gravel.....	27-53
Sand and gravel, coarse, with some clay in the middle part.....	53-83
Clay, bluish green, and gravel.....	83-98
Soft "rotten rock" grading down into "very hard rock".....	98-110

14TH STREET NEAR IRVING STREET

A hole at the store of the G. C. Murphy Co., 3128 Fourteenth Street, between Irving Street and Park Road, started at an altitude of 192 feet and passed through rotten rock from 82 to 102 feet. Hard rock may be at an altitude of about 110 feet above sea level.

Borehole at 3128 14th Street NW.

	<i>Feet</i>
Clay and gravel (terrace cap).....	0-28
Fine sand and clay.....	28-41
Clay, yellow, and sand, fine.....	41-47
Clay and sand, gravelly.....	47-54
Sand, gray.....	54-58
Clay, tough.....	58-71
Sand and gravel (at base of Potomac group).....	71-82
Rock, rotten.....	82-102

MAYFLOWER HOTEL AND VICINITY

Many street cuts and other excavations in the lower part of Washington in the vicinity of Seventeenth Street have exposed the deposits lying on the gneiss and other crystalline bedrock, and these deposits have been penetrated by many borings. (See fig. 13.) One of the

S.

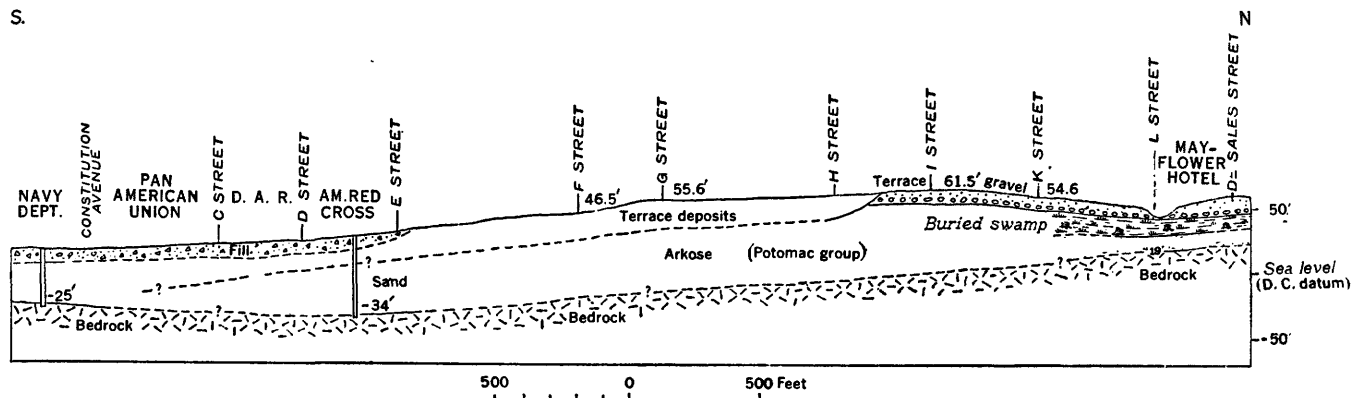


FIGURE 13.—Section along Seventeenth Street from Constitution Avenue to DeSales Street, looking west.

most notable exposures was in the large excavation made in 1922 for the foundation of the Mayflower Hotel (originally called Walker Hotel) on the north half of square 162, bounded by Connecticut Avenue and Seventeenth, L, and DeSales Streets.¹⁰ This excavation was 35 to 40 feet deep in a filled area, the average altitude of which was 57 feet. The gneiss was found at an altitude of 19 feet above sea level (D. C. datum) at Seventeenth Street and sloped upward to the west to an altitude of about 21 feet at Connecticut Avenue. Its surface was nearly smooth.

The gneiss is overlain by about 7 to 12 feet of the basal deposit of the Potomac group, which consists of micaceous gray arkose, mostly gravelly, and grades into a mixture of sand, gravel, and boulders. Some angular masses of schist in the lower part are 1 to 2 feet long. The upper part of the Potomac group is mostly gray sandy clay. Next above is a deposit of light-brown silt, 6 to 9 feet thick, filled with organic matter, including numerous large stumps of bald cypress, some of which were rooted in the top of the underlying sandy clay, and others were scattered at higher levels. These indicate the presence of an ancient swamp. There were many wood fragments and a general admixture of peaty plant material and numerous seeds, all classed as Pleistocene by Berry. A large diatom fauna determined by Mann was classed as pre-Recent. The swamp deposit was overlain by 5 to 15 feet of sandy gravel, sand, and loam, at the top of which was a very thin layer of old soil. Above the old soil was 10 feet or more of artificial fill.

The fossil-wood horizon was found also in an excavation for Stoneleigh Court, at the corner of Connecticut Avenue and L Street, 100 yards south, and in another hole made long ago on the west side of Connecticut Avenue at M Street, about 100 yards northwest.

¹⁰ Wentworth, C. K., Berry, E. W., Mann, Albert, and LaForge, Laurence, The fossil swamp deposit at the Walker Hotel site, Connecticut Avenue and DeSales Street, Washington, D. C.: Washington Acad. Sci. Jour., vol. 14, no. 1, pp. 1-42, pls. 1-4, 1924. Hay, O. P., On the geological age of the Walker Hotel swamp deposit in Washington, D. C., and on the origin and the ages of the Coastal Plain terraces in general: Washington Acad. Sci. Jour., vol. 14, no. 12, pp. 255-264, 1924.

Cuts along L Street between Fifteenth and Sixteenth Streets (1929), notably behind Nos. 1527-1529, showed 2½ feet of arkosic, cross-bedded sand, mostly gray (apparently the Potomac group) overlain by a coarse boulder bed at the base of the terrace deposit. Deep excavations (1926) on the west side of Seventeenth Street halfway from I to K Street exposed light-gray cross-bedded arkosic sand of typical Potomac aspect under 14 feet of terrace deposit (boulders at base, loam above), with a sharp plane of separation. Cuts on the south side of K Street at Nos. 1758-1762 showed 3 feet of typical arkose under brown-red gravel and boulders of the terrace deposits. An 8-foot trench on M Street west of Seventeenth Street showed gray and brown sand very much like Potomac arkose under terrace gravel and boulders, and these deposits were exposed also on Nineteenth Street just south of K Street. None of these excavations, however, was sufficiently deep to reach bedrock, the top of which in this vicinity lies near sea level.

SOLDIERS' HOME

Several wells bored in 1892 at the pump house in Soldiers' Home at an altitude of 209 feet penetrated bedrock, samples of which were examined by me. In one hole soft rock grading down into hard rock was reported at a depth of 163 to 173 feet, and hard "nigger-head" rock from 174 to 478 feet. Well 2 reported soft rock at depths of 173 to 175 feet under greenish clay, and well 5 reached rock at a depth of 165 feet under greenish clay with water-bearing sand at the base.

LYDECKER TUNNEL

The aqueduct tunnel passing under Washington not far north of Florida Avenue to the McMillan Reservoir, known as the Lydecker Tunnel, was entirely in crystalline rock. Several shafts from the surface exposed contacts at the top of bedrock. At the east shaft on the west side of the McMillan Reservoir, dark coarse chloritic rock merging down into chloritic gneiss was entered at a depth of 102 feet. The shaft was sunk at

the bottom of a 40-foot bluff of gravel, sand, and clay. The land surface was at an altitude of 131½ feet. The record, obtained in 1884,¹¹ follows:

East shaft of Lydecker Tunnel at west side of McMillan Reservoir

	Feet
Clay, red and mottled blue and gray under sand (Potomac)-----	0-35
Clay, sandy, mottled-----	35-40
Sand, some clay, some lignite, pyrites-----	40-65
"Kaolin," sandy with thin layers of iron conglomerate-----	65-71
Clay, blue gray-----	71-80
Sand, clayey, red, blue, and gray streaks-----	80-87
Sand, mostly white, red at base-----	87-90
Clay, blue-black, compact, sandy below-----	90-95
Sand, mostly white-----	95-102
Rock, soft, dark, coarse, chloritic; top soft, then blasted-----	102-148½

Figure 14 gives a condensed reproduction of a cross section along the Lydecker Tunnel, compiled from a blueprint in the office of the Corps of Engineers, United States Army. It has the datum of mean high tide. (See fig. 1.) This section indicates that bedrock was entered at an altitude of 29.5 feet at the east shaft, at 43.62 feet at the Thirteenth Street air shaft,¹² and at 85.28 feet (a depth of 45 feet) at the Champlain Avenue shaft, a few rods south of Kalorama Road. The official section does not show the fault with a displacement of about 40 feet that was exposed in 1931 in a trench on Eighteenth Street at California Street. This trench showed typical arkose of the Potomac group on the east side of the fault and gneiss on the west side. The gneiss is exposed for some distance up the slope to the west, where it appears to be overlain by arkose, which probably does not extend quite to Nineteenth Street. The arkose and gneiss west of Champlain

Avenue are thinly capped by terrace gravel and sand, and the smooth surface of the terrace is not broken by the fault. In the Widows Mite air shaft just north of Wyoming Avenue, near the line of Twenty-second Street, the official section shows a capping of "clay and sand 30 feet thick" underlain by 35 feet of "clay," but this is undoubtedly a mistake, as the gneiss has been revealed by many cellars in this vicinity under only a few feet of terrace gravel and sand. In the air shaft on the highest part of the ridge near the corner of S and Thirty-fifth Streets the blueprint of the tunnel section shows 42 feet of "clay" lying on "soft rock" at a depth of 158.7 feet, but in fact the rotted bedrock outcropping extensively in that area is overlain by very thin remnants of terrace gravel at 195 feet above sea level. Probably the clay referred to is mostly rotten rock.

PINEY BRANCH RELIEF SEWER

The Piney Branch relief sewer follows Arkansas Avenue from the vicinity of Decatur Street northeastward to Ingraham Street, where it curves eastward and continues beyond Fifth Street. It is a 9½-foot tunnel in bedrock from the vicinity of Gallatin Street to Seventh Street. The geologic relations as found by wash borings and in the course of its construction by the District of Columbia Department of Sanitary Engineering are shown in figure 15.

Nineteen holes were bored on the line of this tunnel. Their records report sand, clay, and in places gravel on the decayed rock, but except under Ingraham Street from the vicinity of Ninth Street nearly to Fifth Street all this material is valley fill and decayed rock and not the Potomac group. At Eighth and Ingraham Streets a hole entered "very soft decayed rock" at a depth of 10 feet, under compact sandy clay and compact sand (doubtless Potomac), to a contact with bedrock at an altitude of 200 feet (D. C. datum). In the next borehole, 300 feet farther east, the very soft, decayed rock

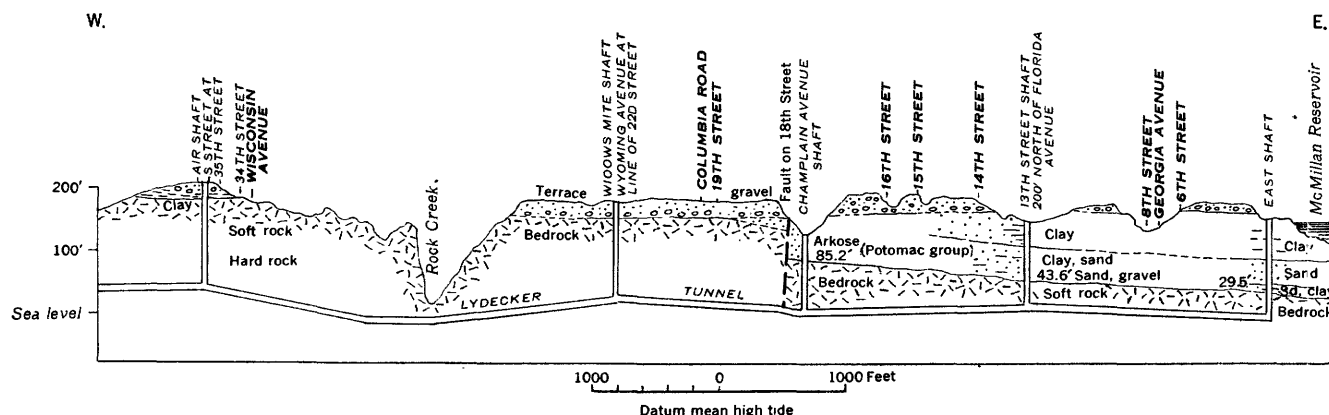


FIGURE 14.—Section along Lydecker Tunnel from the vicinity of Foundry Branch east to McMillan Reservoir. Corps of Engineers, United States Army.

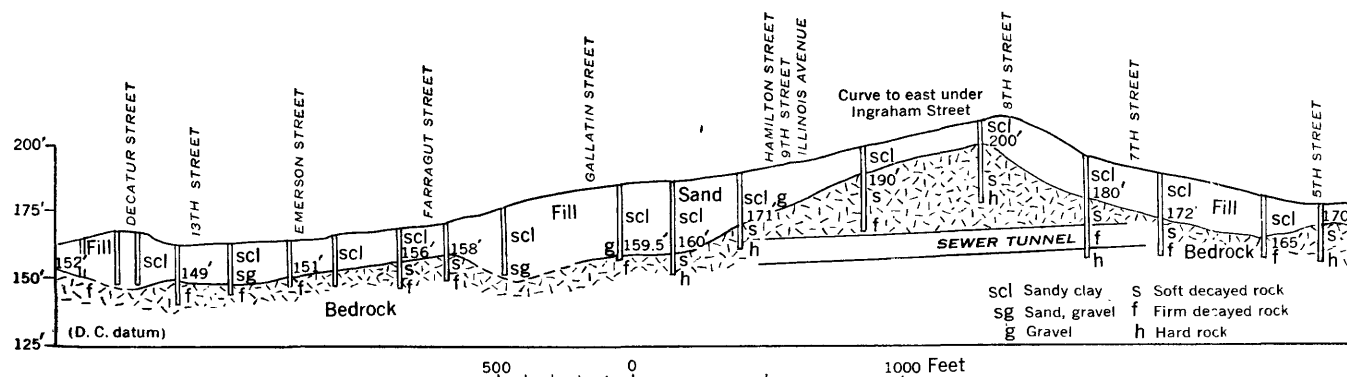


FIGURE 15.—Section along Piney Branch relief sewer, northeast along Arkansas Avenue and east along Ingraham Street NW.

is overlain by 18 feet of soft sandy clay on compact clay sand with bedrock contact at an altitude of 180 feet. A hole just east of Seventh Street reached soft, decayed rock at 13 feet below the surface, or at an altitude of 172 feet. These holes passed through soft, decayed rock to "very firm rock," the surface of which slopes eastward. A short distance down the slope to the east the bedrock was covered by only a thin body of valley fill, under which it was conspicuous in the sewer trench. It is difficult in this area of sand and gravel to distinguish valley fill from the gravel at the edge of the Potomac group unless one is familiar with their character and knows their relations.

