Quadrangular Treasure: The Cartographic Route to Industrial Archeology

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Most industrial structures and sites are by their very nature and location difficult to study systematically. In some instances they are too remote or too concealed to be discovered first-hand. Some are difficult to photograph or measure because of their physical condition, configuration, scale, or setting. Moreover, while industrial archeologists may carefully record and document a site, seldom can they afford to do the same for its larger setting–even though this may be essential to a full understanding of the specific site. Because of the precise and detailed information included on quadrangle maps, these have special value to industrial archeologists. Indeed, as information sources, quads often are more than merely valuable, they are indispensible.

The map as a means of locating places, natural features, and a limited range of cultural features such as railroads and highways needs no further comment. **Less** universally recognized, though, is the value of the ***large-scale*** map as a source of information on a vastly enlarged world of man's additions to and alterations of the earth's surface. Without question, the most informative and generally useful large-scale maps of the United States are the "quads" or "topo" maps published by the U.S. Geological Survey (to which we will henceforth refer as the Survey).

These maps are sold by the millions to local governments, utility companies, planners, scholars, hikers, and a wide variety of other organizations and private citizens having an even wider variety of other interests. The Survey points with justifiable pride to the immense range of purposes to which its maps can be turned. What it has been unaware of is their singular value to the industrial archeologist, for they comprehend astonishing amounts of information relating to historic industrial structures and sites, information that is as readily available in no other form.

It probably is fair to say that while many of the people concerned with industrial archeology—geographers, engineers, and excavating archeologists, for example—have long been familiar with these maps and their value for locating sites and analyzing material evidence, the interdisciplinary nature of the field leads to the suspicion that there are many others to whom these wonderfully useful documents are either unknown or mysterious. To none should they be either.

To industrial archeologists of whatever background quads are useful at all stages of investigation—preliminary identification of sources, gathering of evidence, and interpretation and analysis. Quads are especially helpful for preliminary inventory work, for determining how to gain access to a site, and even for ascertaining the best time and vantage point for taking photographs (see Figures **3-B,** 7-A, and 7-B). Quads also are useful once in the field—for preparing site plans and identifying structures, and for providing a solid base for inference about sub-surface remains (see Figure **4-B).** Last, quads embody information concerning broader contexts—geographic, topographic, and, often, social and economic. They reveal precise spatial relationships between structures on a site, and between sites and their markets and resources. And—if maps of different publication dates are compared—they reveal changes over time (Figure 1-8). It is the intention here to explore the sort of information that can be obtained from these maps, how it may be interpreted for use in industrial-archeological investigation, and one technique for the handling of maps in the field.

The Basis of the Quads

The reference to "quads" in most cases is to a series of "general-purpose" maps published by the Survey since the early 1880s. They are the largest-scale maps routinely published by the government, and show an astonishing variety of natural and cultural (man-made) features. Since they indicate the configuration or relief of the earth's surface—the topography—by a variety of conventions such as elevation figures and contour lines, they are, generically, “topographic” maps. But ***so*** are any maps that show relief. The peculiarity of this series **is** that they cover only a small section of ground—far less than the area of most political units (such as counties or townships) that are the common basis for maps. Having no other basis for their boundaries, and to provide a degree of uniformity in size, the maps are bounded on their four sides by parallels of latitude and meridians of longitude producing a near rectangle called a ***quadrangle.***[1] Hence, generally speaking, these are topographic maps, but more specifically quadrangle maps or, in the parlance of the field, simply “quads.”

The quads originally were published at a scale of 1:62,500 (1 inch = nearly 1 mile) and covered ¼ degree of both latitude and longitude. One-quarter of a degree = ***15 minutes*** of arc, and the series was ***so*** known. The 15-minute series prevailed through the 1950s, and many areas of the country—particularly those where the feature density is light—have been mapped only in that series. Beginning in the 1960s demand for more detail caused a shift to the larger scale of 1:24,000. A map at that scale (1 inch = 2,000 feet) embracing an area 15 minutes by 15 minutes would have been unwieldy, ***so*** the coverage **was** quartered to 7% by **7%** minutes. The resulting *7½-minute* series is the standard today, with most of the densely populated areas of the continental **U.S.** covered.’ Many of the older 15-minute quads have been remapped into four 7½-minute sheets. All that follows relates to this series.

Here a word about scale size, a commonly-misunderstood concept. ***Large scale*** =large amount of detail and small area covered; ***small scale*** the reverse. At the 1:24,000 scale of the 7½-minute quads, **2%**map-inches = slightly less than a mile on the ground.

The quads are identified solely by ***name.*** The quad name usually is that of the most prominent city or town shown. If a large city is covered by two or more quads, each or all may take the city name with directional distinctions added (WASHINGTON EAST, WASHINGTON WEST). Where no cultural feature is present, the name of a natural one may be taken (BALD MOUNTAIN). ***Occasionally*** a quad **is** named for an engineering feature (CONOWINGO DAM). In ordering and referring to quads the state also is specified, as many names are duplicated among states. When a quad covers more than one state, all are shown in the title, the state with the greatest area on the sheet being given first (WHEELING, WEST VIRGINIA-OHIO). For each state and Puerto Rico an index map **is** published with the quads shown as a grid overlay. For each quad the name and date of publication are shown. Both 7%- and 15-minute quads are identified, as available at the time of the index map’s publication.

The date of quad publication varies widely. The Survey attempts to keep the maps current but the term **is** relative. A major revision of a given quad rarely occurs at less than 20-year intervals, even in dense areas where the rate of change is apt to be great. Minor revisions are made more frequently, however, by aerial survey (the principal method by which most Survey mapping is done anyway), the revisions being shown on the earlier edition by a purple overprint indicating features new or changed since original publication.[3] These revisions are regarded as interim, and are not field checked.

The Quad as an Industrial-Archeological Key

The allusion to astonishing amounts of information contained in the quads is no idle comment. There are three fundamental classes of information shown on the quad: natural features; cultural features; and relief, both natural and cultural. It is the demonstrated aim of the Survey to pack the quad format with as much data as humanly possible, the apparent limits being only the cost of information gathering and map legibility. In each class the information content is both verbal and graphic/symbolic, in various combinations. Graphic conventions are used ***so*** far as possible, often supplemented by lettering to specify the particular feature or give its name. Railroads, for example, are shown by the familiar single or double line with “crossties,” the name of the particular railroad lettered along it.

A fundamental element of the quad format **is** the use of color indications. BLACK is employed for **all** cultural features and lettering (except contour numbering); RED for major roads and certain lesser land boundaries; BLUE for all hydrological features (from oceans and rivers to swamps and marshes); and GREEN for wooded areas, orchards, and certain natural growth, but not for “low” growth such as fields and meadows.

All land-relief features—principally contours—are shown in BROWN, as are a few special land configurations, both natural and man-made, such as mine tailing heaps, dunes, and unusual surface conditions. These are the principal colors used. Additionally, PINK (actually a screened red) is used in urban areas where the building density is too high to show individual structures with any degree of legibility? The other secondary color is the already-mentioned PURPLE used to indicate interim revisions by overprint.

A principal value of the quads is the wealth of information that can be packed in (or ***on)*** by reducing features—especially cultural features—to symbols, of which a wide variety is used. Say, for example, that the researcher is faced with the task of locating a factory known to be near a certain town. The name of the respective quad is identified from the index map for that state, and from the quad the factory probably can be found. How? Because of another helpful quad convention. The scale of the 7%-minute quads is large enough that literally every building but the smallest out-buildings can be shown. Structures of about the size of a single residence are indicated symbolically (in black) by a square that more or less approximates the size of a typical house. But anything much larger is shown by a block that quite closely represents it in both scale and plan shape. This, of course, includes most industrial buildings, making a factory relatively easy to spot. It does not, however, permit distinction between a medium-sized factory and a supermarket. Other clues help, though: If the block is on a railroad or stream, it is more likely to be industrial than commercial. Thus, if there is a single factory in the town, it probably is the one sought. If there are several, at least the search is narrowed.

It is in the area of discovery of unexpected industrial-archeological remains, however, that the quad is at its most spectacular. To examine one for an area that is to be visited for whatever purpose is almost inevitably to discover things unknown and unexpected. Letting the eye range along a line of railroad may reveal bridges (fixed or draw), tunnels, directly railroad-related structures such **as** stations and shop buildings, and indirectly associated ones such as factories. Along waterways can be found dams, bypass canals, falls with mills, more bridges, and pumping stations. In mineral-rich areas are likely to he deep and open-pit mines and related installations. A public institution such as a large hospital with a chimney shown adjacent probably means an isolated power plant that may be old enough to contain steam engines. Other examples of the myriad ways by which the quads can be "read" for industrial-archeological purposes are given by the accompanying illustrations.

While the most valuable use of the quads from our standpoint is in site location, there are other, related ones. The maps are documents of genuine worth in the teaching of technological, industrial, and cultural history. For example, the quad of Lowell, Massachusetts, or one of the other highly concentrated textile centers ranged along the Merrimack River makes clear the reasons why these particular places initially were selected for industrial development (Figure 1). The difference in elevation of the river above and below the impounding dam, shown both by the contour lines and the figures at bench marks and "spot elevations," is direct evidence of the waterpower available **as** the water falls through this vertical distance. The system of power canals built to distribute the water is vividly shown. The mills ranged along the canals are seen in some cases (most being absorbed in the pink of built-up area) in contrast to the later steam-powered mills. These, erected after the waterpower capacity at each site was exhausted, were located not on the canals but on the railroads that came later.

Relationships between industrial and town development often can be traced, as can transportation corridors and the development of all cultural manifestations in terms of the hydrology and topography. While such relationships as these can, of course, be shown on other maps of an area of study, these often are difficult to obtain. The quads are ubiquitous and readily available for any and all regions of the U.S.

From the most pragmatic standpoint, the quads have a considerable use in traveling by car, foot, or any other means. ***AN*** roads are shown, from interstate highways down to "jeep trails," as the Survey likes to designate something passable only by four-wheel-drive vehicle. Anything shown of an order above the jeep trail usually is entirely negotiable by conventional car—even though it may be unpaved—opening up a wonder-world of shortcuts, site access, and vistas that is closed entirely to those common folk reliant on the traditional oil-company map. The large scale of the quad provides ***so*** many landmarks that only the most hopelessly inept map reader should manage to become lost when navigating by this means.

A final supplementary use of the quad is as a log sheet in site inventorying. Their relatively low price makes it entirely feasible to use the quad itself for directly marking sites and structures. The margins are generous (the more so the more northerly, as noted) providing ample room for notes. The indications of latitude and longitude, Universal Transverse Mercator (UTM) coordinates, and on some maps of state grid systems along **all** borders make it possible to designate the precise location—in any system—of any structure or area.' From the profusion of data on the quad, location descriptions may be made in terms of proximity to roads/streets and landmarks as well, of course—all this in the comfort of the home base.

Handling the Quads in the Field

The 7½-minute quads are about 27 inches high by **22** inches wide overall. Two schools of thought appear to exist on the most practical method of physically handling the sheets, especially in the field. The most simple method consists simply of folding them into quarters, first with a vertical fold and then a horizontal, which causes the quad name to show on both exposed quarters of the folded map. This method has the advantages of simplicity, of showing the entire quad when opened up, and of leaving generous margins for annotation. There are several disadvantages. The maps being loose, they tend to get jumbled when covering a good sized area involving many sheets. Unless a clipboard is used, there is no inherent writing surface under the map, while with a clipboard—if traveling—it is necessary constantly to shift from one quarter of the sheet to another by unclipping and refolding, and probably even to shift sheets.

The other principal method for dealing with the quads is to use a loose-leaf binder. This involves moderate expense and has one or two deficiencies of its own, but offers the serious quad user some overwhelming benefits. The system is based on filing the maps in standard four-ring legal binders (Boorum & Pease ***S-356,*** for example) which both keeps them in place and in an established order. The order may, of course, be tailored to fit a particular project. They may be arranged regionally, in tiers, to cover an area; or the sheets may be set in the sequence of a route of travel, or of a waterway; or they may cover the major cities of a region; or any other arrangement.