CALVIN COOLIDGE HIGH SCHOOL

The site for Calvin Coolidge High School at Fifth and Tuckerman Streets, was explored by 18 boreholes to bedrock. They passed through from 20 to 40 feet of the marginal sediments of the Potomac group, mainly gravel and sand with some clay admixture in places. The holes revealed some diversity of configuration of the bedrock surface, which is shown in figure 16. At the southeast corner there is a descent of this

surface of fully 15 feet, some of which, however, is part of the general southeasterly slope. A buried valley about 10 feet deep passing north-northeast and south-southwest through the center of the site is a marked feature.

SOUTHWEST WASHINGTON ¹³

GENERAL GEOLOGIC SETTING

The Southwest section, the smallest division of the city, presents the least variety in its geologic setting. The entire section is covered by geologically recent river terrace deposits and artificial fill. The depth to bedrock ranges from 50 to 300 feet except at the Reflecting Pool where it is about 25 feet deep. The subsurface conditions in this section are generally characterized by a predominance of fine-grained sediments, a high water table, and a large proportion of area covered by artificial fill material.

Several deep holes in the Southwest section have reached bedrock, or by failing to reach it have delimited its position. Wells at Twelfth and C Streets and at Fourteenth and D Streets reported "rock" very definitely. The 202-foot hole at 623 D Street reported rotten rock at the bottom at -174 feet, unexpectedly deep, but possibly the rock was entered at less depth. There was a report that the 208-foot hole at the old power house, 4½ and O Streets, reached bedrock, below -196 feet, but no evidence was furnished. The 207½-foot hole at Half and T Streets was perhaps 100 feet too shallow to reach bedrock. The report of bedrock in the 146-foot hole at Second and E Streets and Virginia Avenue undoubtedly was an error.

RAILROAD BRIDGE

The bridge over the Potomac River for the railroads to the South crosses from the foot of Fourteenth Street SW. In planning this bridge to replace the old "Long Bridge," several holes were bored to test the foundation conditions. Hole 5 at the northern abutments was entirely in sand, gravel, and clay, mostly if not all river deposits, to an altitude at 122½ feet below mean low

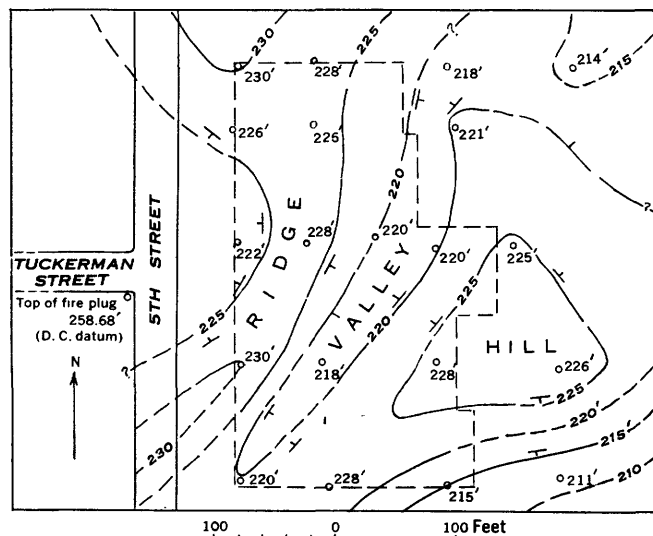


FIGURE 16.—Map showing configuration of bedrock at Calvin Coolidge High School, Fifth and Tuckerman Streets NW. Borings by N. C. Wyeth, 1937. Altitude of land surface, 247.4 feet; top of fireplug at southwest corner, 258.68 feet (D. C. datum).

¹³ See also table, pages 36-37.

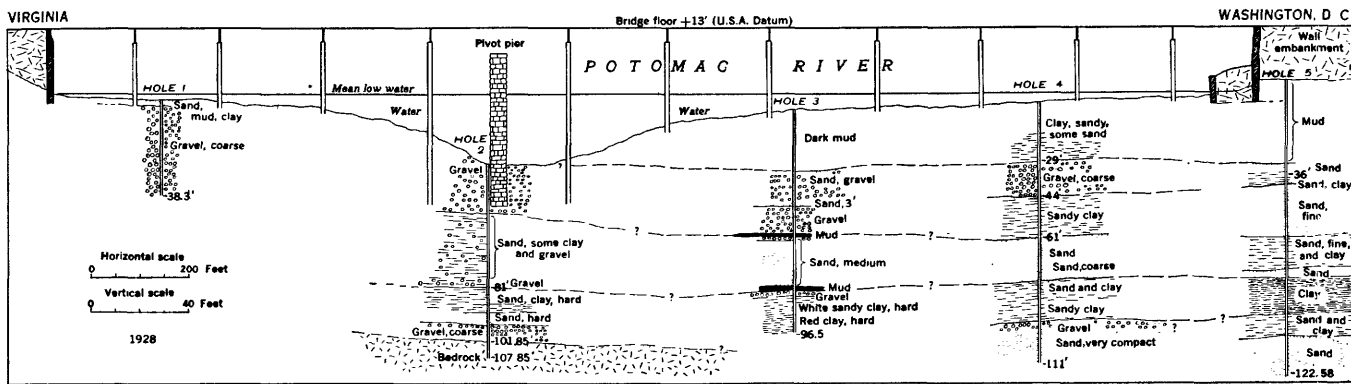


FIGURE 17.—Section across Potomac River at railroad bridge, showing boreholes by Southern Railway. (Datum mean low tide.)

tide. Hole 2, in the bottom of the river near the central pier, entered bedrock at about 102 feet below sea level and penetrated it for 6 feet. A section along the line of the bridge is given in figure 17.

The red clay and hard white sandy clay in hole 3 are very likely part of the Potomac group, and the lower beds in holes 2, 4, and 5 are also probably of that age. The main body of sand, gravel, and mud, however, was deposited by the Potomac River millions of years later after that stream had cut its wide, deep trench during the later part of the long-continued general uplift of the region.

HIGHWAY BRIDGE

In planning to replace the old Long Bridge over Potomac River borings were made in 1903 to ascertain the underground conditions. Three holes reached bedrock from 84 to 110 feet below mean low tide, and five others were sunk nearly to bedrock. The results, kindly furnished by the Corps of Engineers, United States Army, are shown in figure 18. Besides defining the position of bedrock they show a body of river mud 75 feet thick near the northeast abutment and 60 feet thick near the center of the river. Farther southwest this mud gives place to sandy materials, probably by intermingling, for all are river deposits. The lower part of the section is sand and clay with locally a mixture of gravel, probably in part at least of Potomac age.

WASHINGTON MONUMENT

It is popularly supposed that the Washington Monument is built on bedrock, but this unfortunately is not true. Its foundation, a mass of concrete about 37 feet thick and 126½ feet across, lies on sand and gravel about 65 feet above the bedrock floor. This sand and gravel member is separated from the bedrock by 10 to 30 feet of blue clay. In 1898 there was a project to place concrete piers under the original foundation down to bedrock, but after adding to the foundation and placing under it a concrete collar 131½ feet thick it was thought that sufficient stability had been secured, notwithstanding the yielding nature of the underlying deposits. These already had permitted 51½ inches of sinking from 1879 to 1898, but with widened base the amount of subsidence from 1900 to 1930 was only about 0.6 of an inch. The Monument was also made nearly vertical. The load with enlarged foundation is slightly more than 81,000 tons, of which the shaft weighs close to 44,200 tons, or a total of nearly 5 tons to the square foot.

The relations of bedrock at the Monument have been determined accurately by two series of boreholes made by the Washington Monument Committee. The inner series is about 100 feet from Monument, and the outer series is about 400 feet from it. The location of the holes and the altitude of bed rock are shown in figure 19. Some wider areal relations are shown in figure 9.

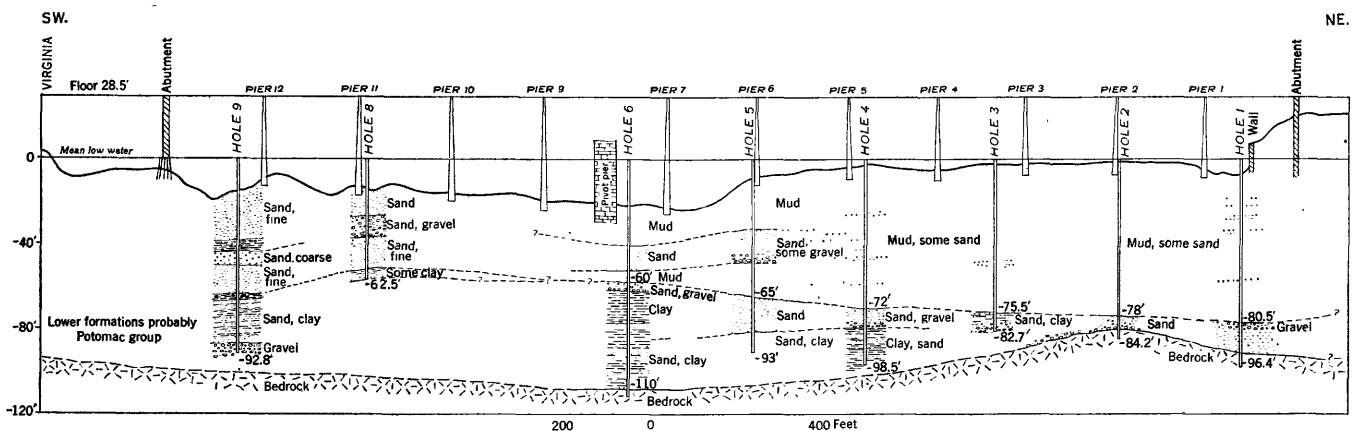


FIGURE 17.—Section across Potomac River at railroad bridge, showing boreholes by Southern Railway. (Datum mean low tide.)

BEDROCK SURFACE OF THE DISTRICT OF COLUMBIA

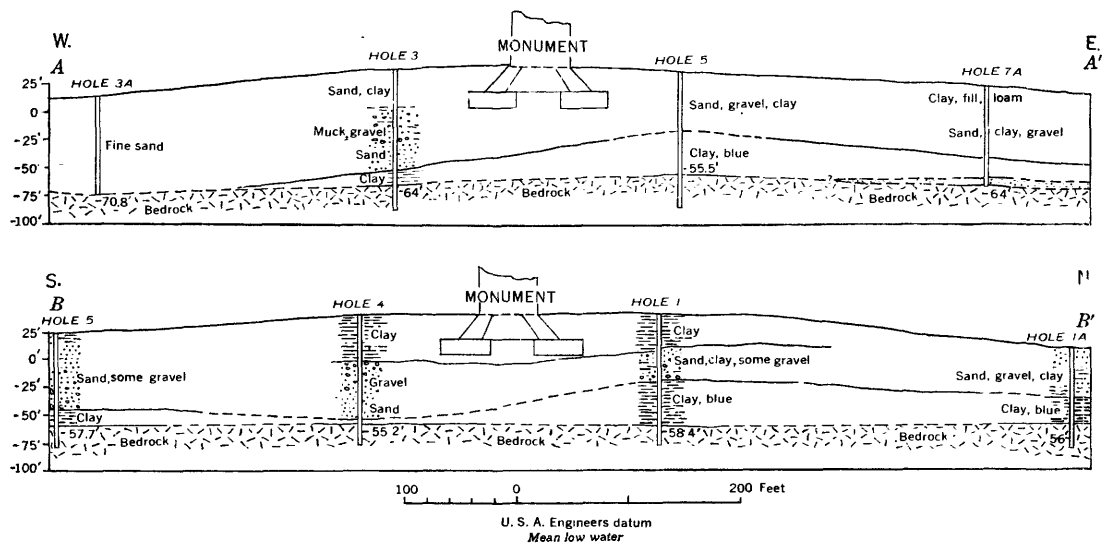
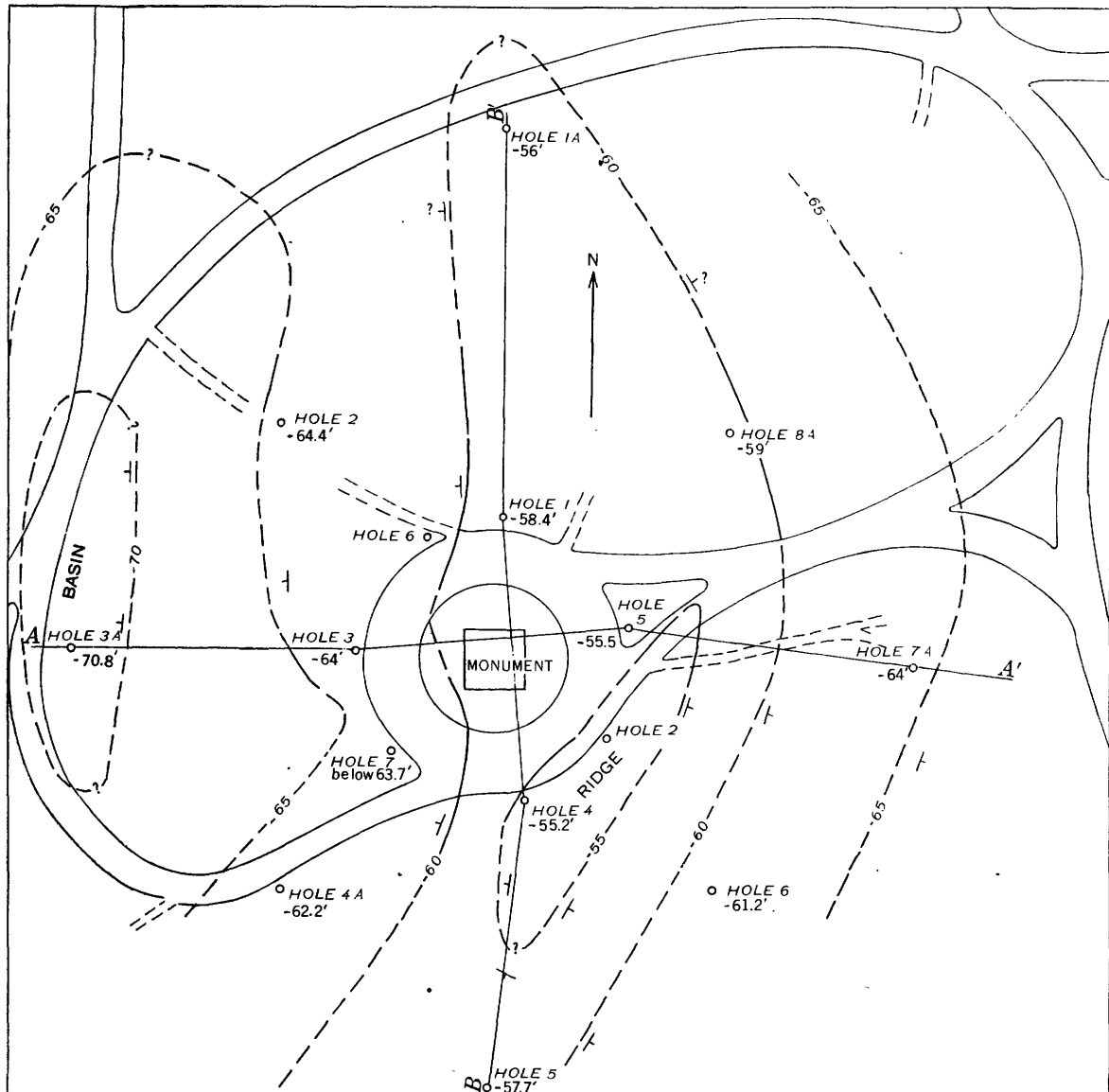


FIGURE 19.—Map and sections near Washington Monument. Based on boreholes by Washington Monument Committee, 1930 and 1931.

The 15 test boreholes about the Washington Monument passed through gravel, sand, and blue clay. At the top is a thick mantle of terrace sand and gravel. The basal beds lie on a low ridge of bedrock. The thick body of the blue clay is regarded by the engineers as a river deposit. "Partly petrified wood" in a thin layer was reported at 47 feet below sea level in borehole 3 (inner series), about 100 feet due west of the Monument, and a thin layer of decayed vegetal matter was penetrated 4 feet below it lying on a foot of white sand. Next below is blue clay, here only 12 feet thick, lying on soft bedrock at $-62\frac{3}{4}$ feet. "Old wood" was reported at -59 feet on the blue clay in hole 7 (inner series), about 100 feet southwest of the Monument. In hole 4 (inner series) "petrified wood" occurs in sand 8 feet above the bedrock, which is at -55.2 feet. These occurrences of vegetal materials are all suggestive of the Potomac group but not proof of its presence, for in places wood occurs in the Pleistocene deposits. The blue clay, regarded as Pleistocene in age, is widespread in the general region of the Monument and was exposed extensively in the adjoining northwest section in excavations at F and Fourteenth Streets, Thirteenth and E Streets, E Street between Thirteenth and Fourteenth Streets, Eleventh Street and Pennsylvania Avenue, and the blocks between Twenty-first and Twenty-third, C and D Streets. Holes 1 and 5 (outer series) penetrated "mica rock" for 20 feet. Holes 1, 3, 4, and 5 (inner series) penetrated "soft rock" grading down into hard rock for 20 to 25 feet. Hole 2 (inner series) reached blue clay at -32 feet, under about 36 feet of sand and gravel, and penetrated it 8 feet to within about 15 feet of the bedrock. Hole 6 (inner series) reached blue clay about -27 feet. Hole 8a (outer series) was in blue clay from -23 to -58 feet, with a small amount of gravel and mica at base.

LINCOLN MEMORIAL

Twenty holes were bored to ascertain the position of the bedrock floor at the site of the Lincoln Memorial at Twenty-third Street. The area was about 200 feet square, on reclaimed river flat with average surface elevation of 16 feet, and the holes were from 42 to 56 feet deep. (See fig. 20.) The material penetrated was mainly river mud down to bedrock. The relations of this area to the Water Gate on the west and Reflecting Pool on the east are shown in figures 9, 21, 22, and 23.

REFLECTING POOL

Eleven holes were bored by the Corps of Engineers, United States Army, to determine the nature of materials under the site of the Reflecting Pool, which lies east of the Lincoln Memorial. The holes are in two lines about 80 feet apart and spaced at intervals for nearly half a mile. Some of the features and relations are shown in figure 21.

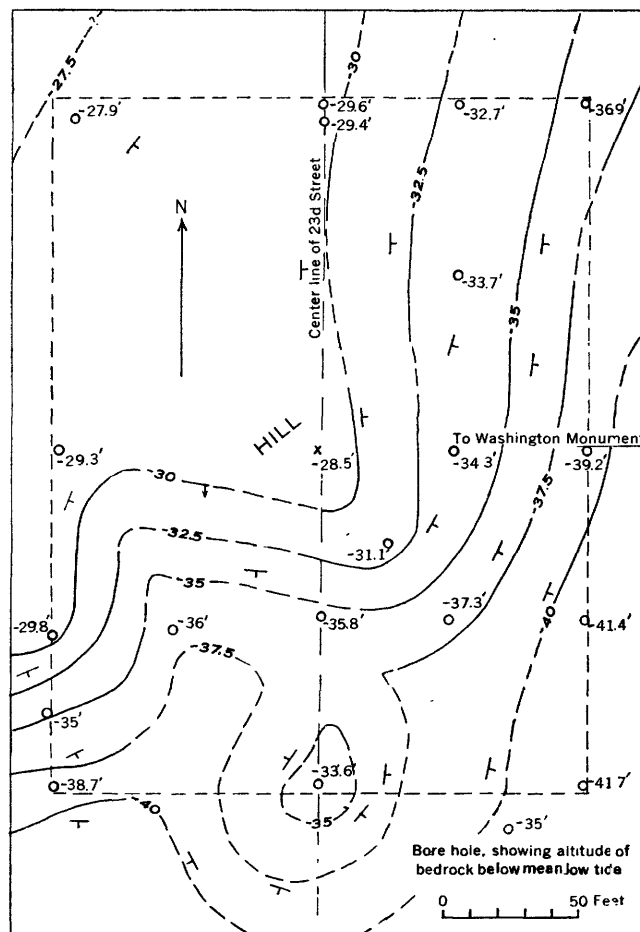


FIGURE 20.—Map showing configuration of bedrock surface at Lincoln Memorial. Based on boreholes by Corps of Engineers, U. S. Army. X, Center of building. Broken contour lines are hypothetical.

WATER GATE

The site for the Water Gate, just west of the Lincoln Memorial, was explored by 69 probings and boreholes by the Corps of Engineers, United States Army. These, together with results of other boreholes to the east and north, are presented in generalized form in figure 22.

The Water Gate area is in a trough cut through the Potomac group into the bedrock in later geologic time and floored by gravel, sand, and clay in irregular bodies deposited by the river. A few years ago the surface was a level tidal flat, which was reclaimed later by a cover of fill.

These data afford a basis for drawing contour lines on the bedrock surface and a cross section from the Water Gate to a point a short distance east of Washington Monument. (See figs. 22 and 23.)

A conspicuous feature in this area is the rise of the bedrock surface as a ridge of considerable prominence with highest known point of -17.6 feet in hole 2, at the southeast corner of Rainbow Pool, just west of Seventeenth Street. Its summit may be higher than this east of borehole 2, but the bedrock surface descends into

BEDROCK SURFACE OF THE DISTRICT OF COLUMBIA

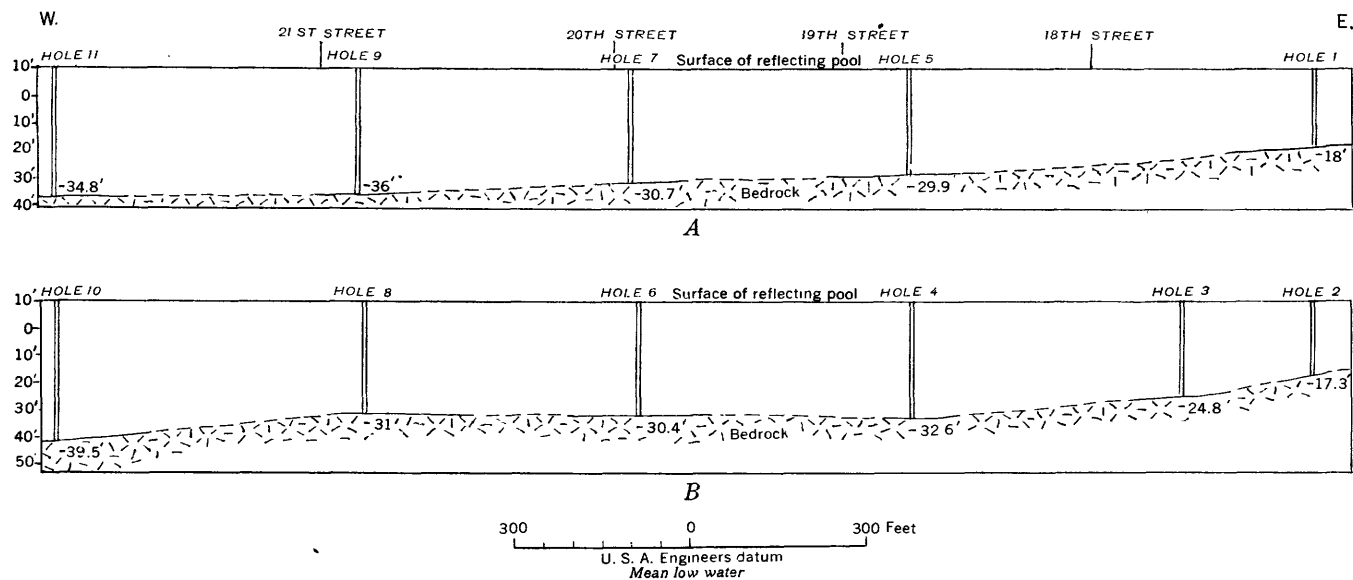


FIGURE 21.—Sections under Reflecting Pool, east of Lincoln Memorial, showing position of bedrock surface. A, near north margin of pool; B, near south margin of pool, 80 feet south of A. Holes 10 and 11 are about 600 feet east of the center of the Memorial.

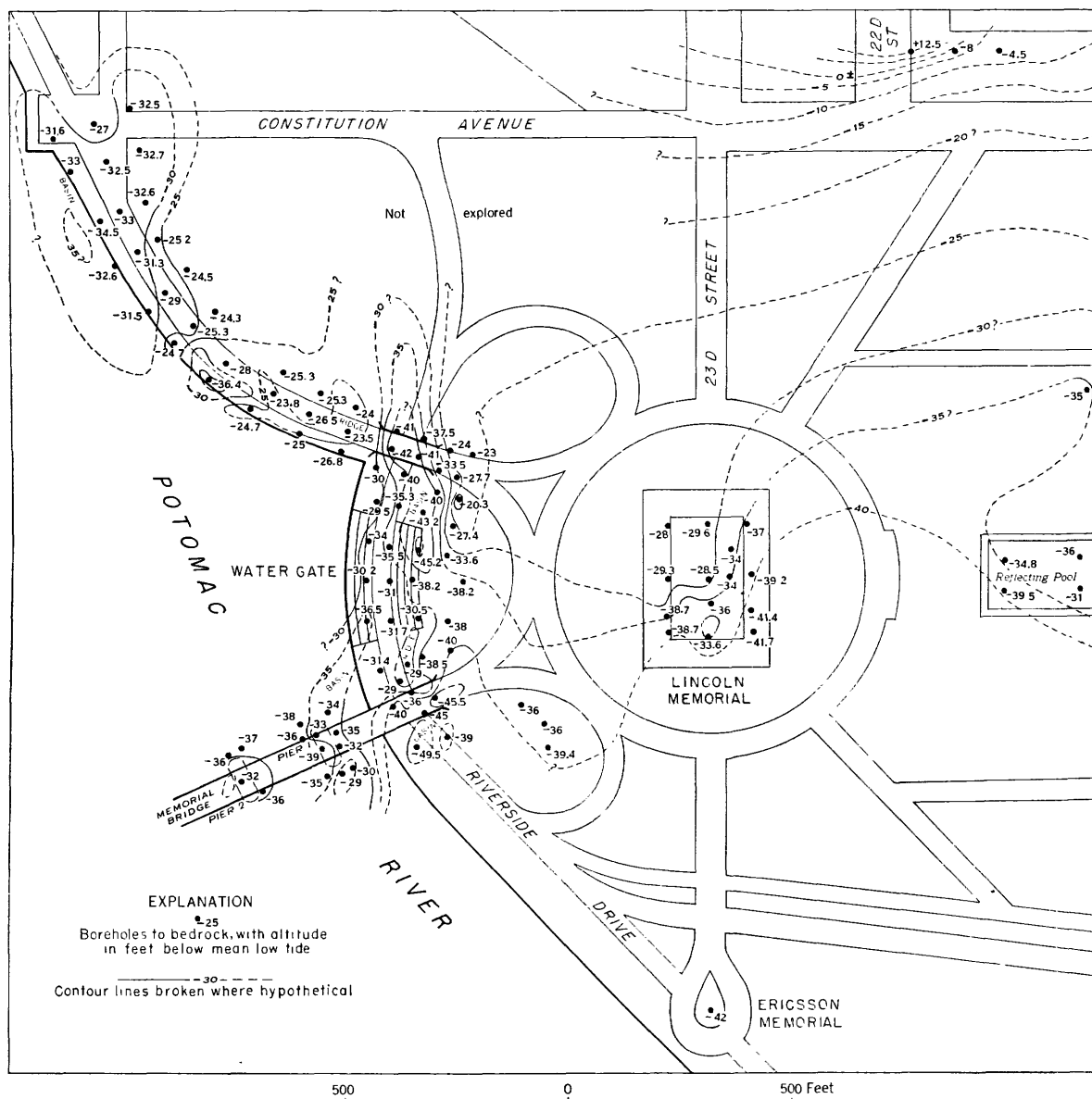


FIGURE 22.—Map showing configuration of bedrock surface around Lincoln Memorial and Water Gate. Based on boreholes by Corps of Engineers, U. S. Army. Contour lines by N. H. Darton.