Finding the sheets in the binder, and relating them to the ground, is best guided by the state index map. This can be made the first sheet and its quad squares numbered in some convenient sequence; covering the entire state if small, or regions if a large one. The quads themselves then are numbered to correspond, and filed in numerical order. Quads present in the album (or in other albums) can be indicated on the index map by diagonal slashes or filling in with light-colored magic marker.[6]

The method of binding the quads consists of:

1. Cutting the sheet exactly in half horizontally, giving a lower and an upper half. Each half thus is **13%** inches high, just under the legal-sheet length of 14 inches. If this will do violence to some important feature or town that ought to be kept whole, the cut can be made slightly above or below it and the top or bottom sheet margin cut down to keep the longer half-sheet within the 14-inch limit of the album. Or, a flap can be folded over. The other half-sheet will be short, of course, but no matter.
2. Each half-sheet is then folded exactly in half on a vertical line, impression out. Note that the impression is not always centered on the sheet left-to-right. Therefore it is best not to make the fold by bringing the sheet edges together, but by lining up the ***printed borders*** of the quad itself by holding it against a window (or light table). When lined up, the fold can be creased.
3. The excess of the side margins is then trimmed off. **A** slight problem arises here. The maximum width of a sheet that will fit entirely within the album covers is nine inches. Trimming the half sheets to that width not only removes nearly all the available note-taking margin, but encroaches to some extent on the figures indicating the various coordinates. The effect naturally becomes the more pronounced the further south the coverage. **A** solution is simply to trim wider—say to 9% inches (for a 19-inch unfolded sheet width) which for most areas leaves the critical figures untouched. This does mean that when the album is closed the bundle of maps projects about a half-inch beyond the covers, but that makes little difference with normal handling.
4. Finally, the half-sheets are punched for the four-hole spacing and inserted. **As** the map name on both sheets is now on the back side of each half-sheet, it is necessary to write it on the upper right-hand corner of each, along with the numbers of any indexing system used. The top and bottom half-sheets of a given quad are easily distinguished by the location of the top and bottom margins.

A disadvantage of the system is that only a quarter of the quad is visible at a time. The "pages" can, of course, be pulled out at will and unfolded exposing the full quad width, and tops and bottoms held together if needed. The various advantages and disadvantages of each system can be weighed with respect to individual needs.

Other Maps Available

While the 7½-minute quadrangle maps (and to a lesser extent the old 15-minute series) are the last word for site location, there are other useful maps in the Survey's arsenal. For broader, less-detailed coverage the 1:250,000-series quadrangle maps are very good. Each map in this family of 473 covers **an** area two degrees of longitude (the boundaries on even-number degrees) by one degree of latitude, except for some for coastal areas. At this scale one map-inch = about four ground-miles. Shown in the same color convention as on the large-scale quads are major water features, major roads and many lesser ones (with route numbers), state and county boundaries, contours, woods cover, places down to fairly small hamlets, and, most useful, railroads, rendered sufficiently heavy and black as to be thoroughly followable. These maps are named for a major place within. Puerto Rico is covered by a single topographic map at a scale of 1:240,000. For Hawaii there are five and for Alaska 153 1:250,000-scale quads in this series. Index maps for Alaska, the Continental U.S., Hawaii, and Puerto Rico are available.

The National Ocean Survey (NOS)[7] publishes a splendid series of nautical charts for all the U.S. coasts and navigable rivers. One index map covers the Atlantic and Gulf coasts, Puerto Rico, and the Virgin Islands; another the Pacific Coast and Alaska. While intended mainly for navigation, much of industrial-archeological interest is shown, and these charts are particularly useful for work in harbor areas.

Beyond the Survey's maps, most states publish map series of their own, some of them at large scale and full of detail. These generally cover counties or other political units rather than quadrangles, and in many cases are at the same scales used by the Survey.

The Canadian equivalent to the U.S. Geological Survey quads are the National Topographic System maps. Most of the country is covered by quadrangles at a scale of 1:50,000 (one inch= nearly 0.8 mile). The more densely-populated areas are mapped by detailed, large-scale quads at 1:25,000 (one inch = 2,000+ feet or nearly 0.4 mile), while the Arctic areas and much of the West are covered only by 1:250,000-scale maps. Indexes to all maps are published.

Availability

Complete information on the availability of USGS quadrangle and other map series may be obtained from the US. Geological Survey, Distribution Section: 1200 S. Eads St., Arlington, Va. 22202, for areas EAST of the Mississippi River, Puerto Rico, and the Virgin Islands; and from Federal Center, Denver, Colo. 80225, for areas WEST of the Mississippi including Alaska and Hawaii. An index map for each state and for Puerto Rico, and a pamphlet describing the various topographic map series are available gratis. Each index map lists a variety of state and U.S. maps also available plus map reference libraries and private dealers within the state, and contains detailed ordering information. The 7½- and 15-minute quads currently are $1.25 each, the 1:250,000 quads are $2.00.

NOS index maps and charts may be ordered from National Ocean Survey, Distribution Division, C44, Washington, D.C. 20235. Chart prices vary according to scale and coverage.

Canadian maps, indexes, and information on all map series available may be obtained from the Canada Map Office, Department of Energy, Mines & Resources, 615 Booth St., Ottawa, K1A OE9. Map prices vary from $.75 to $1.50. Requests for indexes or information should specify the area of interest.

Further References

The ultimate exposition on the Survey's quadrangles and other maps, the origins of the Survey itself, its mapping programs, and on current cartographic technology is a ***tour de force*** by Morns M. Thompson, ***Maps for America: Cartographic Products of the US. Geological Survey and Others*** (xiv + 265 pp.). This was published by the Survey on the event of its centennial in 1979, and contains a glossary and index. Most of the many illustrations are in full color. It is available from the Survey's Arlington Distribution Center noted above for $11.00. The bibliography will lead the serious student as far into this area as wished. Also available is a free pamphlet on the quads for general public use.

Listings of new maps, revisions, and other up-to-date information is contained in the monthly ***New Publications of the Geological Survey.*** available on request from the USGS, MS 329, Reston, VA 22092.

A fine work on Canadian mapping is L.M. Sebert's ***Every Square Inch, the Story of Canadian Topographic Mapping.*** Ottawa: Surveys & Mapping Branch, Department of Energy, Mines & Resources, 1970; address as above.

The origin of topographic mapping in both North American countries is found in the renowned Ordnance Survey maps published by the British government since the 18th century. The interesting history of this service is told by G.B. Harley in his ***Ordnance Survey Maps, A Descriptive Manual.*** Southampton: Ordnance Survey of Great Britain, 1975.

The Selective Bibliography accompanying Stott's article cited in note 5 provides other references of both interest and usefulness.

Notes

1. A near rectangle, for of course while lines of latitude are parallel and therefore so are the top and bottom—north and south—boundaries of the map, meridians of longitude are parallel only at their intersection with the equator. At all other points north and south they are convergent. Thus the east and west boundaries of all US. quads lean inward to the top, the quad in reality being barely-perceptably trapezoidal. The one tangible effect of this is that the quads for southern areas are considerably wider than for northern, as squareness is approached going south.
2. Puerto Rico is covered by 7½-minute quads but at the scale of 1:20,000 (one inch = about 1,667 feet). Alaska coverage is by a quadrangle series at 1:63,360 (slightly smaller than the 15-minute series mentioned in the text) at which scale one inch = exactly one mile. The quadrangles in this series cover 15 minutes of latitude by 20 to 36 minutes of longitude.
3. In these interim revisions, demolished structures are not always removed from the map.
4. This is, of course, a drawback from the standpoint of locating structures in these areas, but there is some mitigation in the fact that certain "landmark" structures are shown, such as public buildings, schools, churches, and, occasionally, factories. (See Figures 1 and 2-A,)
5. A highly informative and practical essay by Peter H. Stott on the basis and use of the UTM grid system of coordinates is in IA 3 (1977): 1-9.
6. An alternate indexing system that maintains a geographical relationship of the quads is suggested by SIA member William E. Davies of the Survey. The quads are keyed to the 1:250,000-scale quad (this series is mentioned later in the article) of which they are part by ruling it into its 128 7½-minute areas, each of which will represent a 7½-minute quad. The rows are numbered 1 through 16 horizontally and the tiers lettered A through H from bottom to top. Each quad then can be designated by its appropriate number and letter plus an abbreviation of the large quad's name. The CHERRY RUN, MD-WV-PA quad, for example, would be designated CUMB 16-F, for it falls in the 16th vertical row and the 6th tier from the bottom of the CUMBERLAND 1:250,000 quad.
7. Formerly the U.S. Coast & Geodetic Survey.

Reading the Quads for Industrial-Archeological Sites

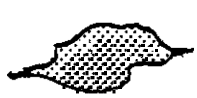
All map details are taken from USCS 7½-minute quadrangle maps, and are shown at the full scale of 1:24,000. One inch thus represents 2,000 feet on the ground. The quad from which the detail is taken is indicated below, with its dates of publication and photorevision, as: 1964/72.

The construction-date of the structures in the photographs is given in parentheses; the date of the photograph at the end of the caption.

Because of the black-and-white reproduction of the quad details shown here, their legibility—compared to that of the original full-color maps—is considerably diminished. The following notes will help in making the translation from the original form to the reproduction.

GREEN—Entirely absent

BLUE—Entirely absent. The dark-blue borders of ponds, lakes, reservoirs, and rivers, and the single line of small streams, have been over-drawn in black. The'light-blue screen representing the body of these water features within the borders has been rendered here with a coarse screen as:



BROWN—This color has reproduced with varying degrees of strength, depending upon the intensity of the original. The index contours appear in nearly every case; the intermediate contours faintly or not at all.

PURPLE—These photorevised features appear as black.

RED—Has reproduced as black.

PINK—The (red) screen indicating urban areas has reproduced very weakly or not at all. These areas, where germane to the detail, have been outlined with a heavy dashed line.

Figure 1. URBAN INDUSTRIAL ARCHEOLOGY. The amount of industrial-archeological information to be found on the quads of the major industrialized cities is nearly boundless. The historic textile city of Lowell, for example, contains industrial remains both unique and typical, much of it reflected on its quad. Evident first is the Merrimack River and the 19th-century system of power canals fed by it, the most extensive such arrangement in the world. At 1. are shown most of the system's hydraulic structures: the principal dam (identified by name) at the head of the falls, and the various locks, weirs, and other control elements. (The quad is not infallable—several are not shown.) At 2. arc a number of railroad bridges over the canals (curiously, no railroads cross the river in the immediate vicinity). Highway bridges over the river, railroads, and canals abound at 3.: large and small; modern, early (the Aiken St. or Ouelette Bridge of 1883 is a five-span parabolic truss bridge by the Berlin Iron Bridge Co.), and of all intermediate ages. At 4. is a foot bridge. A pair of local water-supply structures is seen at 5., either one of which might be early enough to be of interest.

In looking for the famed mills of Lowell the principal failing of the quad as an industrial-archeological locator becomes immediately apparent. Where are they? Without much doubt the two buildings at 6. are factories or mills. The long, narrow building on the Concord River (southeast corner) suggests a water-powered mill (or formerly so), the