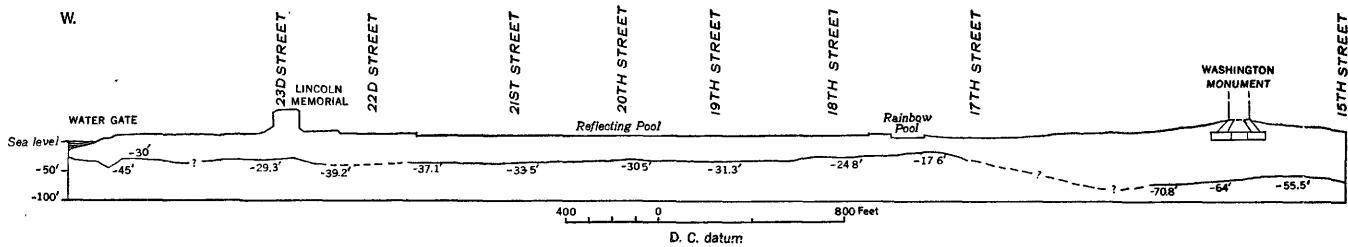


FIGURE 23.—Section from Potomac River at Water Gate through Lincoln Memorial, Reflecting Pool, and Washington Monument. From boreholes by Corps of Engineers, U. S. Army. Figures for the Reflecting Pool are an average of the north and south sets given in figure 22.

a valley (-71 feet or lower) between Seventeenth Street and Washington Monument. The approximate configuration is shown in figure 9.

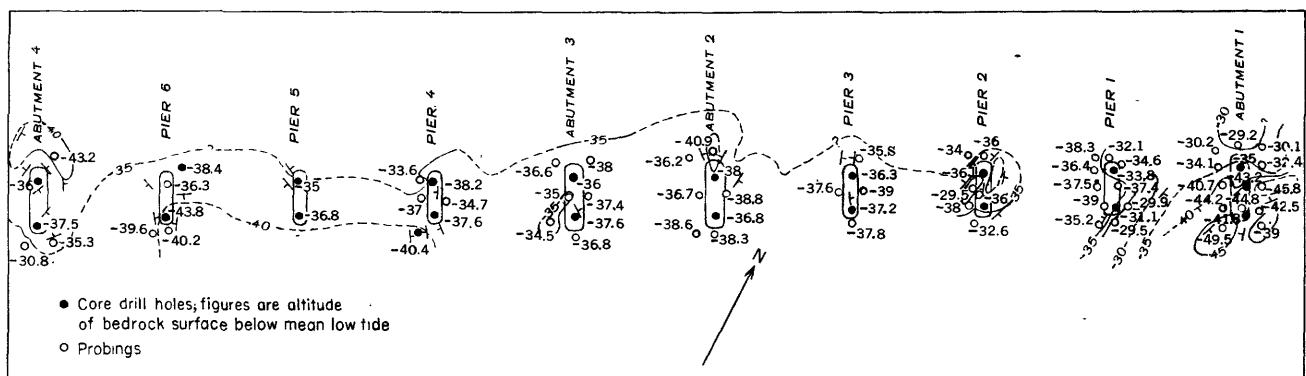
ARLINGTON MEMORIAL BRIDGE

The boreholes and soundings for foundations for piers and abutments of the Arlington Memorial Bridge across Potomac River afforded many data as to the configuration of the bedrock surface under the river deposits. The more important results are given in figure 24. The river trench at this place is below the original basal contact of the Potomac group, which was widely removed, and the underlying rock has been deeply channeled by the river at the stage of maximum uplift. Though the general slope of the old valley bottom was a gentle downgrade to the southeast it was cut by local

channels, the bottoms of which are 35 to 40 feet below present sea level. At abutment 1, the rock surface is notably irregular, with one hole reaching rock 50 feet below datum..

JEFFERSON MEMORIAL

The 27 holes bored in 1938 at the site of the Jefferson Memorial, the center of which is on the line of Sixteenth Street at a point 300 feet south of the line of Maryland Avenue, have indicated the configuration of the bedrock surface in an area of considerable extent, as shown in figure 9. One hole 82.7 feet deep at the intersection of the lines of Seventeenth Street and Maryland Avenue found bedrock at 77 feet below mean low-tide level. On the south side of the Memorial the bedrock elevation is 88 feet below mean low water.



A

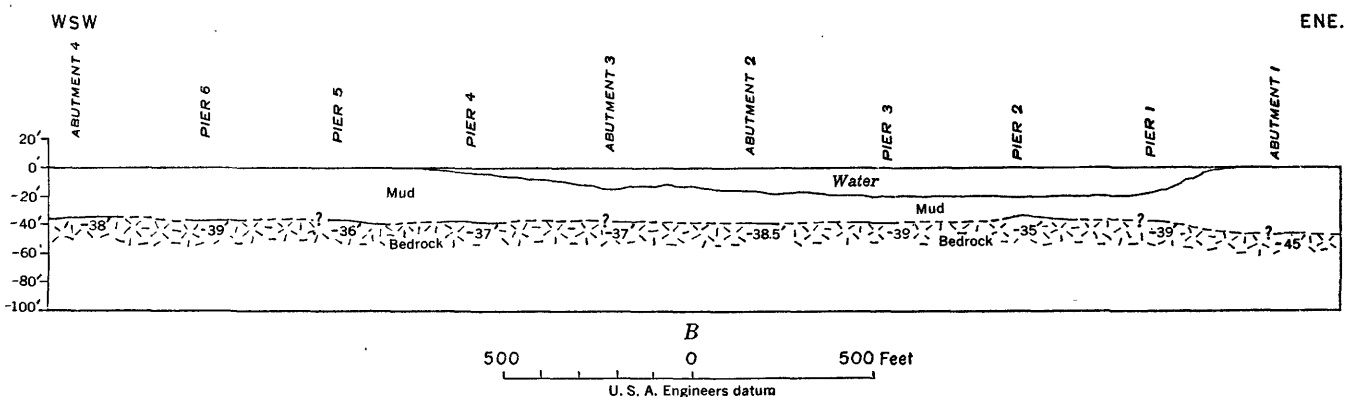


FIGURE 24.—Plan and section across Potomac River at Arlington Memorial Bridge, showing probable configuration of bedrock surface as revealed by boreholes at abutments and piers. Broken lines are hypothetical contours. Based on boreholes and probings by Arlington Memorial Bridge Commission, 1925.

BEDROCK SURFACE OF THE DISTRICT OF COLUMBIA

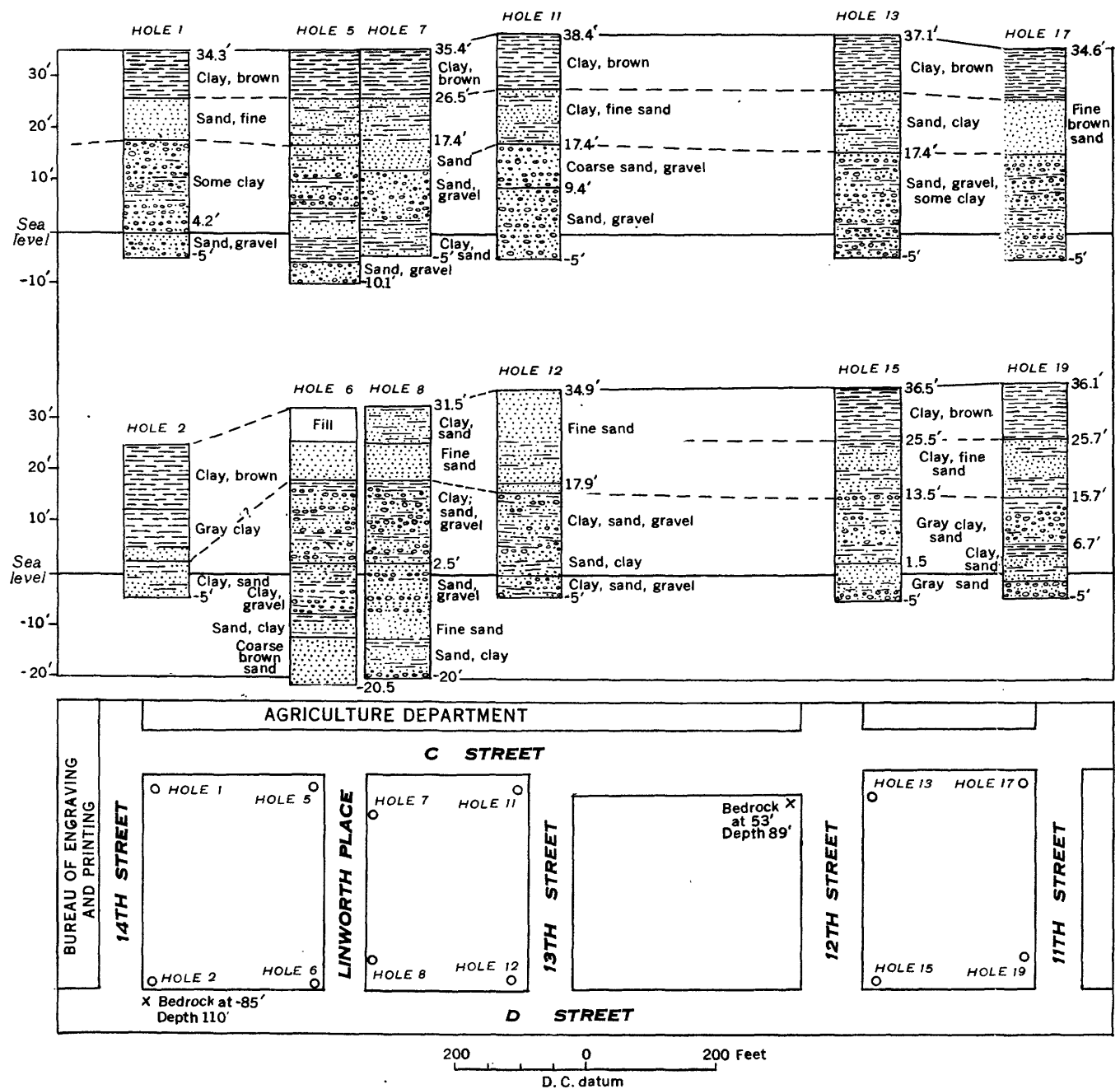


FIGURE 25.—Boreholes at site of Federal buildings between Eleventh and Fourteenth, C and D Streets SW. Borings by Standard Drilling Co., 1935.

Some of the holes to bedrock in the southern part of the Jefferson Memorial area appear to have passed mostly if not altogether through river deposits. The average depth of the holes near the memorial was near 100 feet, with the bedrock surface ranging from 80 to 90 feet below sea level. The top materials were fill and river silt, "mud," and sand, mostly of fine grain, but there was coarser "sand" and "gravel" near the bottom of most holes. Very little clay was reported as such. I should hesitate to class any of the material as Potomac group either from its character or from any theory as to probable maximum thickness of river deposits.

AGRICULTURE DEPARTMENT BUILDING

A boring made in 1938 at Twelfth and C Streets, for the building of the Department of Agriculture, reported "blue rock" at 89 to 90 feet, which indicated that here the bedrock surface is close to 53 feet below sea level, a high place in the bedrock surface. The following record was furnished by the Washington Pump & Well Co.:

Boring at Department of Agriculture Building, 12th and C Streets SW.

	<i>Feet</i>
Soil and clay.....	0-26
Clay, yellow, and gravel.....	26-39
Sand, medium fine, some clay.....	39-49
Sand, coarse, and gravel.....	49-58
Clay, brown.....	58-63
Sand, brown.....	63-69
Sand, coarse, and gravel.....	69-84
Clay, blue.....	84-89
Rock, blue.....	89-90

FEDERAL BUILDING SITE BETWEEN 11TH AND 14TH STREETS, C AND D STREETS

A series of test holes was bored in 1935 at the Federal site between Eleventh and Fourteenth, C and D Streets. The holes varied in depth from 22 to 58 feet, the deepest ending about 65 feet above bedrock which was reported to be 85 feet below sea level in an old well at Fourteenth and D Streets. (See fig. 25.) The records are of interest because they indicate the materials constituting the river terrace.

NORTHEAST WASHINGTON¹⁴

GENERAL GEOLOGIC SETTING

Throughout the Northeast section of the city the crystalline bedrock is overlain by unconsolidated sedimentary formations. The depth to rock ranges from a few feet around Takoma Park to about 800 feet at the east corner of the District. Various deep holes have reached bedrock, and other holes not deep enough to reach rock have delimited its position. The data reported show the general southeastward slope of the rock surface. The 162-foot hole at Lincoln Road and S Street, reported "talcoose rock" at -38 feet. The 150-foot hole at U Street between Fourth and Fifth reported rock at -43 feet. A 225-foot hole at Fourth and

R penetrated bedrock between depths of 159 and 225 feet below sea level with its top at -79 feet, and a 159-foot hole at 18 O Street reported bedrock at -100 feet. The 300-foot hole at Fourth and F Streets shows that bedrock is below -225 feet at that place.

1ST STREET JUST NORTH OF M STREET

One hole at Chapin-Sacks Co., on First Street just north of M Street, was reported to have penetrated granite from 197 to 210 feet, and another hole, "150 feet south," reported "hard rock" from 145 to 208 feet (indicating bedrock surface altitudes of -150 feet and -103 feet, respectively). A difference of nearly 50 feet within so short a distance seems improbable, and the record of the deeper hole may not be reliable as to the position of the top of the bedrock.

7TH STREET BETWEEN A AND B STREETS

The following record of a well drilled in 1940 for the Chesapeake & Potomac Telephone Co. Exchange, on Seventh Street between A and B Streets, shows the position of bedrock overlain by the lower formation of the Potomac group.

Borehole on 7th Street between A and B Streets NE.

	<i>Feet</i>
Sand, gravel and clay, brown (terrace deposit on Potomac group).....	0-105
Clay, blue.....	105-158
Sandy clay, brown.....	158-175
Sand and clay, blue.....	175-197
Clay, blue, tough.....	197-242
Sand, water.....	242-256
Clay, blue, tough.....	256-272
Sand, water.....	272-288
Clay, blue, tough.....	288-307
Sand and gravel, water.....	307-328
Granite (top at -261 feet).....	328-331

15TH AND E STREETS

The old 365-foot hole at the Hygienic Ice Works, started at an altitude of 50 feet, encountered rock at 300 feet below sea level, and penetrated rock for 15 feet. The water-bearing gravel here is probably near the base of the Potomac group.

Well at 15th and E Streets NE.

	<i>Feet</i>
Sand, fine.....	0-20
Clay and sand, gravel streaks.....	20-50
Sand, fine, white, with wood.....	50-53
Clay, white and red (red, 95-128 feet).....	53-135
Sand, full of water.....	135-159
Clay, white and red.....	159-184
Sand and clay, mixed.....	184-212
Clay, dark blue, tough.....	212-216
Sand and clay, some gravel streaks.....	216-240
Clay, sticky, sandy streaks.....	240-256
Clay, dark, very tough.....	256-260
Clay and sand.....	260-272
Clay, dark, hard.....	272-274
Clay and sand mixed, light lead color.....	274-298
Pebbles and sand, conglomerate streaks.....	298-320
Not given.....	320-350
Crystalline bedrock.....	350-365

¹⁴ See also table, pages 37-38.

WASHINGTON TERMINAL CO.

The deep wells of the Washington Terminal Co. at the Ivy City shops all end in gravel, indicating that the bedrock here lies deeper than 162 feet below sea level. One hole had the following record:

Hole at Ivy City shops of Washington Terminal Co.

	Feet
Clay, red-----	0-43
Clay, blue-----	43-72
Sand, fine and white-----	72-92
Clay, blue, tough at top-----	92-108
Sand and gravel-----	118-143
Sand and gravel-----	119-143
Clay, blue-----	143-179
Clay and sand-----	179-244
Hardpan and boulders-----	244-249½
Clay-----	249½-260

LANGDON

Several holes reached bedrock in Langdon at the yeast works of Standard Brands Inc., in the block between Twenty-fourth and Twenty-sixth Streets, a short distance south of Douglas Street and just east of the Baltimore & Ohio Railroad. Holes bored for the Corby Co. yielded samples of granite at 250 and 260 feet, or less than 190 feet below sea level. A 207-foot hole bored in 1900 did not reach bedrock. A later hole found rock at 244 feet below the surface; another at 262 feet, under 2 feet of "boulders" (probably bedrock); and a third penetrated bedrock from 217 to 220 feet, considerably higher than in the other holes.

Hole 1 at Langdon (Standard Brands Inc.)

	Feet
Clay, sandy below-----	0-42
Sand, fine-----	42-70
Clay, yellow-----	70-97
Sand, coarse-----	97-118
Clay, hard-----	118-151
Sand, white, lower half coarse-----	151-216
Gumbo-----	216-218
Sand-----	218-230
Clay, tough-----	230-244
Rock-----	244-247

Hole 3 at Langdon (Standard Brands Inc.)

	Feet
Fill-----	0-20
Clay, red, tough-----	20-56
Sand, fine, dark gray-----	56-75
Clay, sandy, blue-----	75-101
Sand, fine, gray-----	101-125
Clay, red, hard-----	125-158
Sand-----	158-207
Clay, tough-----	207-217
Rock-----	217-220

WOODRIDGE

In Woodridge, at Twenty-fourth and Irving Streets, nearly a mile north of Langdon, a 312-foot hole bored about 1903 reported "rock" under Potomac clay and sand at 167 feet below sea level. This figure falls in a plane with the slope indicated by supposed bedrock con-

figuration in the region northwest of Woodridge and near Hyattsville.

SOUTHEAST WASHINGTON¹⁵

GENERAL GEOLOGIC SETTING

The Southeast section of Washington is similar to the Northeast in that unconsolidated sedimentary formations form a continuous cover over bedrock. The depth to rock ranges from about 300 feet near the Capitol to about 1,000 feet on the hills along the southeastern boundary of the District. Several geologic formations are present in the Southeast section that are not known to occur in any other section of the city.

Information as to altitude of the bedrock surface under most of this part of the city is scanty, and the contour lines for this area on plate 1 are drawn with the belief that the general slope to the southeast is regular, as it is in other parts of the District of Columbia region. The known altitude of the bedrock surface at the old ice works, Fifteenth and E Streets NE., and at St. Elizabeths Hospital is an important guide. The well of the Colonial Ice Cream Co. at South Capitol and E Streets (1940) penetrated bedrock at 237 to 263 feet below sea level, and several other deep holes indicate its position, but the altitudes shown by the contour lines on plate 1 will doubtless need to be modified somewhat when more holes are bored to bedrock.

NAVAL GUN FACTORY

Several holes have been bored at the Naval Gun Factory, between First and Eleventh Streets, M Street and Anacostia River, but the deepest one, 162½ feet, bored in 1938, stopped about 200 feet above bedrock. Its record was as follows:

Boring No. 1, Washington Navy Yard, on line of 9th Street just north of O Street SE.

	Feet
Fill-----	0-33
Mud and sand-----	33-38
Sand-----	38-50
Sand and clay-----	50-76½
Clay-----	76½-92½
Sand-----	92½-95½
Clay-----	95½-98
Sand-----	98-134
Sand and clay-----	134-136½
Clay-----	136½-162½

Two other holes 100 and 120 feet deep in the south-central part of the Navy Yard have somewhat similar records.

ST. ELIZABETHS HOSPITAL

Three holes for St. Elizabeths Hospital reached gneiss; two of them are at the pumping station on the low plain near the eastern edge of Bolling Field, and the third is on the high terrace a mile east of the hospital.

¹⁵ See also table, page 38.

The 590-foot hole was bored in 1907. The record supplied by the drillers is given below. The fine gray arkosic sand reported at a depth of 400 feet is probably bedrock, for it was classed as "Piedmont crystalline" in the log, and hard rock began at 440 feet. The sedimentary material is all of Potomac age, and the very coarse gravel extending from 350 to 379 feet is basal Potomac.

As this hole is on the lowland about 120 feet below the contact between the Potomac group and the Magothy formation in the terrace to the east, the record indicates that the deposits of Potomac age lying on bedrock are here about 560 feet thick. The records accord in indicating the altitude of the bedrock surface at about 390 feet below sea level.

590-foot well at St. Elizabeths Hospital

	<i>Feet</i>
Sand and clay.....	0-40
Clay, reddish yellow on red.....	40-60
Clay, blue, few pebbles.....	60-70
Clay, sandy, reddish brown.....	70-120
Clay, dark gray; some sand, pebbles and iron concretions.....	120-130
Sandstone, brown.....	130-150
Sand, gray or brownish; pebbly.....	150-170
Clay, sandy, gray.....	170-180
Sand, pebbly, light brown.....	180-190
Clay, sandy, light gray.....	190-210
Sand, coarse, light gray.....	210-214
Clay, sandy, brownish gray on reddish brown.....	214-230
Clay, pink on brown.....	230-250
Clay, sandy, bluish gray on brown.....	250-270
Sand, light brown.....	270-280
Clay, sandy, gray.....	280-300
Sand, gray, coarse, with pebbles and boulders.....	300-340
Gravel, fine above and below, coarse in middle.....	340-382
Not given.....	382-400
Sand, arkosic, compact near base (probably all or in part bedrock).....	400-440
Crystalline rock (gray granite).....	440-590

The record of the 398½-foot hole gives "granite" at a depth of 397 feet, under 20 feet of boulders, some of which were gneiss and other crystalline rocks. The 600-foot test hole on top of the terrace to the east at an elevation of 160 feet, reached bedrock about 440 feet below sea level; it was regarded as a failure for water supply. The borings indicate that the slope of the bedrock surface east of Anacostia is close to 125 feet to the mile.

MARYLAND¹⁶

PRINCE GEORGES COUNTY

Data concerning the location and configuration of the bedrock floor northeast and east of the District of Columbia are rather widely spaced, but they appear to be reliable and have afforded the basis for drawing the contour lines and cross sections. (See pl. 1 and fig. 3.)

CHILLUM GAS TANKS

At the gas tanks on Chillum Road about 2 miles west of Hyattsville, bedrock was reached by a well bored

about 1934, and by several test borings made to ascertain foundation conditions. The following record of the well was furnished by the drillers:

Well at gas tanks on Chillum Road

	<i>Feet</i>
Soil on muck.....	0-10
Clay, very compact, white.....	10-18
Sand.....	18-36
Clay, yellow above, blue below.....	36-45
Rock, rotten.....	45-68
Rock, hard.....	68

In the test borings rock was mostly reported as hard greenish clay, and it was noted that its surface sloped to the east. Considerable lignite was found in the sands and clays of the Potomac group.

HYATTSVILLE

Several holes in or near Hyattsville have reached bedrock or ended in the immediately overlying sand and gravel (Potomac). One on the Lewin place (prior to 1915), a short distance west of the railroad station, ended in coarse sand at a depth of 206 feet; others at the Waterworks (1908) at 242 feet, and one at the ice works, 285 feet deep, ended in sand. A well a quarter of a mile east of the village, on the low flat, reported granite at 247 feet, and a well at the Hot Shoppe (A. & W.), 5315 Baltimore Avenue, sunk in 1940, has the following record:

Well at Hot Shoppe (A. & W.), Hyattsville

	<i>Feet</i>
Clay (brown), sandy above, blue below.....	0-68
Sand, fine.....	68-92
Clay, blue, with red clay at 120-145 feet.....	92-170
Sand, water.....	170-185
Clay, blue.....	185-194
Sand, some clay, some gravel, water.....	194-220
Clay.....	220-234
Rock.....	234-242

UNIVERSITY OF MARYLAND

Several holes have been bored at College Park for the University of Maryland. One is at the old heating plant, another at the old laundry, another at the rear of the old horticulture building. A hole bored in 1916 on Paint Branch, just south of the crossing of the stream by the highway to Baltimore, passed through valley fill, terrace deposit, and sand and clay of the Potomac group to a depth of 154 feet, where it reached "green rock" at -94 feet, in which it continued for 25½ feet. An old well in the University group¹⁷ started at an altitude of 145 feet and was 284 feet deep. It passed through red and blue clays of Potomac age, and at depths of 145 to 191 feet was in "soft rock of a soapstone nature" (probably hard dark-green clay). From depths of 191 to 193 feet it was in quartz, and from 193 to 284 feet in gneiss, the upper part of which was soft. This hole was southeast of the one on Paint Branch and at a much higher altitude.

¹⁶ See also table, page 38.

¹⁷ Maryland Geol. Survey Report, vol. 10, p. 381, 1918.

AGRICULTURAL RESEARCH CENTER, BELTSVILLE

Bedrock was reached by most of the holes bored at the Agricultural Research Center of the United States Department of Agriculture east of Beltsville, Md. The principal data reported are given in the table on page 38, and locations of the holes are shown on plate 1. The records are fairly satisfactory and accordant and indicate that the regular slope of about 100 feet to the mile continues eastward to 100 feet below sea level, where locally the rate diminishes somewhat. The F. D. well 1, in which rock was reported at a depth of 260 feet, indicates the presence of an underground mound, for in hole A1. No. 2 the rock was found at a depth of 315 feet, and in hole N at 307 feet below the surface, indicating a valley in the bedrock surface.

GLENN DALE

Three test holes were drilled at the Glenn Dale Sanatorium, 3 miles due east of Lanham (outside the area shown on pl. 1), two of them to bedrock. The first one, drilled in May 1936, reached rock at 950 feet; hole 3, drilled in 1938, reached rock at 946 feet. As these holes were at an altitude of about 145 feet, the bedrock surface here is close to 800 feet below sea level. The following record is condensed from notes by F. H. Klaer.

Well 3 at Glenn Dale Sanatorium

Clay, red and white and reddish brown, sandy near base.....	Feet 0-234
Sand, reddish brown, some reddish clay.....	234-244
Clay, blocky with nodules and few pebbles.....	244-254
Clay, red, brown and gray; red, sandy in lower part.....	254-300
Sand, pinkish white, moderately fine, some clay below; water 300-310 feet.....	300-317
Sandy clay, white.....	317-319
Sand, clean, white above pink, some coarse and fine gravel at base.....	319-340
Sand and clay, pink, intermixed, few small pebbles.....	340-349
Clay, sandy, white and red.....	349-354
Sand, reddish, grades down into coarse sand and red sand and gravel.....	354-373
Clay, brick-red, dark gray, tough in center.....	373-414
Sandy clay, red brown and white, some small pebbles.....	414-424
Sand, reddish, grades down into coarse sand and gravel; water, 450-460 feet.....	424-474
Clay, blocky, some gravel, grading down into red and gray clay.....	474-494
Clay, yellowish brown sandy and tough, brick red.....	494-540
Clay, brown to buff on purplish and brick red.....	540-620
Clay, tough, red on yellowish.....	620-670
Sandy clay, pink and white with ironstone layers.....	670-700
Sand, coarse and gravelly near bottom; water 726-732 feet.....	700-734
Clay, sandy, coarse, gray.....	734-745
Sand and gravel, coarse at base; water, 750-753 feet.....	745-753
Sand, fine, dirty, some clay near base.....	753-767
Sand, red, and gravel on gray sandy, gravelly clay.....	767-785
Clay, brick red, brown and gray, on white and gray.....	785-854
Sand and gravel on dirty gray sand. Water 854 to 856 feet.....	854-864
Clay, gray and pink brown.....	864-884
Sand, light brown and gray.....	884-910
Clay, dark gray, tough.....	At 920

Feet

Sand, gray, medium coarse..... 935-945
Bedrock, weathered rust-colored; fragments of quartz, feldspar, and hornblende..... At 946

This hole is located on the slope of a slight depression a few rods east of the main building and near the top of the Potomac strata. The rate of slope of the bedrock surface indicated is close to 110 feet to the mile, when compared with holes at the Beltsville experimental farm and a hole at Muirkirk where the bedrock surface is 22 feet above sea level. The general structure is shown by the section in figure 3.

MEADOWS

In 1902 a hole was bored by Capt. F. A. Lucas at a point about half a mile south of Meadows (Centerville), later a part of the farm of L. C. Matthews. It was started at an altitude of 260 feet and ended at a depth of 1,511 feet in a thick body of dark-colored clay with some sand and gravel, doubtless the lower beds of the Potomac group.¹⁸ More than a thousand feet of the Potomac group was penetrated. A short time later Champ Robinson, of Baltimore, bored in the vicinity a hole that is reported to have reached a depth of 1,728 feet, or an altitude of about 1,468 feet below sea level. Mr. Robinson stated the depth to Arthur Bibbins, who is authority for the report that the hole ended in reddish-brown sandy clay. The distance to bedrock here is not known, but the depth of the hole indicates an increase in the rate of declivity of the bedrock surface greater than that suggested by holes farther west.

FORESTVILLE

A hole was bored by the Potomac Oil & Gas Co. in the late spring of 1920 at a point about four-fifths of a mile west of Forestville, at an altitude of 280 feet. The depth of this hole is not on record, but a notation on a reference card in the United States Geological Survey files gives 1,400 feet as its total depth, and a letter to me from Arthur Bibbins, geologist of the company, stated that he was informed that it reached granite "about the depth expected on the basis of the average bedrock slope elsewhere of about 60 feet per mile." It is stated that the oil company sank another hole in the same general vicinity, but no data were obtained.

FORT WASHINGTON

A 1,000-foot hole at Fort Washington failed to reach bedrock. This hole began near the top of the Potomac group and ended in clays of that group. Bedrock probably is not far below, or near 900 feet below sea level. The subsurface relations between the Fort Washington area and the area on the Virginia side of the Potomac River are indicated in figure 27, section A, and a record of the lower part of the Fort Washington hole is given on page 31.