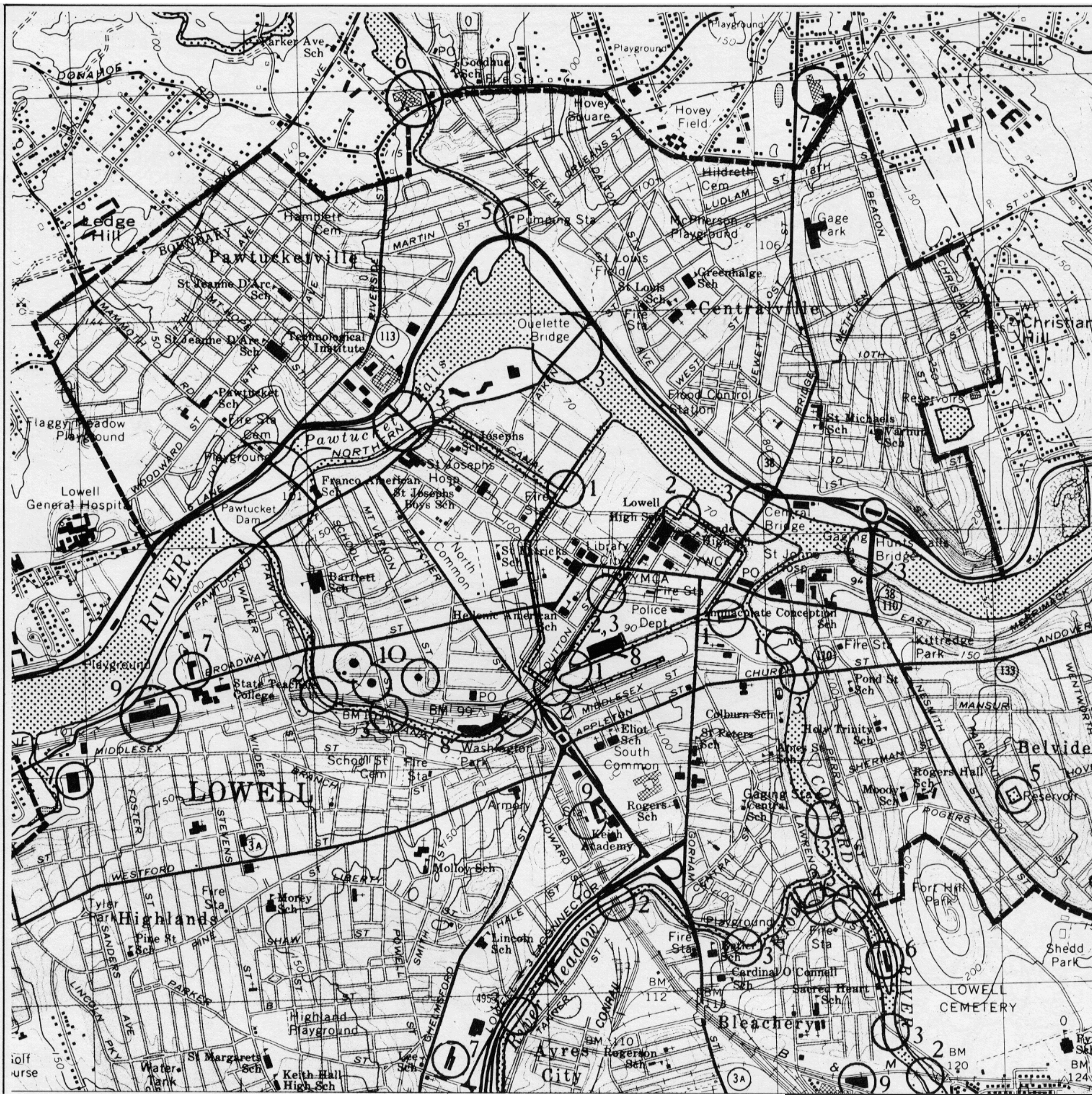


Figure **1.** *LOWELL,* **Moss.** *1966/79*

more *so* because of the adjacent railroad siding, while the small Lshaped block on Pleasant St. (north edge) could be an early water mill that expanded into a later structure represented by the squarish block on the opposite side of the brook. Or it might be another pumping station. Or something entirely different. And the four structures shown at 7. might or might not be factories or mills; lacking positive knowledge only a visit would reveal that to the explorer. But the great cotton mills (and the Lowell Machine Shop) that brought Lowell its fame are swallowed up in the cloak of invisibility that is the Survey's "urban area." While the pink area (seen here as a screen) gives up its schools, churches, and public buildings, it effectively hides from us most of the array of industrial buildings ranged along the east reach of the river and in several clusters on the canals. The two large structures at 8. are in purple and thus must be new, erected between the quad's publication and its photorevisipn in 1979.

At 9. are apparent railroad structures—perhaps freight houses. Finally, at 10. are what probably are simply oil storage tanks but which might be gas holders, on the basis of the **rail** siding that suggests the one-time delivery of coal for gasmaking.

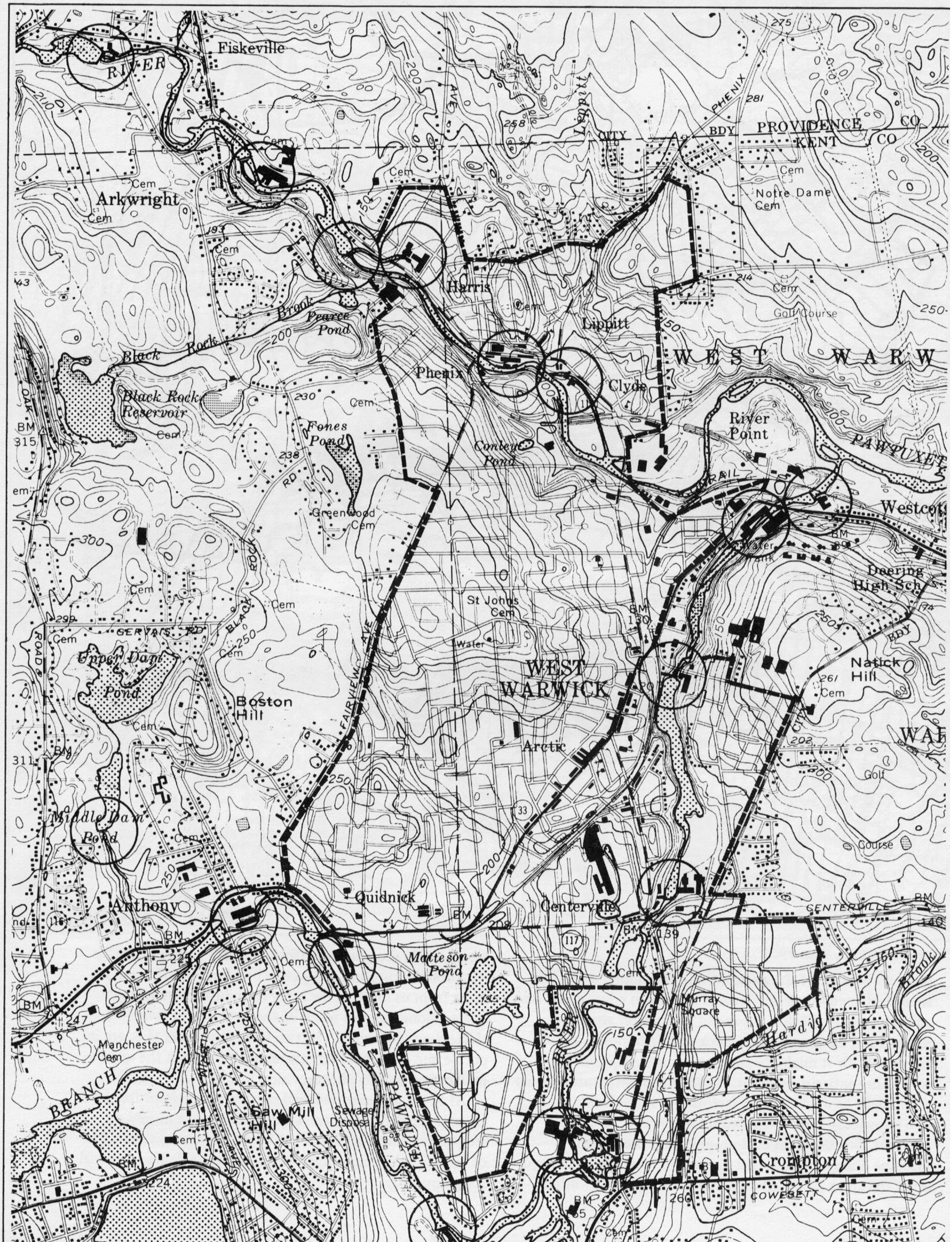


Figure 2-A. ***CROMPTON, R.I. 1955/70 & 75***

Centerville Mill (mid-19th **century).** Works **Progress Administration, 1940**

Figure 2. HYDRAULIC POWER STRUCTURES. **A)** No better example exists of the 19th-century practice of utilizing the descent of a single stream to produce power for a number of manufactories than the harnessing of the falls on Rhode Island's Pawtuxet River and its main branches. The series of dams, **pools,** races, and cotton mills that appeared between about 1808 and the 1860s largely survive and are strikingly reflected on the CROMF'TON quad. That these are 19th-century mills is clear not only from the evidence that they are water-powered but by observing that they are **long** and narrow, the ruling configuration of that period of inadequate artificial lighting, when it was essential that no machine be far from a window. (Note a certain inconsistency from quad to quad in what constitutes "landmark" buildings in the screened urban areas. While the mills of Lowell were not shown, here mills are the most prominent of the landmark structures.)

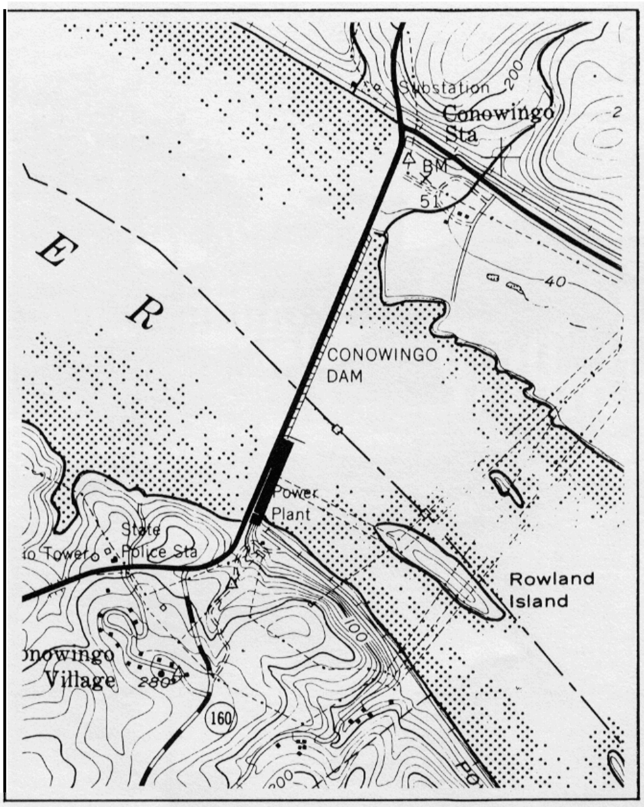
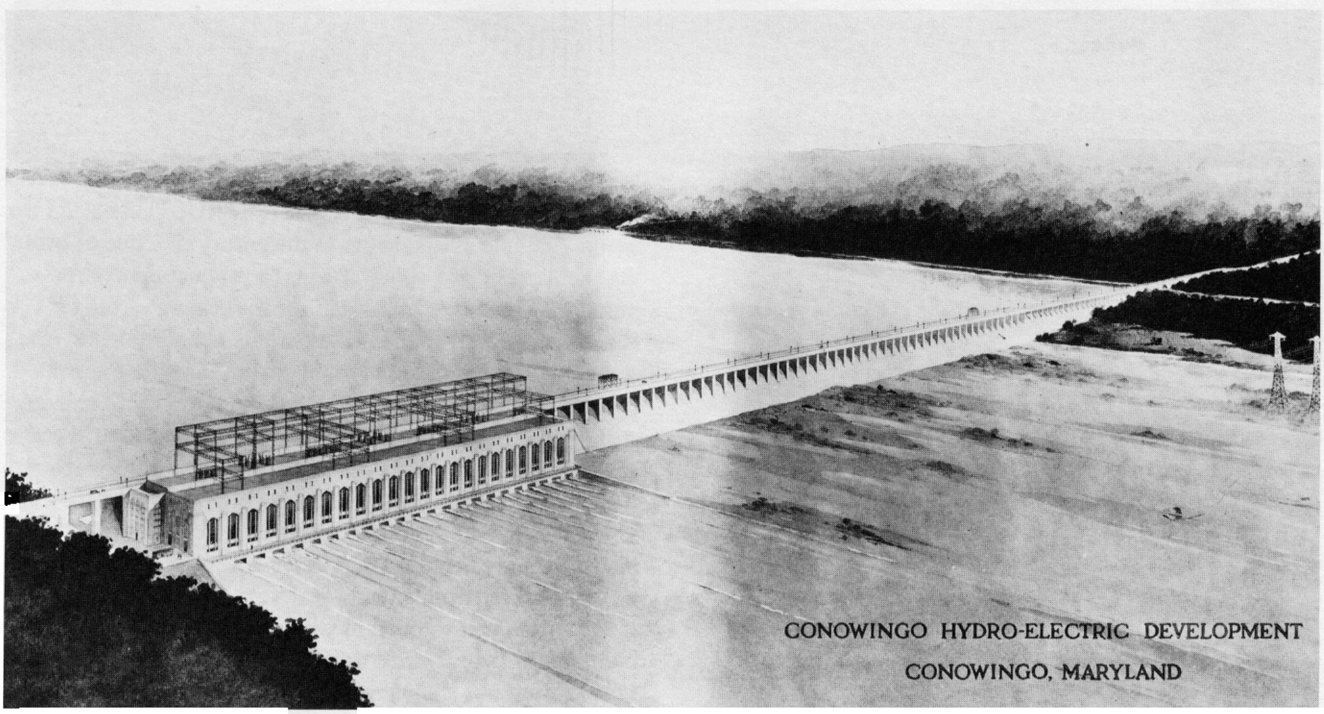


Figure 2-B. *CONOWINGO DAM, Md.-Pa. 1953/70*

B) The necessity of subdividing the drop of a river among a number of waterpower sites in the 19th century (each with a fall of some 10 or 15 feet) is contrasted with the capability a century later of extracting the energy of even a major watercourse in a single, huge, high-head installation, made possible by hydro-electric generation. Conowingo Dam and powerplant on the Susquehanna River (1927; enlarged 1964) is a good example of a large plant of its time. Head: about 90 feet (discoverable from the pool-elevation and contour-line figures). Capacity: 718,000 horsepower.