¹⁸ A log of this well by N. H. Darton is given in Maryland Geol. Survey Report, vol. 10, pp. 383-384, 1918.

Partial record of a deep boring at Fort Washington, Md.

	Feet
Clay, blue-----	582½-584½
Sandstone, soft gray-----	584½-600
Clay, yellow on blue-----	600-627
Clay, blue, with sand-----	627-677
Clay, yellow-----	677-718
"Rock," with 2 feet of yellow clay-----	718-726½
Clay, blue, with sand-----	726½-732½
Sand, fine, white-----	732½-737½
Clay, light red, with sand-----	737½-765½
Gravel, coarse-----	765½-785½
"Slate"-----	785½-790
Sand, some yellow clay-----	790-846
Clay, yellow and blue, some sand near base-----	846-1,000

CHARLES COUNTY**INDIAN HEAD**

A boring at the Naval Proving Grounds, Indian Head, in Charles County, is reported to have entered rock at a depth of 735 feet. A blueprint of the log gives no data for a gap of 32 feet between a thick body of clay extending to a depth of 708 feet and the "hard rock" from 740 to 1,200 feet. Another statement is that the "last 450 feet, at least, were in solid rock." The elevation of the hole is about 95 feet above sea level. The slope of the bedrock surface is shown in figure 27, section C.

VIRGINIA¹⁹**ARLINGTON COUNTY**

The floor of granite gneiss and other crystalline rocks rises above sea level near the center of Arlington County and attains an altitude of nearly 450 feet at Minor Hill, on the west line of the county. The basal or marginal gravels of the Potomac group rise to an altitude of about 350 feet west of Clarendon, and they occur as outliers on some of the slopes to the west. They are deeply trenched by the valleys of Fourmile Run and Potomac River, down which the outcrops of gneiss extend for several miles. In the sides of these valleys the contact of gravel on bedrock slopes at the rate of about 100 feet to the mile east-southeast, and although there are some local variations of rate and direction of slope no marked irregularities of configuration are apparent. Borings on the plateaus and terraces from Clarendon to Alexandria afford data for the underground contours in that area.

It was stated years ago that a boring for an abutment of the old Long Bridge reached "rock" at a depth not far below 100 feet. This was verified by the 314-foot hole at the American Oil Co. filling station one-half mile southwest of Highway Bridge where "bedrock" was entered at a depth of 114 feet, and by the McGuire and Rolfe hole, 303½ feet deep, a few rods southwest, which reported "bedrock" at a depth of 105 feet and contains 112 feet of 6-inch casing. At the oxygen factory nearby a boring 97 feet deep did not reach bedrock, but a hole

at the Norton rendering plant reached it at about 95 feet. A 102-foot hole bored in 1925 by Mr. Hagman at a transient amusement park at the former Hoover Airport (then on Alexander Island), entered bedrock between 90 and 92 feet below the surface. A hole bored to a depth of 330 feet in the Hoover Airport by Mr. Dowling in 1926 penetrated schist, but no data were obtained as to the position of the top of the rock. Samples of "gray sand" submitted to the Geological Survey as coming "from above 320 feet" in this hole contained rounded grains that were evidently of sedimentary origin, but they probably came from high up. The hole was shot when its depth was between 320 and 330 feet and yielded masses of schist from an unstated depth in its wall, presumably near 325 feet. It is stated that the rate of drilling changed from 20 to 3 feet per day at 320 feet in this hole, which, if it is a fact, would give the impression that the top of bedrock was entered at that depth. However the evidence of other holes in the vicinity is that the top of bedrock is here only 100 feet below sea level, as shown on the map in the Washington folio.²⁰ Any local trough or deep reentrant in the otherwise regular slope at this place is most unlikely.

The Morris No. 2 well in Aurora Hills near Oakcrest, 538 feet deep, and at an altitude of about 150 feet, penetrated bedrock, but no information was given as to the depth to its top. In many places the decayed upper portion of the gneiss or schist is so completely disintegrated that it is regarded as sand by the driller, and this was doubtless true at this place.

PENTAGON BUILDING

In 1941 two sites were under consideration for an office building in Virginia for the War Department. Both were on low terraces between the Potomac River and Arlington Ridge Road, the Arlington Memorial Highway, and U. S. Highway No. 1. The first site was in the northern part of the experimental farm of the Department of Agriculture; the second, finally selected for building, was partly on the former Hoover Airport. Both sites were explored as to underground conditions by holes, mostly from 30 to 60 feet deep, bored at corners of squares 200 feet on a side in a checkerboard arrangement about 30° out of meridional alinement. The purpose was to reach "bedrock" or "refusal" for piles, and although some of the materials penetrated were not discriminated accurately, the records of the holes throw much light on the geology and configuration of the bedrock surface. The location of the holes and some of the reported results of the boring are shown in figure 26, constructed from drillers' records furnished by F. W. Walker, constructing architect of the Quartermaster Department. The materials penetrated were pumped out as a casing was sunk, and most of the holes are re-

¹⁹ See also table, page 39.

²⁰ Darton, N. H., and Keith, Arthur, U. S. Geol. Survey Geol. Atlas Washington, D. C.-Md.-Va. folio (No. 70), 1901.

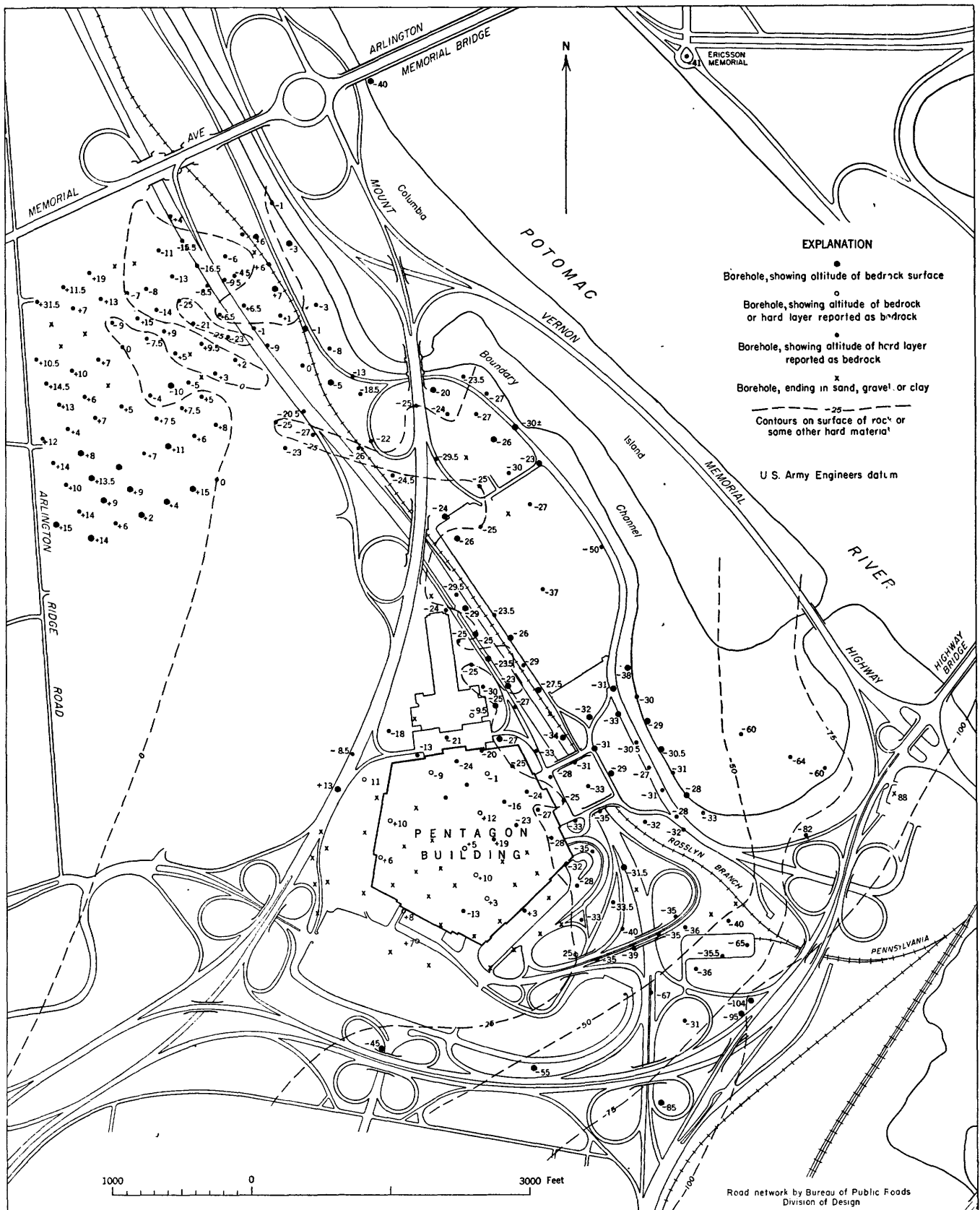


FIGURE 26.—Map of eastern part of Arlington County, Va., showing boreholes in site of Pentagon Building and adjacent area.

ported to have stopped at "rock" or "boulder". In some holes the rock reported may not have been true bedrock. In 40 holes "mica schist" or "crushed rock" was reported for a few feet.

The edge of the Potomac group is known to be about 100 feet below sea level in several old holes along or near Highway No. 1 and at less depth, rising to the west, along Columbia Pike. A considerable part, if not all of the area shown in figure 26, is in an old trench of the Potomac River, cut nearly 100 feet deep in places through the eastward-sloping Potomac group into the underlying bedrock. All of it is floored by river deposits. The configuration of the rock surface or floor under the river deposits is not known in detail, but the boreholes show that it is of irregular contour, with valleys and ridges of considerable size. Some features of this configuration are shown approximately in figure 26 by underground contour lines drawn on the assumption that "rock" or "refusal" in the borehole records indicates bedrock surface.

One 26-foot hole at an altitude of 39 feet 400 feet west of the northern point of the Pentagon Building had a rather doubtful report of mica schist at the bottom at +13 feet, under brown clay, sand, and gravel. Possibly there is here a local high place in the floor, and other holes near and under the southern and western parts of the building, which were sunk to only a few feet above sea level, may indicate the presence of an underground mound of considerable extent and prominence.

ALEXANDRIA ²¹

Two deep borings made in Alexandria many years ago at the ice plant and the brewery undoubtedly failed to reach bedrock, the depth of which under Alexandria is not known precisely. Near the wharves it is about 500 feet.

ALEXANDRIA TUNNEL (PROPOSED 1941)

A series of holes was bored from Alexandria, Va., across Potomac River to Marbury Point, D. C., by the Corps of Engineers, United States Army, for the office of the Quartermaster General. Records of the two deepest holes in the bottom of the river area follow. At this place bedrock was to be expected at a depth of about 500 feet. The clay and sand penetrated under the mud is part of the Potomac group.

Hole 4 (west)	Feet
Water (mean low tide)-----	0-29
Mud, mostly soft-----	29-58
Mud, some sand, stiff below-----	58-65
Sand, some mud, mixed-----	65-74
Sand, medium-----	74-84
Sand, fine, and clay, soft-----	84-124
Clay, hard to medium-----	124-152
Clay, sandy-----	152-162
Sand, coarse, some clay-----	162-182
Clay, hard-----	182-201

²¹ See also table, page 39.

Hole 5 (east)	Feet
Water-----	0-28
Mud, some sand below-----	28-81
Sand, medium-----	81-86
Sand, hard, and clay-----	86-126
Clay, hard, sandy-----	126-157
Clay, hard-----	157-169
Clay and sand-----	169-201

FAIRFAX COUNTY ²²

The bedrock floor of gneiss and other crystalline rocks rises gradually from below sea level in the eastern part of Fairfax County and appears in ledges in the larger valleys about 5 miles west of the Potomac River. It has been reached by various wells, and these and some deep borings ending in Potomac deposits indicate the general configuration of the floor in the area where it is buried. The deeper contour lines in plate 1 are constructed from these data, and those from +100 feet to +250 feet are in greater part based on contacts of gneiss and basal Potomac deposits exposed along the sides of the intervening ridges. The relations indicate a remarkably regular slope of about 100 feet to the mile, and probably there are but few local variations in this rate or few notable old topographic features buried under the Potomac deposits. This is in accord with observations in the outcrop zone in Maryland already described, and it indicates that, in general the basement is a nearly smooth plain sloping east-southeast at a fairly regular rate.

SEMINARY RIDGE

The borings on "Seminary Ridge" from Seminary Station to the vicinity of School A, indicate some local irregularity in the configuration of the bedrock surface.

A 150-foot well a quarter of a mile southeast of the Theological Seminary, at an altitude of 200 feet, found no rock.

A hole just north of old Fort Crawford, half a mile north of Seminary Station, at an altitude of 230 feet, had 240 feet of casing, all in the Potomac group, indicating that the bedrock surface at that place is lower than 10 feet below sea level.

The 448-foot hole at the Episcopal High School, at an altitude of 260 feet, reported granite from 440 to 448 feet, but no log seems to be available and no data as to the top of the granite, which I believe must have been entered at a depth of about 300 feet, or about 40 feet below sea level. Another hole at the same altitude and 300 feet deep reported "petrified wood" at the bottom.

A 170-foot well a third of a mile north-northwest of the Episcopal High School and at about the same altitude penetrated granite from 165 to 170 feet, indicating that the surface of bedrock is 95 feet above sea level. A

²² See also table, page 39.

205-foot well at a house a third of a mile northwest of the Episcopal High School, at an altitude of 272 feet, contains 192 feet of casing extending to an altitude of about 80 feet above sea level, probably nearly to bedrock.

It is evident from the above data that there is a zone of steep slope in the bedrock surface near the Episcopal High School, northwest of Alexandria. Probably when more data are available it will be found that there are various other local irregularities of this kind in the bedrock floor.

FORT HUNT

Several deep borings throw light on the configuration of the buried bedrock surface in the southern part of Fairfax County. Data supplied by D. J. Cederstrom, of the Geological Survey, have aided in locating bedrock contour lines along the south edge of the map (pl. 1). The available information indicates remarkable regularity in the rate and direction of slope of the bedrock surface, as shown in the three cross sections in figure 27.

A 284-foot hole at Fort Hunt is reported to have reached bedrock, but considering the general relations shown in figure 27, *A*, and the fact that a 1,000-foot hole at Fort Washington, Md., failed to reach bedrock (see p. 31), the report is believed to be a mistake.

FORT BELVOIR

In a test hole at Accotink for Fort Belvoir (formerly Fort Humphrey), "hard rock" was penetrated from depths of 253 to 272 feet and gneiss from depths of 272 to 279 feet. (See fig. 27, *B*.)

MOUNT VERNON

At Mount Vernon, a hole at the tool shed, about 100 feet above sea level, is in water-bearing sand from 522 to 530 feet. A hole at the edge of the Potomac River nearby penetrated bedrock from 515 to 525 feet, beginning at about 515 feet below sea level, as shown in figure 27, *B*.

DATA ON BOREHOLES AND EXCAVATIONS INDICATING ALTITUDE OF BEDROCK

The table that follows lists the boreholes described in the text and some other holes and excavations for which information was available. The localities are arranged first by numbered streets, in order from lowest to highest, then by lettered streets. Avenue have been fitted in between the adjacent numbered and lettered streets. Constitution Avenue and Independence Avenue are equivalent to B Street north and south. For the localities in Maryland and Virginia a similar arrangement in north-south or east-west has been followed as far as practicable.

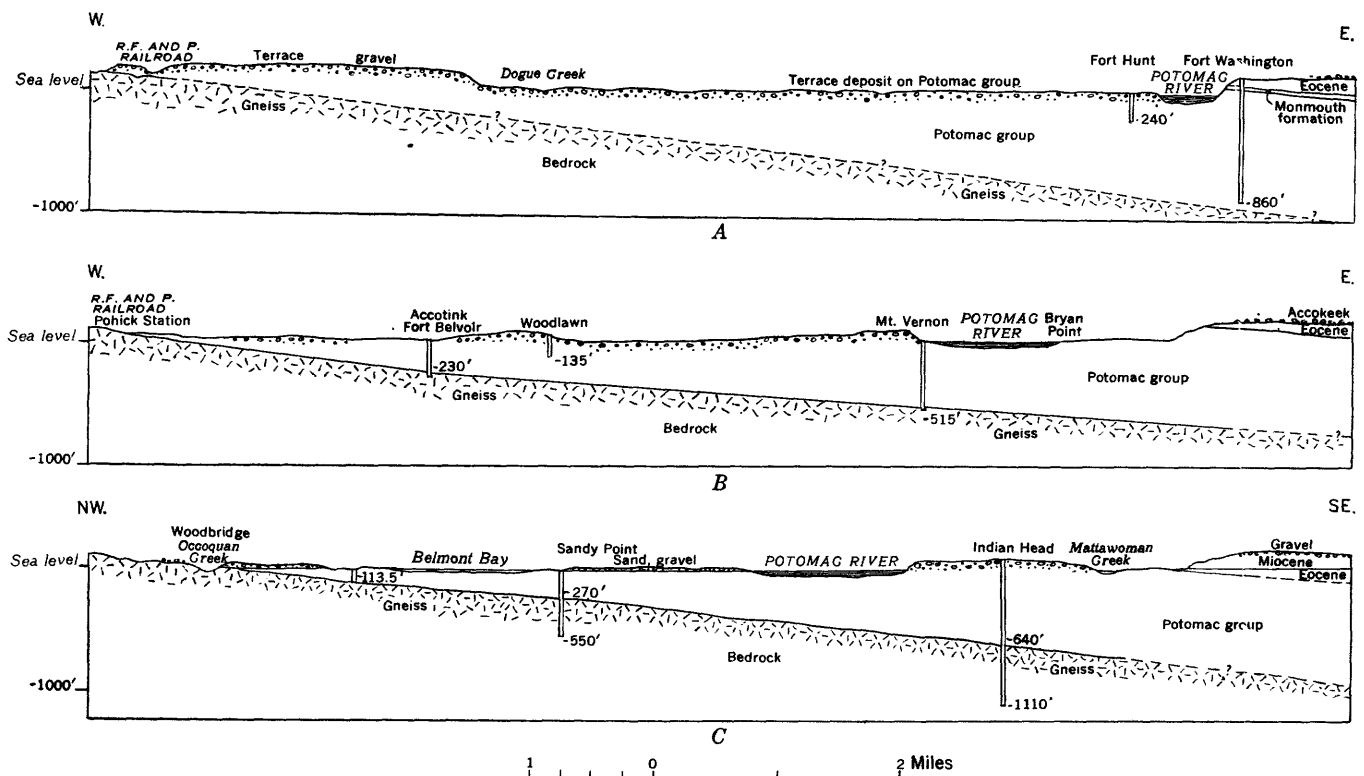


FIGURE 27.—Sections from southern Fairfax County, Va., eastward into Maryland. *A*, Through Fort Hunt, Va., and Fort Washington, Md.; *B*, From Pohick Station, Va., through Mount Vernon to Accokeek, Md.; *C*, From Woodbridge, Va., through Indian Head, Md.

Data on boreholes and excavations, indicating altitude of bedrock

Location	Depth of hole (feet)	Land surface altitude (feet)	Materials	Bedrock surface altitude (feet)
District of Columbia				
NORTHWEST WASHINGTON				
[See also pages 8-20.]				
1140 North Capitol St. (near M St.; Sibley Memorial Hospital).	161	50	Rotten rock at 154 feet -----	-104
52 G St. (between North Capitol and 1st Sts.; old location of Yale Laundry).	130	27	Rock at 105-130 feet -----	-78
1st and G Sts. (old Gales School) -----	141	30	Soft rock (gneiss) at 133-141 feet, under water sand.	-103
1620 1st St. (near R St. and Florida Ave.) -----	122	72	Rotten rock at 118-122 feet, under sand -----	-46
3d and H Sts. -----	166½	48	Soft rock at 158 feet, under blue clay -----	-110
4th St. and Pennsylvania Ave. (proposed Municipal Center).	179	20	Rotten rock at 174 feet, under gravel, etc. -----	-154
460 K St. ¹ -----	100	80	No record -----	
4th and 5th Sts., N St. between -----	150	82	Talcose rock at 127-144 feet under sandy muck.	-45
5th and L Sts. ¹ -----	120	60	No record -----	Below -60
5th and Tuckerman Sts. (Calvin Coolidge High School).	11-40	247	Footings on rock -----	211 to 230
6th and B Sts. (old pump) -----	140	8	Soft rock at 125-134 feet, hard 134-140 feet.	-117
6th and 7th Sts., Constitution and Pennsylvania Aves. (Apex Building; Federal Trade Commission; 6 holes). ¹	70	5-10	Clay 15-25 feet, clay and sand 50-60 feet -----	Below -115
6th and 7th Sts., O St. between -----	201	86½	Soapstone and gneiss 100-201 feet -----	-14
7th St. north of B St. (old Center Market) -----	628	8	Rock at 120 feet -----	-112
434 7th St. (between D and E; S. S. Kresge Co.) ¹	90	30	No record -----	
7th and M Sts. ¹ -----	151	87	"Conglomerate" 143-151 feet, possibly on bedrock.	Below -64
721 M St. -----	120	82	Gneiss at 98 feet -----	-16
2146 Georgia Ave. (near V St.) -----	500	100	"Medium hard rock" at 79 feet, under sand and gravel, solid rock at 89 feet. Another report gave blue clay and gravel to 87 feet, where "solid rock" was entered.	21
7th and 9th Sts., Constitution and Pennsylvania Aves. (National Archives; 19 holes).	65-120	5-10	Fill, river deposits, sand, and clay to bedrock. Some thin gravel beds.	-74 to -103
8th St. and Florida Ave. (near U St.) -----	103	88½	"Granite and soapstone" at 60 feet -----	28½
8th St. between Upshur and Varnum Sts. ¹ -----	195½	200	Soft rock at 75 feet, under gravel -----	125
9th and D Sts. (U. S. test hole) -----	95	12	Bedrock at bottom, under arkose 55-95 feet.	-83
425 9th St. (between D and E; Central Theater). ¹	127½	30	No record -----	Below -97½
9th St. and New York Ave. SW corner -----	183	55	Rock at 133 feet, under sand and clay -----	-78
909 Pennsylvania Ave. ¹ -----	81	12	No record.	
411 10th St. (between D and E; old building of Washington Gas Light Co.) ¹	77	25	Clay with some sand and gravel. Ends in very dark clay.	Below -52
10th and E Sts. -----	116	30	Test hole; rock at 94-116 feet -----	-64
10th and 12th Sts., Constitution Ave. and C St. (Internal Revenue Bureau; 9 holes).	68-83	5-10	Mud, sand, clay, and gravel on mica schist.	-60 to -65
11th St. and Pennsylvania Ave. SE corner (near D St.; old Harvey's Restaurant). ¹	60	12	Clay and sand -----	
11th and E Sts. (Harrington Hotel, basement).	83	15	Clay, sand, and gravel -----	Below -68
11th and G Sts., NE. corner (Woodward & Lothrop North Building, formerly Palais Royal).	97	37	Ended in gravel -----	Below -60
11th and G Sts., NW. corner (S. S. Kresge Co.) ¹	85	37	No record -----	
2012 11th St. (between U and V Sts.; Thompson's Dairy).	80	95	No record -----	Below 15
1110 New York Ave. (Greyhound Lines) ¹ -----	124	55	Sand and gravel -----	Below -70
12th St. and Constitution Ave. (Interstate Commerce Commission; 13 holes).	60-80	7-10	Fill, clay, silt, sand, and gravel on rock -----	-54 to -69
12th and F Sts., NW corner (F. W. Woolworth Co.) ¹	88	35	Clay, sand, etc. -----	Below -53
1214 G St. (G. C. Murphy Co.) -----	103	37	Rotten rock at 102 feet -----	-65
12th and M Sts. (Security Storage Co.) -----	149	87	Soft rock at 102-115 feet, hard talc rock at 115-149 feet.	-15
12th and V Sts. -----	135	100	Rotten rock at 44 feet -----	56
12th and 13th Sts., Pennsylvania Ave. between (Post Office Department; many holes).	70-80	8-11	Bedrock -----	-65
725 13th St. (between G and H; Chesapeake & Potomac Telephone Co.).	125	40	Rock at 122-125 feet, under 30 feet of clay --	-82
14th St. and Constitution Avenue (Labor Department; 12 holes).	68-80	7-12	Fill, clay, silt, sand, and gravel on rock -----	-55 to -68
14th and D Sts. (old electric power plant) ¹ -----	78	10	No record -----	
14th and D Sts. (U. S. test hole) ¹ -----			Bedrock -----	-56
14th and F Sts. (Julius Garfinckel & Co., sub-basement). ¹	69	35	Ended in black mud -----	Below -34

¹ Not on plate 1.

Data on boreholes and excavations, indicating altitude of bedrock—Continued

Location	Depth of hole (feet)	Land surface altitude (feet)	Materials	Bedrock surface altitude (feet)
NORTHWEST WASHINGTON—Continued				
14th and K Sts., SW. corner (Ambassador Hotel).	102	62	Rotten rock at 96 feet, hard at 101 feet.....	—34
14th and K Sts., NE. corner (Hamilton Hotel, basement). ¹	85	42	Rotten rock at 77 feet, under gravel, hard rock at 85 feet.	—35
14th and R Sts. (Chesapeake & Potomac Telephone Co.).	110	101	Soft rock at 98 feet, under gravel.....	3
3128 14th St. (near Irving St.; G. C. Murphy Co.).	102	192	Rotten rock at 82–102 feet, under clay, sand and gravel.	110?
14th and 15th Sts., E St. and Constitution Ave. (Commerce Department; 18 holes).	77–90	8–15	Bedrock at 66 to 87 feet.....	—58 to —74
15th St. between Pennsylvania Avenue and F St. (old Corcoran Building; present site of Washington Hotel).	140	30	Rotten rock at 120 feet, hard at 140 feet...	—90
15th and G Sts., SE. corner (Keith's Theater; site of old Riggs House).	558	-----	"Schist" under terrace deposits.....	-----
15th and H Sts. (Shoreham Building).....	110	60	"Gravel on crystalline rock".....	—48
15th and M Sts. (Security Storage Co.).....	99	70	To rock. Another report records rock at 46 feet (altitude +24 feet).	—29
715 Madison Place (between Pennsylvania Ave. and H St.; east of Lafayette Square; old Belasco Theater).	70	51	Ends in clay.....	Below —19
1619 Q St. (Cairo Hotel).....	312	85	0–70 feet clay, 70–312 feet granite.....	15
17th St. between Pennsylvania Ave. and H St. (square 167, west half; 6 holes). ¹	60–65	55–67	4 holes to rock; each penetrated rock 10 feet...	—10 to —5.7
17th St. and Connecticut Ave., L and DeSales Sts. (Mayflower Hotel).	40	57	Excavation through Potomac group.....	19 to 21
17th and 18th, D and E Sts. (American National Red Cross; 15 holes).	45–75	23–35	15 holes to rock, under terrace deposit.....	—23 to —39
Champlain St. and Florida Ave. NE. corner (between 17th and 18th Sts. near V St.). ¹	5	115	Pit through arkose to granite.....	110
18th St. and Constitution Ave. (Navy Department; 17 holes).	30–48	About 15	Fill, sand, peat and some gravel on rock....	—18 to —33
18th St. between California St. and Wyoming Ave. ¹	10	135	Fault; gneiss on west, arkose of Potomac group on east.	135
18th and 19th, C and E Sts. (Interior Department):				
18th and D Sts.....	59	27	Test holes to gneiss.....	—32
18th and E Sts.....	67	35	do.....	—32
18th to 19th Sts. near C St.....	53	22	do.....	—31
18th to 19th Sts. near E St.....	62	37	do.....	—25
19th and D Sts.....	57	31	do.....	—26
19th and 20th Sts., Constitution Ave. and C St. (square 128; 8 holes). ¹	55–60	About 22	Fill 25 to 30 feet; clay, sand, and gravel or gneiss.	—25 to —32
20th and B Sts. (U. S. test hole). ¹	-----	-----	No record.....	—25
20th St. and Pennsylvania Ave.....	203½	72	Rock at 43 feet, under terrace gravel.....	29
20th and M Sts. (brewery). ¹	900	-----	All gneiss below terrace deposit.....	-----
20th and 21st Sts., Constitution Ave. and C St. (Federal Reserve Board; 12 holes). ¹	42–58	25–32	Fill, mud, clay, sand, and boulders.....	—9 to —24
20th and 21st, C and D Sts. (21 holes)	34–77	25–40	Fill, clay, silt, sand, and gravel.....	—3 to —25
2107 Pennsylvania Ave. (bet. I and K). ¹	12	About 70	Decayed rock under terrace gravel.....	60
21st and M Sts. ¹	150	60	Gravel at 5–25 feet, soft rock 25–33 feet, hard rock 33 feet to bottom.	25
21st and 22d Sts., Constitution Ave. and C St. (National Academy of Sciences; 4 holes).	35–40?	About 30	Fill 5 to 10 feet thick, clay and sand 6 to 28 feet thick, on decomposed rock.	12 to —8
21st and 22d, C and D Sts., at Virginia Ave. (State Department; 55 bore holes).	10–70	30–60	Fill, clay, sand, and gravel on rock.....	20 to —24
21st and 22d Sts., E St. between. ¹	132	65	All gneiss below terrace deposit.....	-----
Lydecker Tunnel shafts:				
East end, at McMillan Reservoir.....	148½	131½	Chloritic gneiss at 102–148½ feet.....	29½
13th St. north of Florida Ave.....	125	140	Talcoose schist at 80 feet.....	60
			Another record gives rock at 96 feet.....	44
Soldiers' Home:				
Pump.....	205	209	Soft rock at 173 feet, under green clay.....	35
Pump house.....	478	209	Rock at 174–478 feet, under gravel.....	35
Brightwood, Georgia Ave. near Peabody St....	146	291	Soft rock at 64 feet, "gneiss" 99–146 feet...	227

SOUTHWEST WASHINGTON
[See also pages 20–27]

Half St. (between South Capitol and 1st Sts.) at T St.	207½	22.4	Clay and sand.....	Below —185
2d St. at E St. and Virginia Ave.....	146	12	do.....	Below —134
324 B St.....	147	11	Gravel, coarse below.....	Below —136
3d and D Sts. ¹	96	13	Clay and sand.....	Below —83
4th and B Sts. (formerly 4½ and B Sts.).....	141	11	do.....	Below —130

¹ Not on plate 1.