Conowingo Dam and hydroelectric station (1927).

C) Both the graphic and the verbal evidence of an intermediate-capacity hydraulic power site springs from the SHEPHERDSTOWN quad. **As** it is set in Roman type, we see that "Dam No 4" is, in fact, a place name, and an absolutely descriptive one. There is no canal leading from above the dam and the contour-line figures indicate a difference in river level above and below the dam—or head—of about 20 feet. Thus: a medium-head hydroelectric installation, fairly small so probably early 20th century. The photo shows the Dam No 4 hydroelectric station, built in 1909 with two units, the turbines driving the generators above through rope drives (see the SIA *Newsletter*, March-May 1975:3). What cannot be deduced from the quad **is** that Dam No 4 itself was built in the mid-19th century to supply water for the Chesapeake & Ohio Canal—the abandoned trace of which **is** indicated on the north bank—and that electricity generation is a later byproduct. Note also that the transmission lines leading from the station are on such a small scale that they are not shown on the quad, as are the prominent ones at Conowingo.

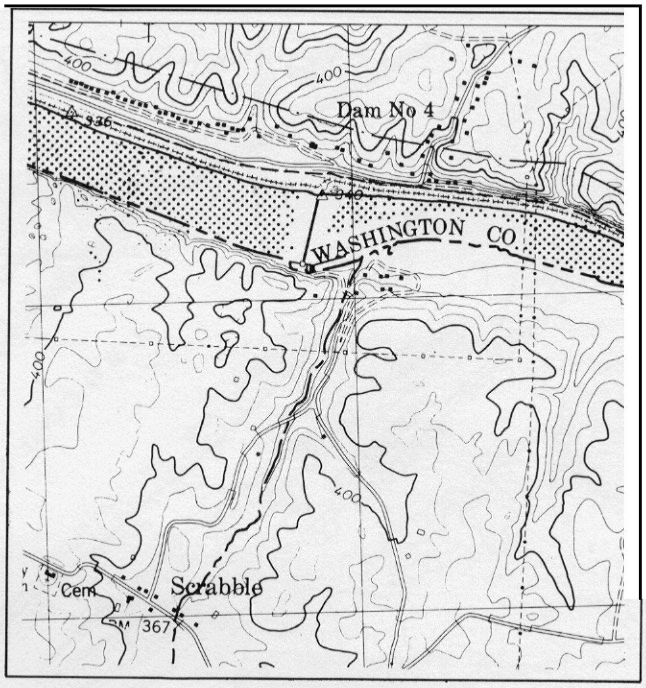
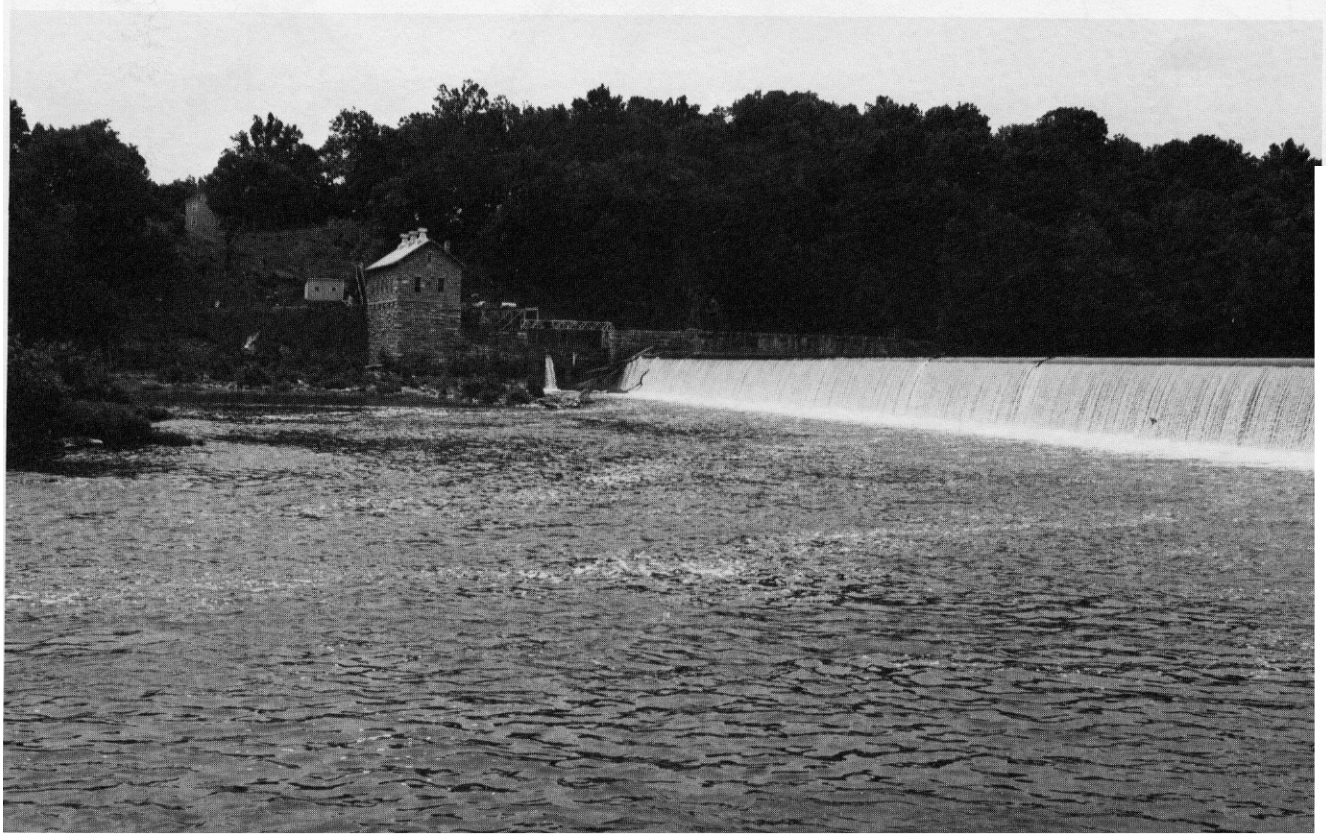


Figure 2-C. *SHEPHERDSTOWN, W. Va.-Md. 1978*


Dam 4 and hydroelectric station (1842 and 1909). 1975 *Photos* **by** *author unless otherwise noted.*

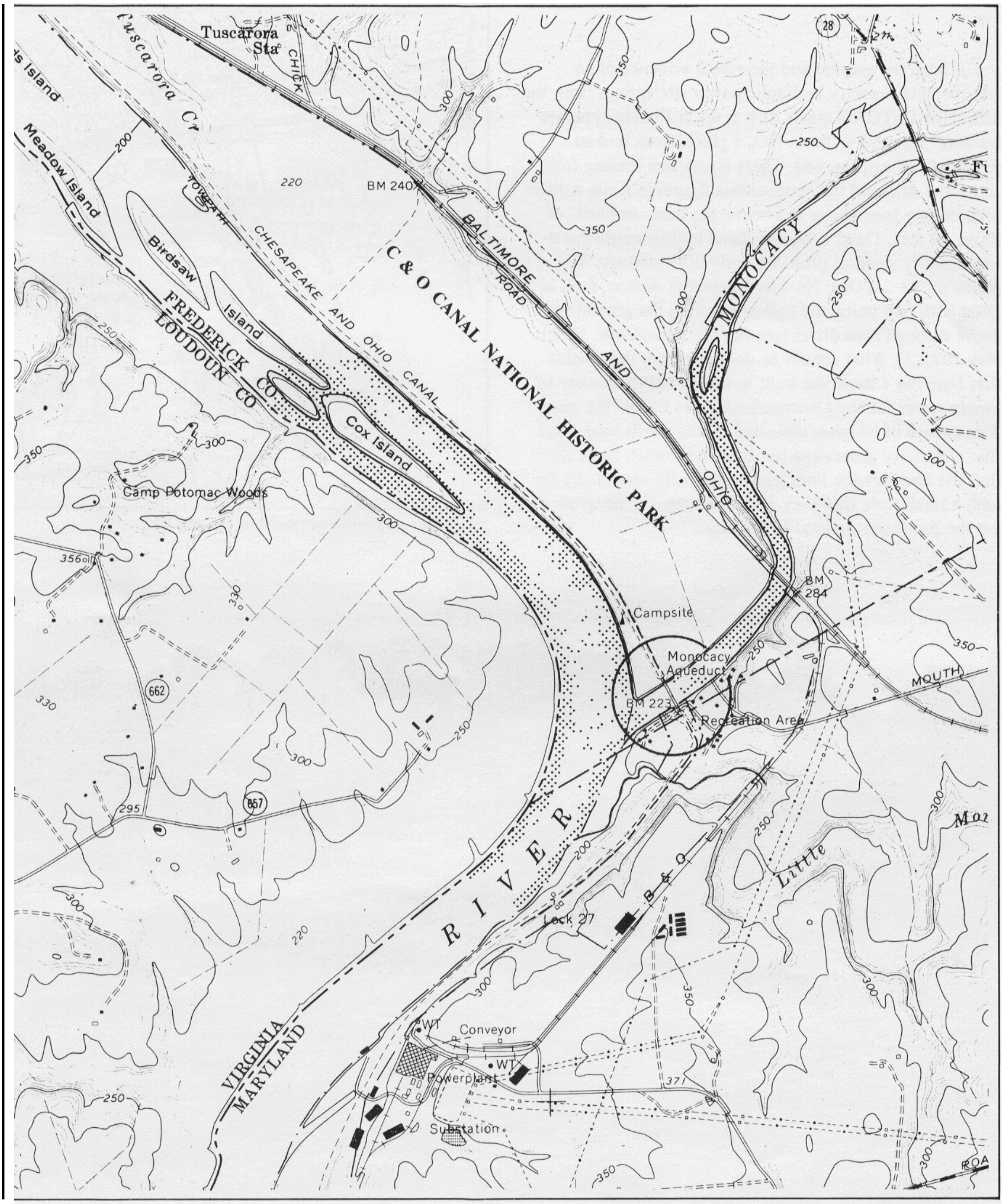
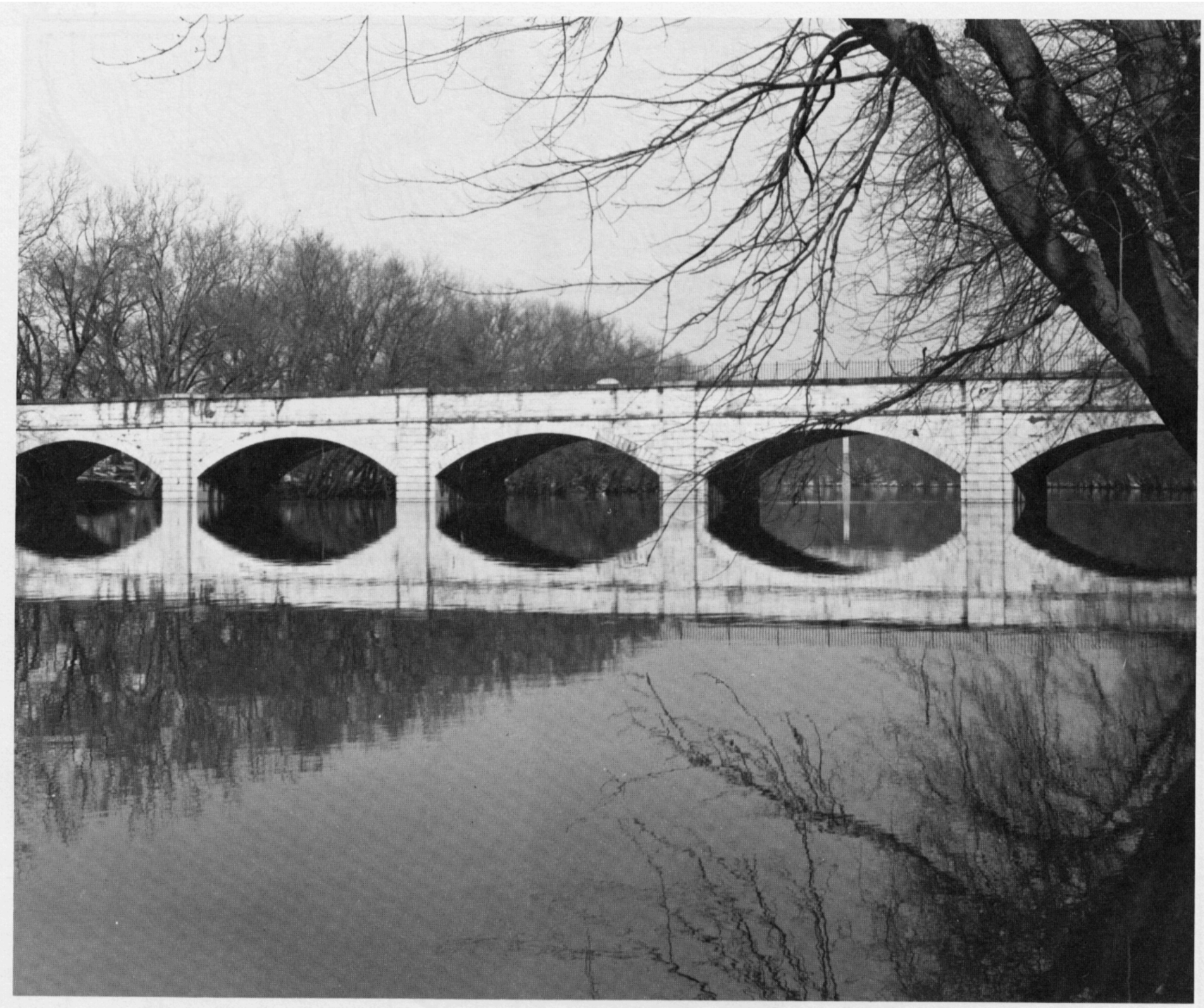


Figure 3-A. *POOLESVILLE, Md.-Va. 1970/78*



Monocacy Aqueduct (1833), **Chesapeake & Ohio** *Canal.* National **Capital Parks, National Park** Service, *c1950*

Figure 3. BRIDGES. **A),** B) Bridges are perhaps the most readily discovered structures on the quads. Every road and railroad that crosses a watercourse means a bridge (except in the case of ferries, which are clearly indicated). From the quad several things can be learned directly about a bridge: its name, when shown **(A);** its total length, which can be scaled between the abutment symbols (the wide "V" at each end, pointing toward the opening); its height above the ground or water, which usually can be read from the contour lines and any bench marks or other elevation figures that may be given; the means of access to either end or the area below, by noting roads and trails; the suitability of photography (or simply viewing), by noting the topography and the amount of woods growth at the site; and whether or not there is a draw span, by noting the presence

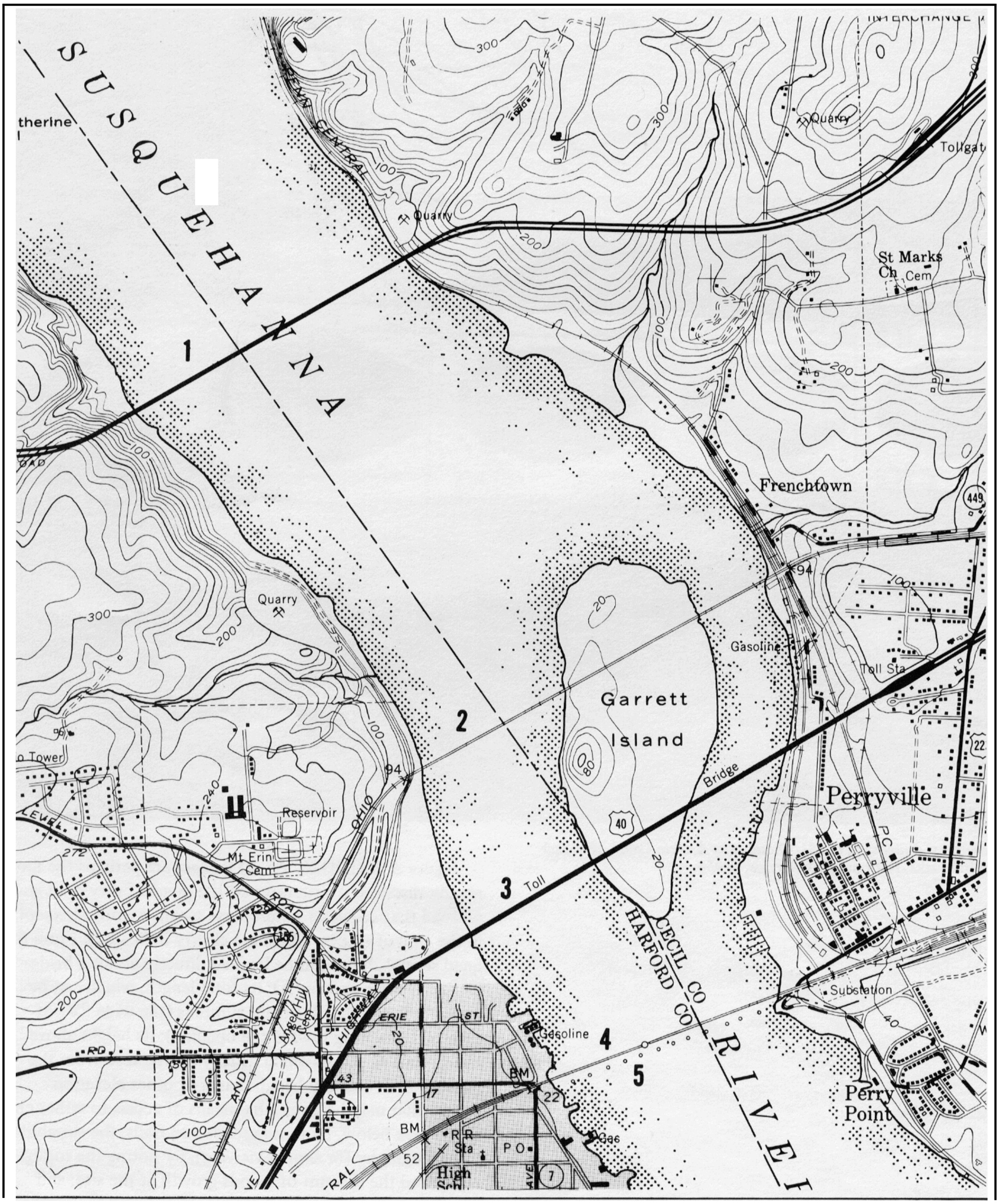
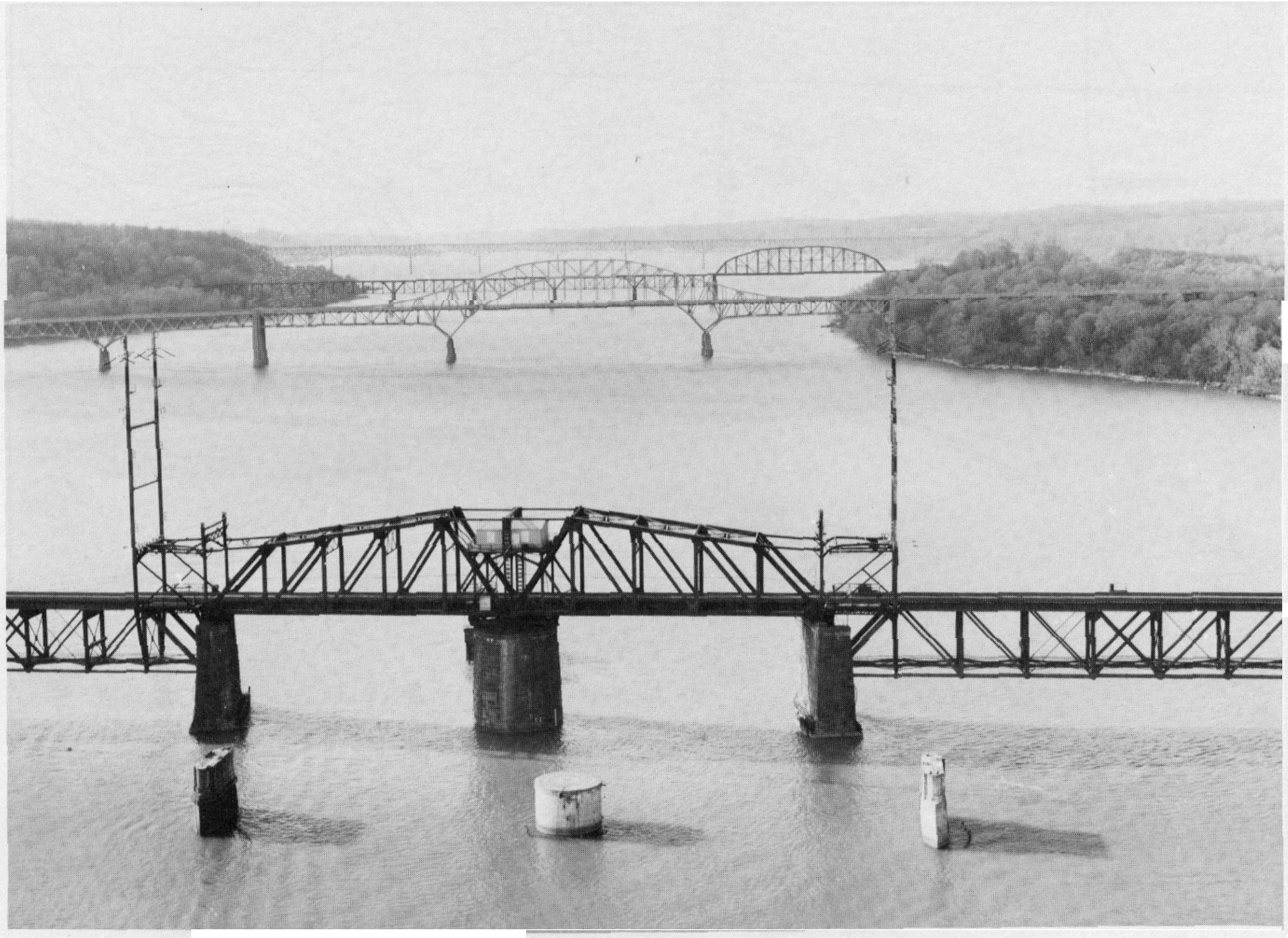