Data on boreholes and excavations, indicating altitude of bedrock—Continued

Location	Depth of hole (feet)	Land surface altitude (feet)	Materials	Bedrock surface altitude (feet)
SOUTHWEST WASHINGTON—Continued				
4th and O Sts. (formerly 4½ and O Sts.; old powerhouse).	208	12	Sand at 198–208 feet.....	Below — 196
6th and G Sts. (SE. corner).....	145	24½	Clay and sand.....	Below — 120
623 D St. (or 630 Virginia Ave.; formerly Auth's). ¹	202	28	Rotten rock at bottom.....	At — 174
7th and H Sts.....	144	22	Clay and sand.....	Below — 122
12th and C Sts. (Agriculture Department).....	90	37	Blue rock at 89–90 feet, under 5 feet of blue clay, which is overlain by sand, gravel, and clay.	At — 53
14th and D Sts.....	247	25	Rock, soft 110–144 feet, hard 144–247 feet.	At — 85
Washington Monument (15th and 16th Sts., Independence and Constitution Avenues; 15 holes).	72–128	10–40	Fill, sand, gravel, and river silt to bedrock.	From — 55 to — 71
Jefferson Memorial (Tidal Basin; 27 test holes).	60–150	8–10	Fill, river silt, sand, and gravel to bedrock.	From — 65 to — 91
Reflecting Pool (between 17th and 22d Sts., Independence and Constitution Avenues; 11 holes).	27–50	About 10	Clay and sand.....	From — 17 to — 40.
Lincoln Memorial (23d St. between Constitution and Independence Avenues; 20 test holes).	42–56	16	Mainly river mud to bedrock.....	From — 28 to — 40.
Eriasson Memorial (23d St. and Riverside Drive).	53	12	Fill, river silt, sand, and gravel to rock.....	At — 41
Water Gate (west of Lincoln Memorial at edge of Potomac River; 69 holes).	15–58	6–20	.....	From — 20 to — 42.
Arlington Memorial Bridge (many jet probings; 23 core borings).	50–70	Below mean low water to 10.	Mud, fine sand to rock.....	From — 35 to — 50.
Highway Bridge (8 holes).....	.....	Below mean low water.	Mud, sand, gravel, and clay to bedrock.....	From — 84 to — 110.
Railroad Bridge, hole 2.....	.....	— 30	Gravel, sand, and clay to bedrock.....	— 102

NORTHEAST WASHINGTON

[See also pages 27–28]

North Capitol and G Sts. (old Pabst Brewery). ¹	96	26	Sand and gravel.....	Below — 70
60 M St. (Southern Dairies) ¹	176	60	Clays and sands, sand 152–176 feet.....	Below — 116
18 O St. (Goldcraft Co.).....	159	58	Rock, 158–159 feet under sand and clay.....	— 100
Lincoln Road and S St. (east of North Capitol St.).	162	110	Talcose rock at 148 feet.....	— 38
Washington Terminal Co.:				
1st and K Sts.....	210	50	Bedrock, 170–210 feet.....	— 120
3d St. and Florida Ave.....	185	60	Ends in coarse sand.....	Below — 125
New York Ave. at Fairview Ave.....	175	95	Ends in coarse sand.....	.....
300 feet east of round house.....	218	95	do.....	Below — 123
Ivy City shops.....	260	98	do.....	Below — 162
New York Ave. at Montana Ave.....	260	95	do.....	Below — 165
1st and Patterson Sts. (between M and N Sts.; Chapin-Sacks Corp.). ¹	210	47	Granite, 197–210 feet.....	— 150
Do.....	208	42	Hard rock, 145–208 feet.....	— 103
3d and H Sts.....	157	44½	Sand and gravel, 150–157 feet.....	Below — 112
3d St. and Florida Ave.....	185	68	Sand and clay.....	Below — 117
4th and C Sts. and Maryland Ave. (Stanton Square).	232	80	Clays and sands, clay 81–197 feet.....	Below — 152
4th and F Sts. (old brewery).....	300	45	Water at 270 feet.....	Below — 255
4th and R Sts. (old powerhouse).....	225	80	Bedrock, 159–225 feet under gravel.....	— 79
4th and 5th Sts., U St. Between.....	150	84	Crystalline rock at 127–150 feet.....	— 43
1262 5th St. (between M and N).....	162	79	Dark gray tough clay, 150–162 feet.....	Below — 83
7th St. between A and B Sts. (Chesapeake & Potomac Telephone Co.).	331	67	Rock, 328–331 feet.....	— 261
7th and D Sts. and Maryland Ave.....	232	75	Water sand 218–232 feet.....	Below — 157
11th and East Capitol Sts. (Lincoln Park, SW corner).	181	85	Clay 33–178 feet, sand 178–181 feet.....	Below — 96
12th and K Sts.....	188	45	Ends in sand and coarse gravel.....	Below — 143
Warren and B Sts. (between 14th St. and Tennessee Ave.). ¹	125	80	Red clay, 52–120 feet, sand 120–124 feet.....	Below — 45
1400 Rhode Island Ave. (between Evarts and Franklin Sts.; Hot Shoppe).	298	171	Rotten rock under water-sand at 284 feet.....	— 123
15th and E Sts. (old Hygienic Ice Works).....	365	50	Bedrock, 350–365 feet.....	— 300
15th St. and Maryland Ave. (near H St.).....	197	45	Clays and sands, sand 186–196 under red clay.	Below — 152
911 Bladensburg Road (between 16th and 17th, Neal and K Sts.; Sears, Roebuck & Co.).	304	54	Stopped in gravel.....	Below — 250
2301 Bladensburg Road (between Queens Chapel Road and 24th Place; Hot Shoppe). ¹	139½	50	No Record.....	.....

¹ Not on plate 1.

BEDROCK SURFACE OF THE DISTRICT OF COLUMBIA

Data on boreholes and excavations, indicating altitude of bedrock—Continued

Location	Depth of hole (feet)	Land surface altitude (feet)	Materials	Bedrock surface altitude (feet)
NORTHEAST WASHINGTON—Continued				
24th and Channing Sts. (Langdon; Corby Co.)	260	60	Granite samples at 250 and 260 feet	Above — 190
24th to 26th Sts., south of Douglas St. (Langdon; Standard Brands Inc.)	207	60	Ended in gravel	
Do	247	60	"Reached rock" at 244 feet	— 184
Do	262	60	"Boulders" at 260–262 feet, on rock	— 200
Do	220	55	Rock 217–220 feet	— 162
24th and Irving Sts. (Woodridge)	312	145	"Stopped at rock under 8 feet of sand"	— 167
Terra Cotta (near Baltimore & Ohio Railroad)	183	180	Crystalline rock, depth not given	
National Training School for Boys (Bladensburg Road and South Dakota Ave.)	270	170	Clay and sand	Below — 100

SOUTHEAST WASHINGTON

[See also pages 28–29]

South Capitol and E Sts. (Colonial Ice Cream Co.)	273	10	Bedrock 247–273 feet	— 237
41 L St. (Wakefield Dairy)	120	30	Clay and sand	Below — 90
Naval Gun Factory (between 1st and 11th Sts., M St. and Anacostia River). ¹	162½	20	Clay and sand	Below — 142
2d and D Sts. and North Carolina Ave.	232½	67	Blue clay, mostly, to 232 feet	Below — 166
3d and M Sts.	223	15	Ends in sand	Below — 208
10th St. and South Carolina Ave. ¹	147	77	Clay and sand, coarse sand at bottom	Below — 70
12th St. and Virginia Ave.	290	49	Clay and sand	Below — 241
1337 D St. (Carry Ice Cream Co.) ¹	300	76	Clay and sand	Below — 224
Do	325	76	do	Below — 249
14th and C Sts. ¹	149	78	Clay and sand (red clay) 128–148 feet	Below — 71
14th and D Sts. (brewery) ¹	320	76	Clay mostly	Below — 244
St. Elizabeths Hospital (1907)	590	10	"Arkosic material" 400–440 feet, probably rotten rock; crystalline rock 440–590 feet.	— 390
Do	398½	10	Granite at 397 feet	— 387
St. Elizabeths Hospital, 1 mile east of ¹	600	160	"To rock"	— 440

Maryland

PRINCE GEORGES COUNTY

[See also pages 29–31]

Chillum, gas tanks (well)	68	35	Rotten rock at 45 feet, hard at bottom	— 10
Hyattsville:				
West of railroad station (Meyer Lewin)	206	50	Coarse water sand, 200–206 feet	
Ice works ¹	285		Sand at 285 feet	
¼ mile east of post office	247	12	Granite at 247 feet deep	— 235
5315 Baltimore Ave. (Hot Shoppe) ¹	242	20	Rock, 234–242 feet	— 214
University of Maryland:				
College Park	284	145	Quartz 191–193 feet; gneiss 193–284 feet	— 46
Paint Branch near highway	180½	60	Hard green rock, 154–180½ feet	— 94
Beltsville, Agricultural Research Center:				
Al. No. 2 (1934)	425	160	Rock at 315–425 feet	— 155
F. D. No. 1	260	125	Rock at 260 feet	— 135
Hole "N"	359	157	Rock at 307 feet	— 150
Hole "E"	363	130	Rotten rock, 263–272 feet	— 133
D. F. No. 5 (1934)	250	126	"Loose rock" at 196 feet; also "rotten rock, 185–197 feet."	— 70?
Beltsville, Agricultural Research Center:				
Dairy No. 3	364	150	Gneiss, 228–304 feet	— 78
Dairy No. 4	251	123½	"Sand and broken rock" 215–233 feet, gray rock 233–251 feet.	— 110
Glenn Dale Sanatorium ¹	946	145	To rock under entire thickness of Potomac strata.	— 801
Suitland (Gerstenberg farm) ¹	387	290	Water sand at 383–387 feet	
Forestville, ½ mile west of	1,400	280	No reliable data, but granite reported	— 1,120
Meadows, near ¹	1,728	260	"Reddish-brown sandy clay at bottom"	— 1,468
Meadows, ½ mile south of	1,511	260	Bedrock not reported	Below — 1,250
Fort Washington ¹	1,000		Ends in clay of Potomac group	

CHARLES COUNTY

[See also page 31]

Indian Head (Naval Proving Ground)	1,200	95	Hard rock 740–1,200 feet	— 645
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¹ Not on plate 1.

Data on boreholes and excavations, indicating altitude of bedrock—Continued

Location	Depth of hole (feet)	Land surface altitude (feet)	Materials	Bedrock surface altitude (feet)
Virginia				
ARLINGTON COUNTY [See also pages 31-33]				
Hoover Airport (amusement park, 1925) ¹ -----	102	10	Schist at 92 feet-----	-82
Hoover Airport (1926) ¹ -----	330	10	Schist samples from 320 to 330 feet, but no data as to top of rock.	-----
Pentagon Building (test holes)-----	30-60	10-50	-----	From 13? to -27
American Oil Co., filling station, ½ mile southwest of Highway Bridge (1926).	314	10	Fill and muck to bedrock at 114 feet-----	-104
McGuire and Rolfe, a few rods southwest of American Oil Co.	303½	10	Fill 0-62, sand 62-105, bedrock 105-303½ feet.	-95
Oxygen Co. ¹ -----	97	15	No rock-----	Below -82
Norton Rendering Co. (1933) ¹ -----	355	10	Bedrock entered at about 95 feet-----	-85
Abattoir (1920)-----	480	30	Rock at 85 feet-----	-55
Columbia Pike, corner of Highway No. 1, 1920. ¹	125	12	Bedrock at about 105 feet-----	-93
Jefferson School-----	130	150	Sand and clay-----	-----
18th St. near Arlington Ridge Road, southwest of Hume School.	163	100?	No bedrock reported to 60 feet or more below sea level.	Below -60
ALEXANDRIA [See also page 33]				
Alexandria, Pendleton and St. Asaph Sts. (brewery).	430	30	Did not reach bedrock-----	Below -400
Alexandria, Union and Cameron Sts. (ice plant).	401	10	-----do-----	Below -39
Alexandria tunnel to Marbury Point (proposed, 1941; 2 holes.	201	-----	Mud, sand, and clay. Did not reach bedrock.	-----
FAIRFAX COUNTY [See also pages 33-34]				
Seminary Station, ½ mile north of (just north of old Fort Crawford).	240	230	240 feet of casing. All Potomac group.	Below -10
Theological Seminary, ¼ mile southeast of-----	150	200	Ends in Potomac group-----	Below 50
Episcopal High School-----	300	260	"Petrified wood" (Potomac) in bottom-----	-----
Episcopal High School, ½ mile north-northwest.	170	260	Granite 165 to 170 feet-----	95
Episcopal High School, ½ mile northwest-----	205	272	Has 192 feet of casing-----	Below 80
Lincolnia, ¼ mile south of-----	117	247	Ends in Potomac group-----	Below 130
Lincolnia, ¾ mile west of-----	93	228	-----do-----	Below 135
Do-----	125	240	-----do-----	Below 115
Lincolnia, ¾ mile northwest-----	72	270	-----do-----	Below 198

¹ Not on plate 1.

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