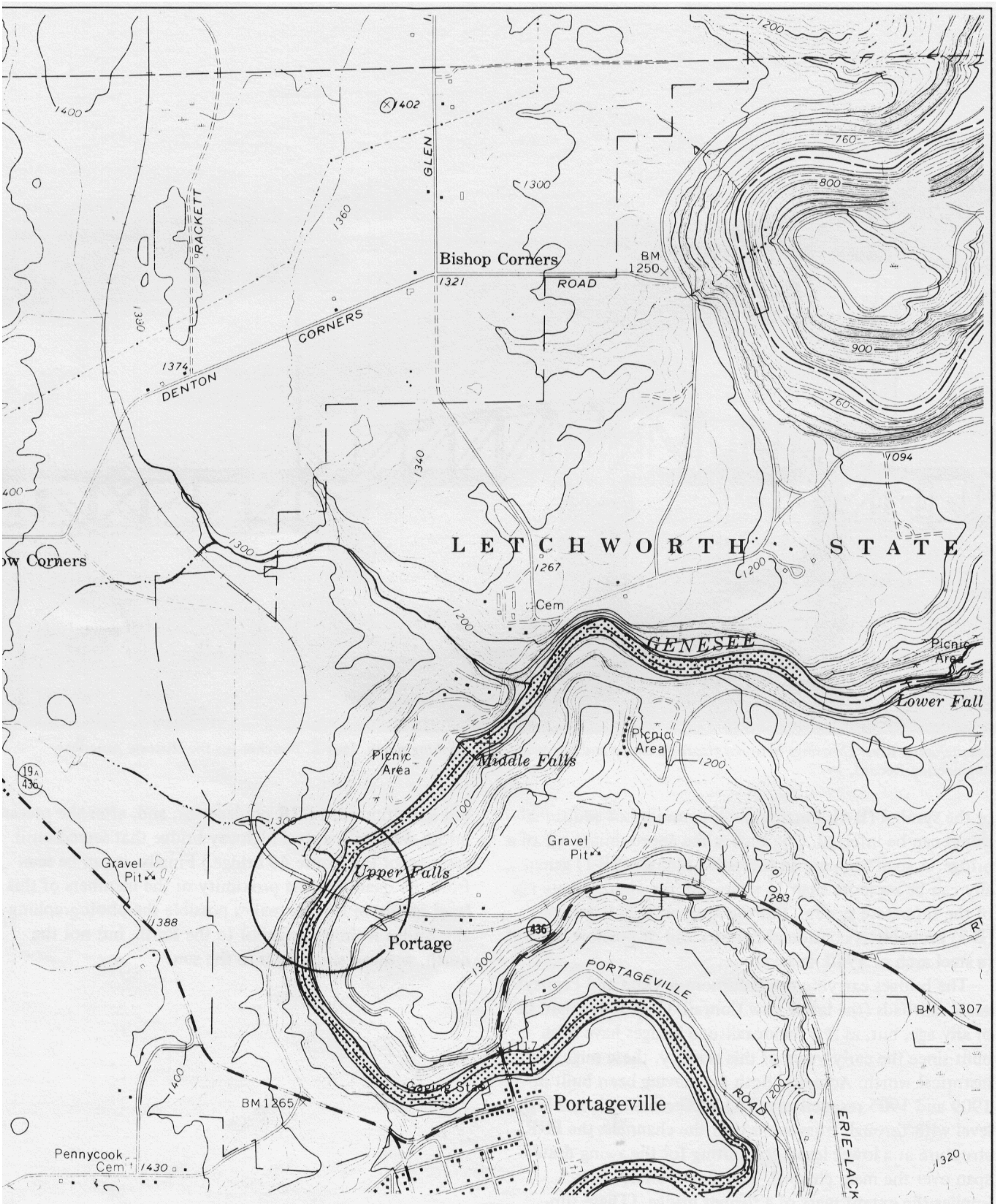
Figure 3-B. *HAVRE DE GRACE, Md. 1953/70 & 75*



Susquehanna River Crossings between Havre de Grace and Perryville, Md., looking north. Jack E. Boucher far the Historic American Engineering Record, *1977*

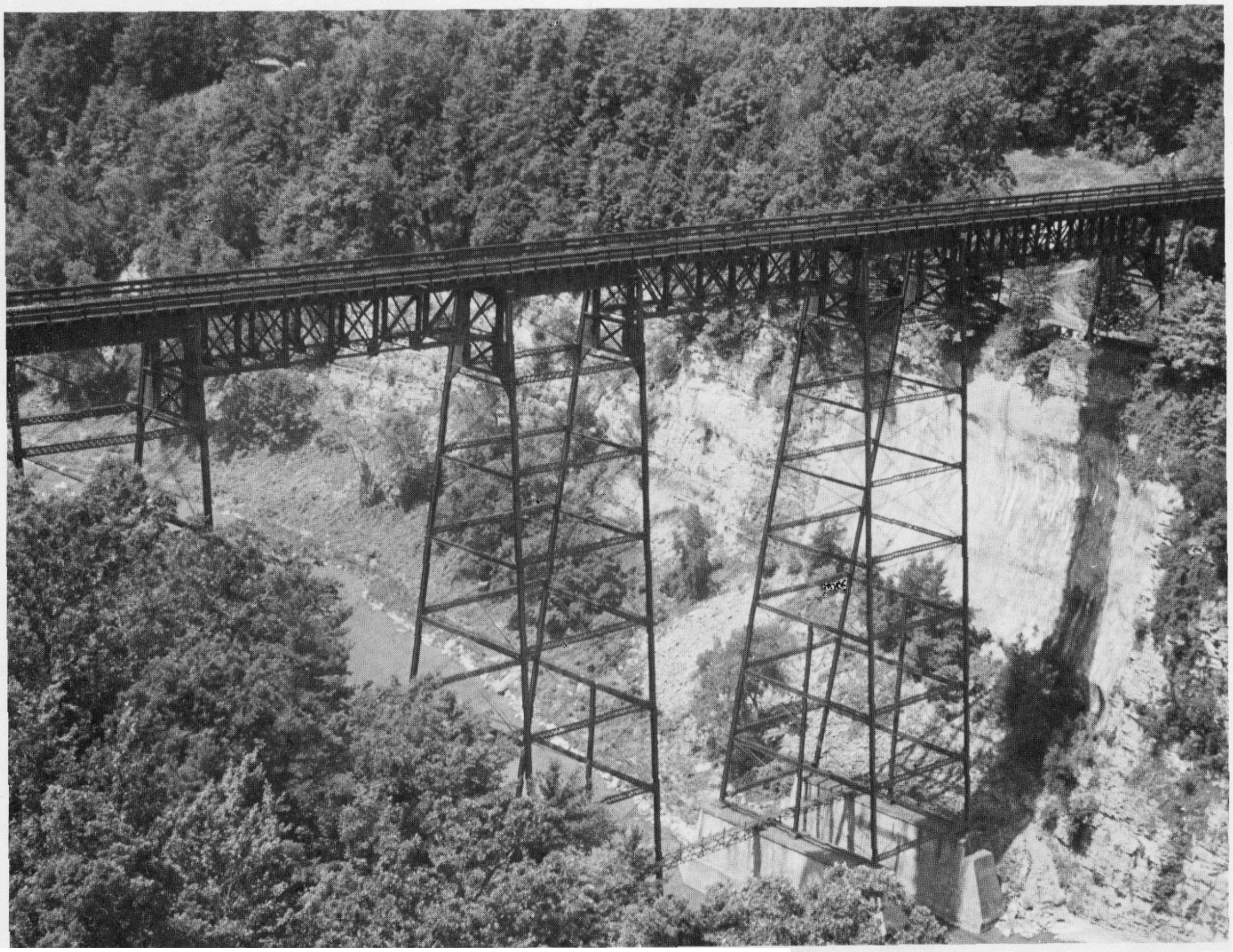
of the symbol (B-4). Furthermore, a number of additional things can be inferred. One such is the approximate age of a bridge. A span carrying an Interstate highway **(B-1)** generally can be no more than 15 years old, the approximate age of the Interstate system. But the span on **U.S.** Route 40 **(B-3)** probably is considerably older and of possible interest (a steel arch of **1940,** in fact).

The bridges carrying the Baltimore & Ohio and Pennsylvania railroads (the latter now Conrail) (B-2; **B-4)** might be of any age, but, as few major railroad bridges have been built since the early years of this century, these might be of historical worth. Actually, both are, having been built in **1909** and **1905** respectively. The **B&O** crossing is at a **high** level with through truss spans over the channels; the PRR structure at a lower level, accounting for the swing draw span over the main channel. The line of circles at B-5 implies the extant piers of **a** former bridge. (These supported the timber-truss bridge of the Philadelphia, Wilmington & Baltimore, a PRR predecessor, and, after the present bridge was built, a steel highway bridge that served until erection of the Route **40** bridge.) Finally, it can be seen from the quad that the proximity of the members of this large family of bridges makes possible the photographing of any bridge from its neighbor to the south, but not the north, without shooting into the sun.



w e 3C. *PORTACEVILLE, N.Y. 1972*

C) Although the only direct clue to a bridge's structural type found on the quad is the drawbridge symbol, again, some inferences can be drawn. Viaducts, for example, are clearly indicated when a railroad (or occasionally a highway) crosses a deep gorge containing a relatively narrow watercourse. The Erie Railroad's celebrated Portage Viaduct, though not named on the quad, can be located with absolute certainty by observing that there is a place (consisting, apparently, of five houses and perhaps a bam) called *Portage* at a point where the Erie (at the time of the quad's publication the Erie-Lackawanna, now Conrail) crosses the Genesee River, and that the contours indicate clearly **a** very steep, narrow gorge. The height of the rail above the river, read from the contours, is about 240 feet; the length of the viaduct, scaling between the abutments, is about 820 feet. And so it actually is, within a few feet.



Portage Viaduct (1903), ***Erie Railroad.*** **Jack** E. Boucher for the Historic **American** Engineering Record, *1971*

Figure 4. MINING & MINERALS. **A)** Many signs of mines and other workings and structures related to minerals extraction—both active and abandoned—are present on the quads. Open-pit mines are plainly shown symbolically, verbally, and usually by the contours. Deep mines are indicated by a pair of unique symbols. A "Y"—the stem pointing into the opening—indicates a drift (side-hill) mine, and a half-solid square a shaft. The abandoned coal mine tunnel in the photograph was found from the symbol (circled). (Note that the place names on quads are themselves often clues to the presence of industrial-archeological sites: Eckhart Mines as here; just south of which [not shown] is Borden Shaft. There are countless "Mills," "Factories," "Falls," "Fumaces," and like suggestions of human industries, as well as a variety of other indicative names such as Ironton, Glassboro, Coke Oven Hollow, Graniteville—to draw the explorer on.)

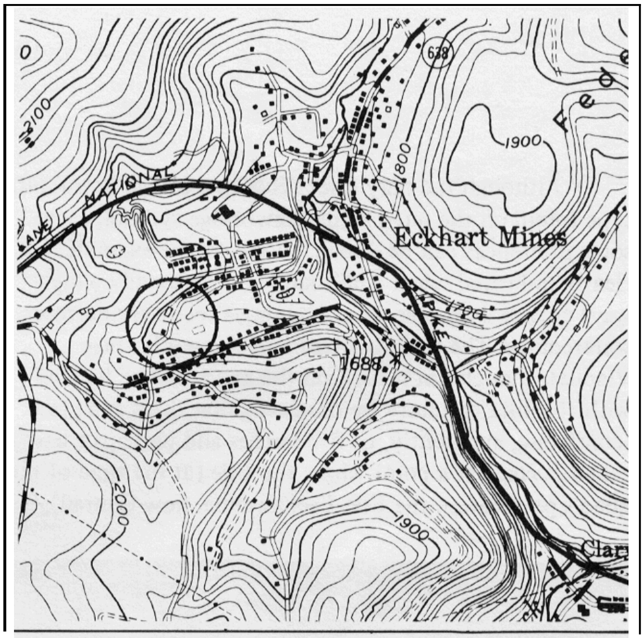


Figure 4-A. ***FROSTBURG, Md.-Pa. 1949/74***

Entrance to abandoned coal mine (1916). 1975

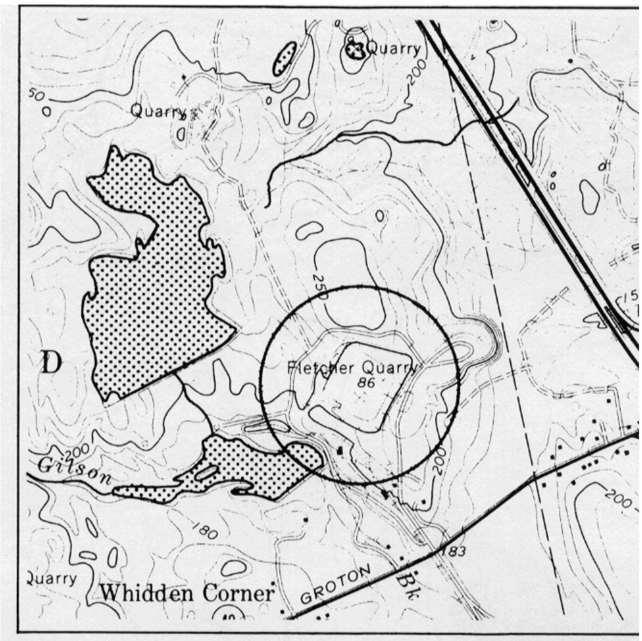
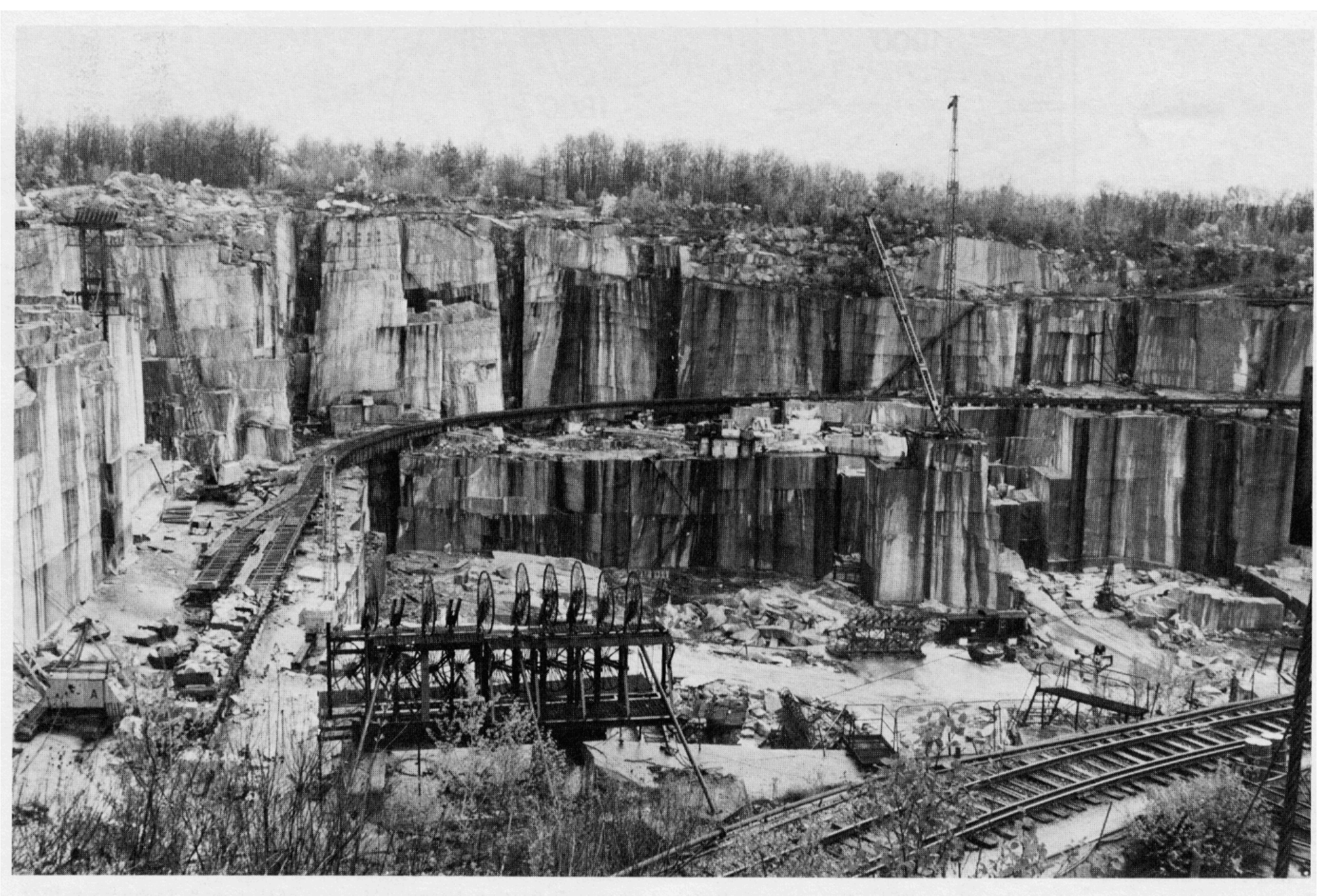


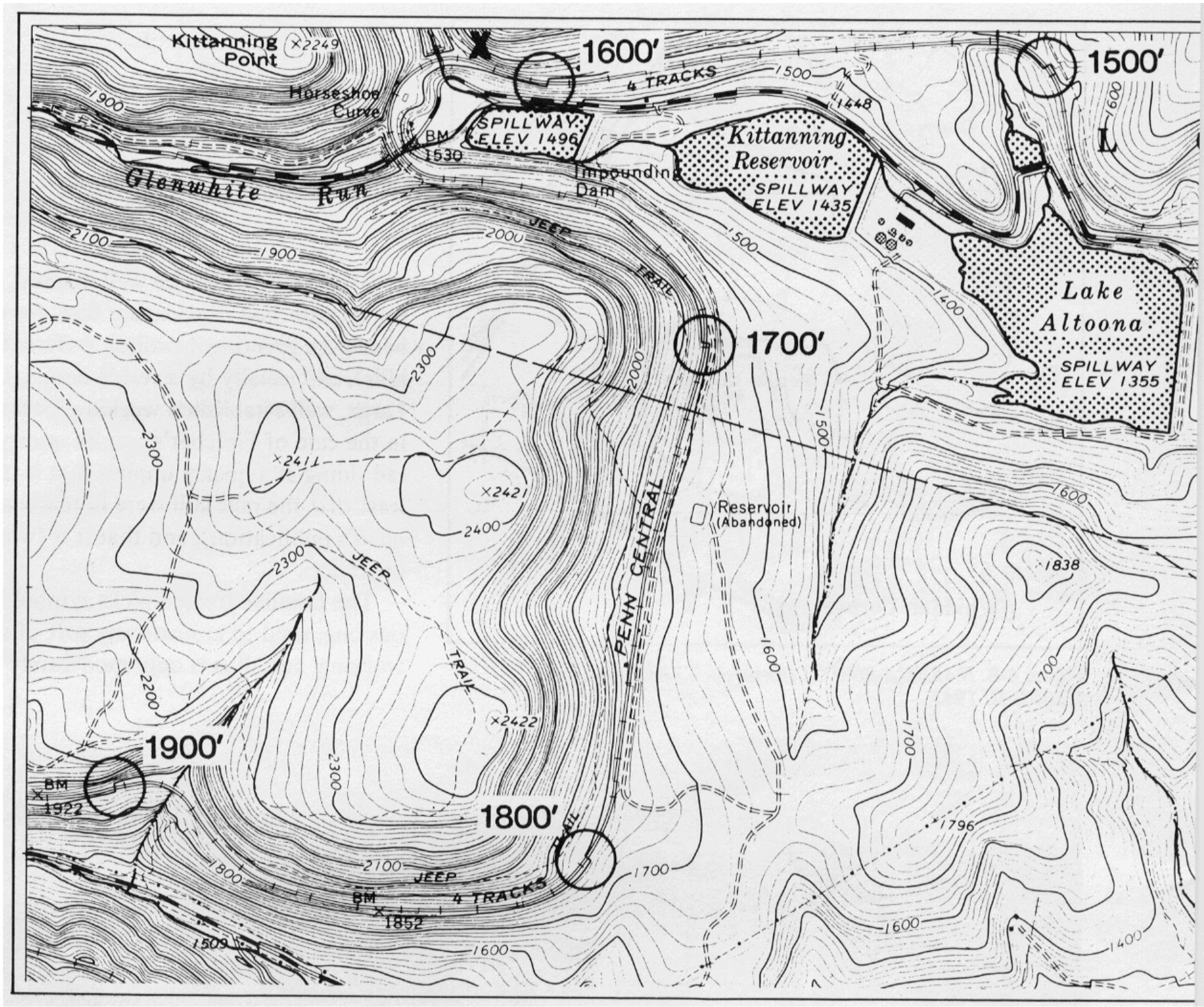
Figure 4-B. *NASHUA SOUTH (formerly TYNGSBORO), Mass.-N.H. 1965*

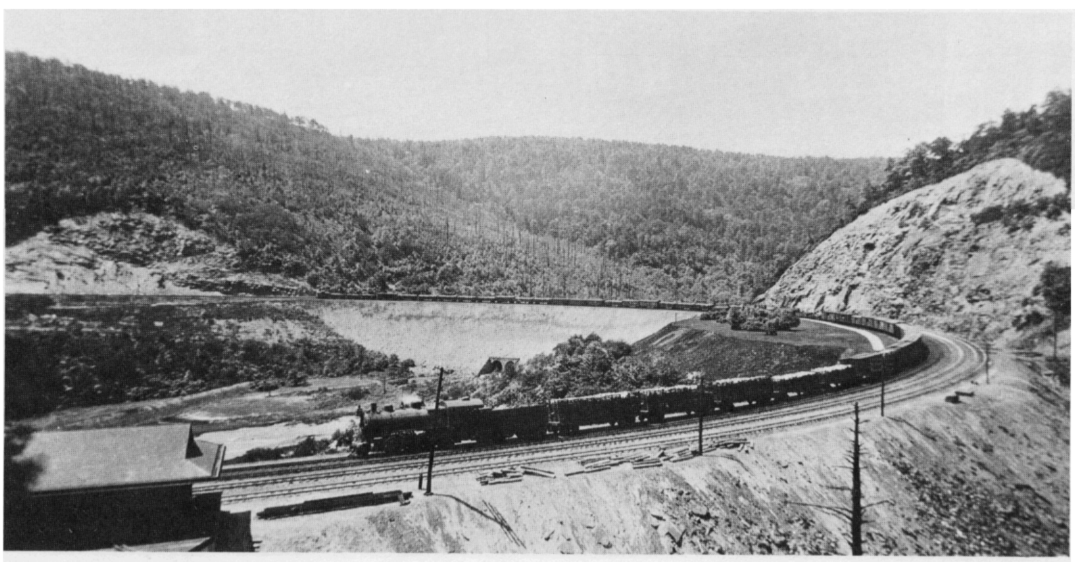
B) Quarries, too, are well marked, always by the contours (note that the contour lines for depressions or pits bear ticks pointing downhill, differentiating them from hills), and usually by a verbal designation and symbol. Large, well-established workings occasionally are named, as in the case of Fletcher's granite quarry. The presence of a rail siding at a quarry implies that it might be active (at least that the rails still were in place at the time of the quad's publication), and that it **is** (was) a fairly large operation.

The familiar crossed-picks symbol is a somewhat ambiguous one, used to indicate any sort of surface mineral working, and thus is only moderately useful.



Fletcher's granite quarry. 1976





Horseshoe Curve (1853), Pennsylvania Kailroad. **Cheney Collection, National Museum of** History & Technology, *1920*

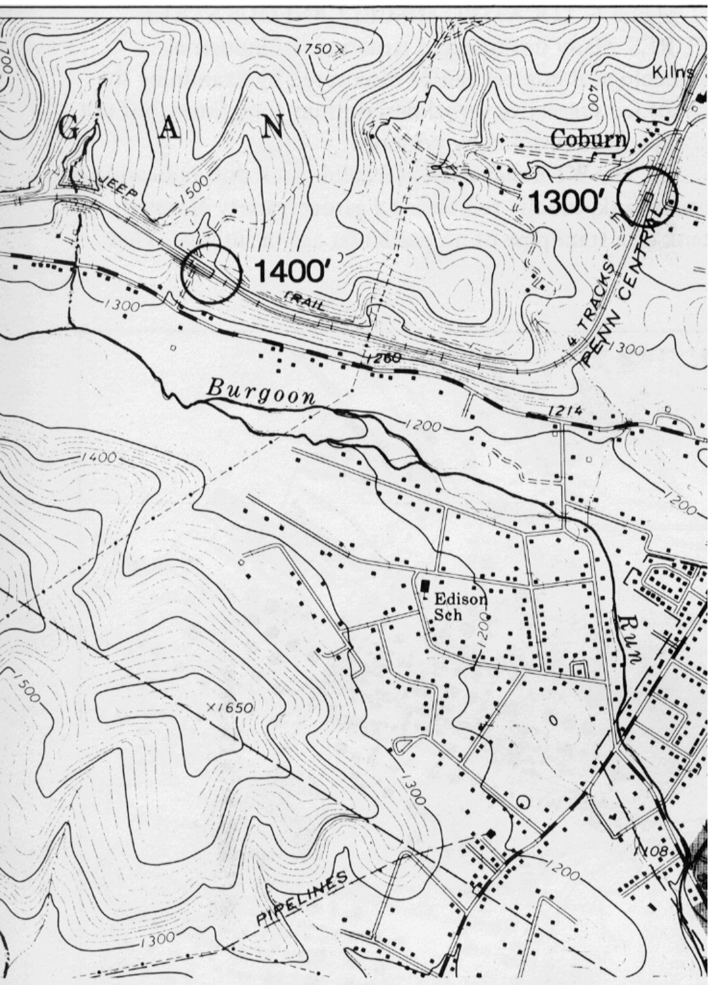


Figure 5. ***HOLLIDAYSBURG, Pa. 1963/72***

Figure **5.** RAILROAD ENGINEERING. The means by which rail lines traverse irregular terrain while maintaining a grade that rarely exceeds two percent (a rise of two feet in a run of 100 feet) is vividly shown on the quads. It is quite as interesting to "read" a rail line in a mountainous section as to walk it on the ground. It is perfectly clear how railroads in such regions follow the contours by side-hill cuts or benches where possible, and how, where the line cannot follow the contours, it must cross them. When the crossing is made through solid material, the result is a cut if the obstruction is minor, or a tunnel if major. If the obstruction to a level line is the "absence" of material—a depression or valley—the line is carried on a solid earth till or embankment, or a viaduct if the opening is a significant one. All of these features are plainly visible on the quad.

One of the most interesting examples of heroic railroad engineering in the East is the celebrated Horseshoe Curve on the Pennsylvania Railroad's main line west of Altoona. The problem and solution it represents can be read directly from the quad. The problem was to connect the line in its march over the Alleghenies at a point south of Cobum, where its elevation was **1,340** feet (above sea level) with the pass formed by the valley of Sugar Run to the west. There it was to follow the valley's north wall in a side-hill cut at **an** elevation starting at about 1,800 feet. To join those points as the crow flies would have involved immense quantities of till and a colossal viaduct over Burgoon Run south of Coburn. But worse, the difference in elevation between the two points is some 460 feet. **To** overcome that rise in the straight-line distance of ***2.5*** miles would have resulted in an unacceptably steep gradient of some **3.3** percent. The solution was to lengthen the run by an amount that would bring the grade down to the design maximum of something under two percent. The line, accordingly, was continued westward up the north side of Burgoon Run valley on a fairly easy route along the natural contours to the point where the valley divided at Kittanning Point. The route then was doubled back eastward along the south side of the valley in a perfect "horseshoe" 1,100 feet across. Then it followed the contours south and west around the base of a steepsided hill, passing through the range via the Sugar Run valley on its way west.

The distance between the two points via the Horseshoe Curve was some **5.3** miles. **A** climb of 460 feet in that distance resulted in a relatively easy grade of about 1.9 percent. Apart from the great quantity of benching, the only heavy earthworks involved in the project were embankments some 100-feet high where the route crossed the prisms of the two streams flowing from around Kittanning Point, and a deep bench cut into the Point itself. This work is seen on the quad and the photograph, which is taken from point X on the quad looking about south-by-west. The line's rate of climb can be determined from the values of the index contours that cross it. These lines, representing levels of elevation at 100-foot intervals, intersect the tracks about one-mile apart; in other words, the railroad climbs the mountain at the rate of just under 100 feet per mile.

Figure 6. **LOCATING MISCELLANEOUS** STRUCTURES. Many unsuspected structures of industrial-archeological interest can be discovered by examining the quads for suggestive verbal descriptions sometimes, but not always, accompanied by symbols.

A) The WT designation at a solid black dot, indicating a water tank, usually represents a garden-variety elevated tank or a standpipe of no particular age or interest. That

Figure 6-A. *CURTIS BAY, Md. 1969/74*

such seemingly mundane clues can, on occasion, lead to sites and structures well beyond the ordinary is seen in the case of the Curtis Bay (Baltimore) Tank, a large above-ground reservoir in a striking masonry casing. While the expectations of such discoveries normally will not justify field explorations on their own, if in an area on other business it can be rewarding to wander a bit off course to see just what certain suggestive map indications actually represent.

Curtis Bay Tank (1931). 1975

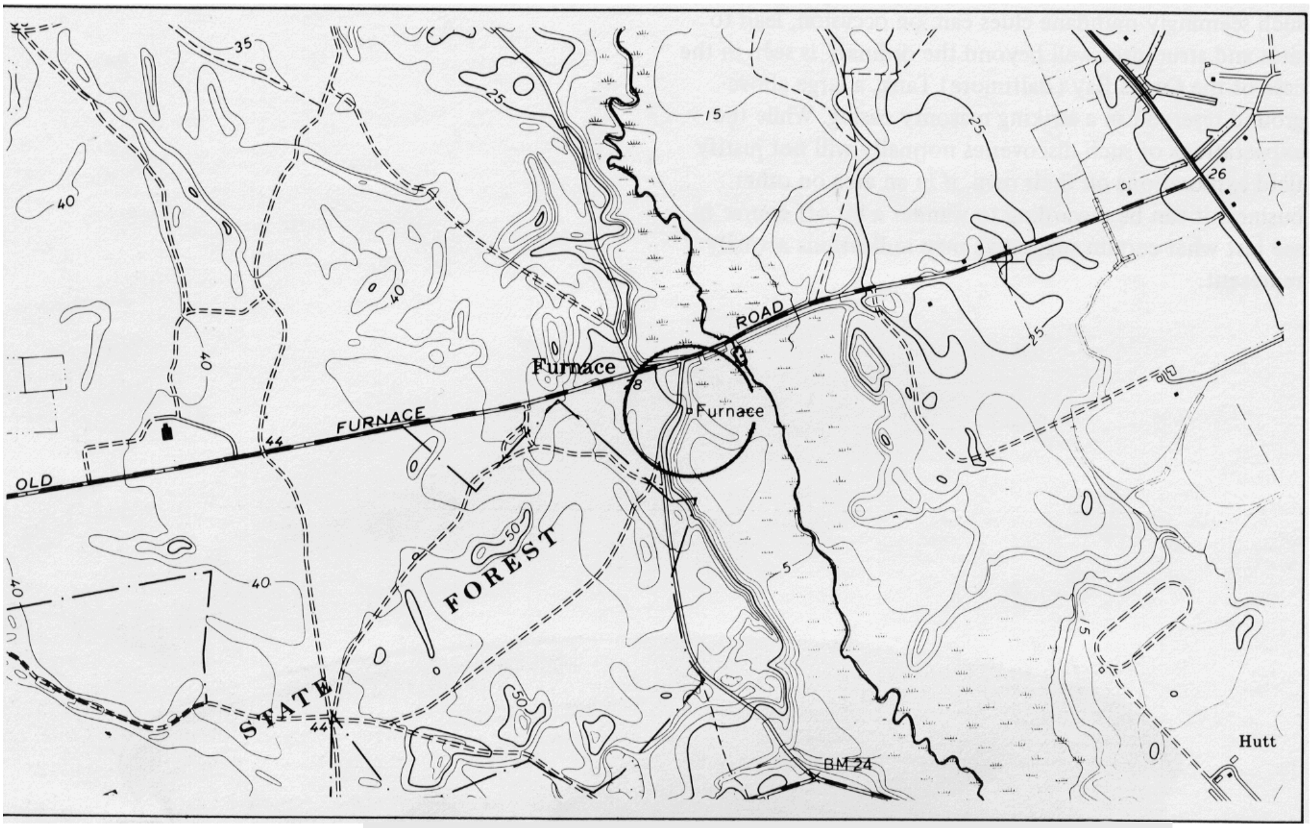
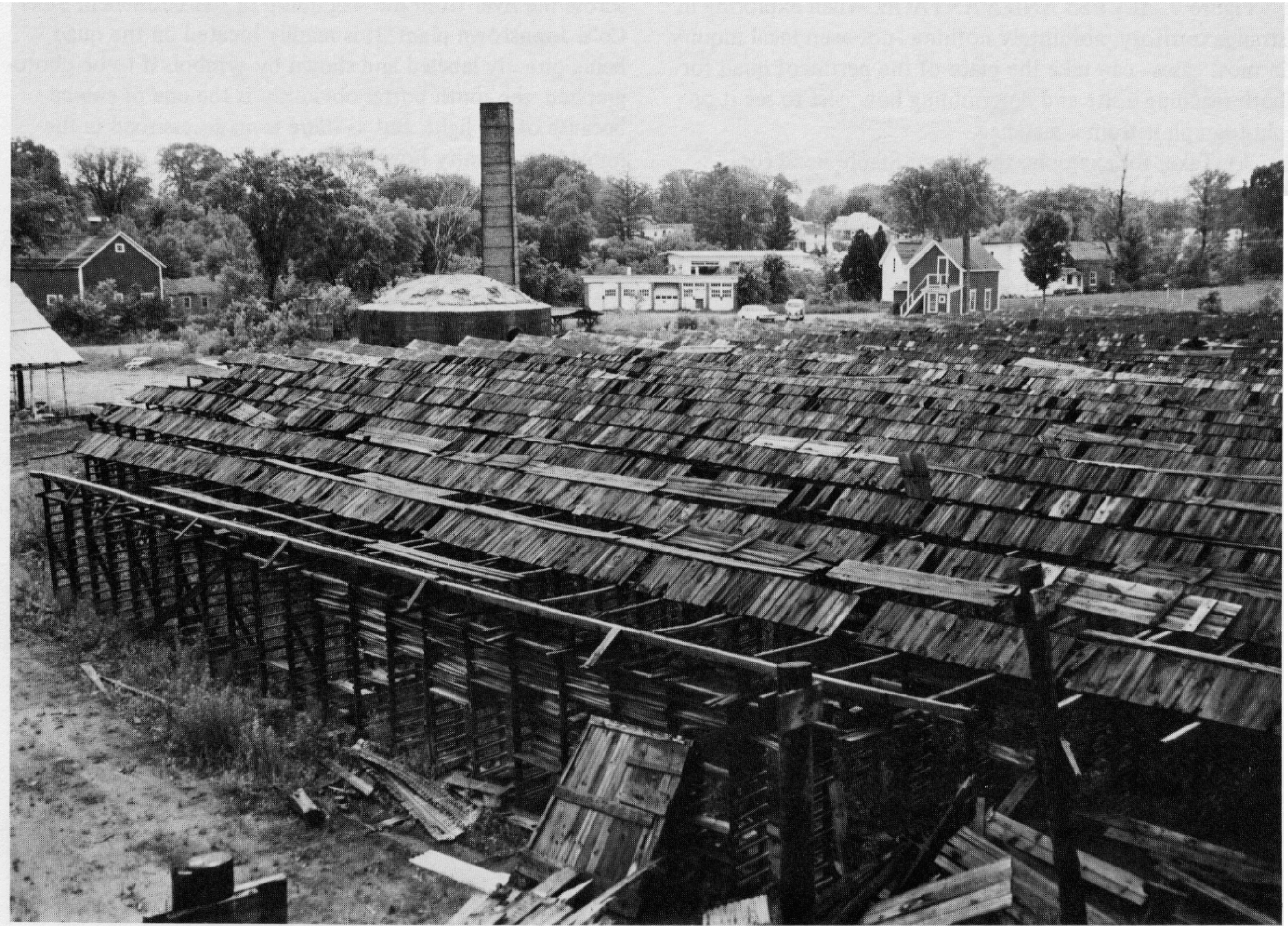


Figure 6-B. *SNOW HILL, Md. 1966*

B) Certain types of "non-building" industrial structures are so rarely occurring that they do not warrant a symbol of their own, but nevertheless are of a large enough scale that they must be indicated in some way. The Survey's convention in such cases is to show them as open squares or rectangles roughly to scale, and label them appropriately. These designations can bear wonderful fruit. The Nassawango blast furnace is one instance of this. The symbol and label confirm that a furnace of some type still exists in an area where one could be anticipated on the basis of the place-name *Furnace* (in which no buildings at all seem to survive), and the presence of ***Old Furnace Road*** and ***Furnace Creek*** (not shown on the detail).

Nassawango blast furnace (1830). 1977

Figure 6-C. *ESSEX JUNCTION, Vt. 1948/72*



Racks for air-drying green brick, and coal-fired beehive kiln (1920s?), Drury brick works. 1972

C) An unusually interesting example of an obscure structure is shown here. The rather large open rectangle suggests a sizable building of some sort. But what are "Racks?" Investigation produced a set of the now-rare racks used for the open-air drying of green bricks prior to their firing. At this site, too, appeared a slight lapse in the quad, for while the "Brick Kiln" indicated was indeed present, not shown is a far more interesting predecessor beehive kiln—abandoned—the more significant for retaining the coal-firing grates that in most of these kilns have been removed during conversion to gas or oil firing.

Figure **7. ACCESS AND VANTAGE.** When exploring in strange territory, absolutely nothing—not even local inquiry in most cases—can take the place of the pertinent quad for both reaching a site and determining how best to see it or photograph it from a distance.

A) Take, for example, the famed Staple Bend (or Portage) Tunhel, the first railroad tunnel in the U.S. It is across the river from the slag dump of the Bethlehem Steel **Co's.** Johnstown plant. It is readily located on the quad, being directly labeled and shown by symbol. If to be photo. graphed, the south portal obviously is the one of choice because of the light. But as there is no access road in the immediate vicinity how to reach it? The quad tells all. From the town of Franklin a "light-duty" road departs to

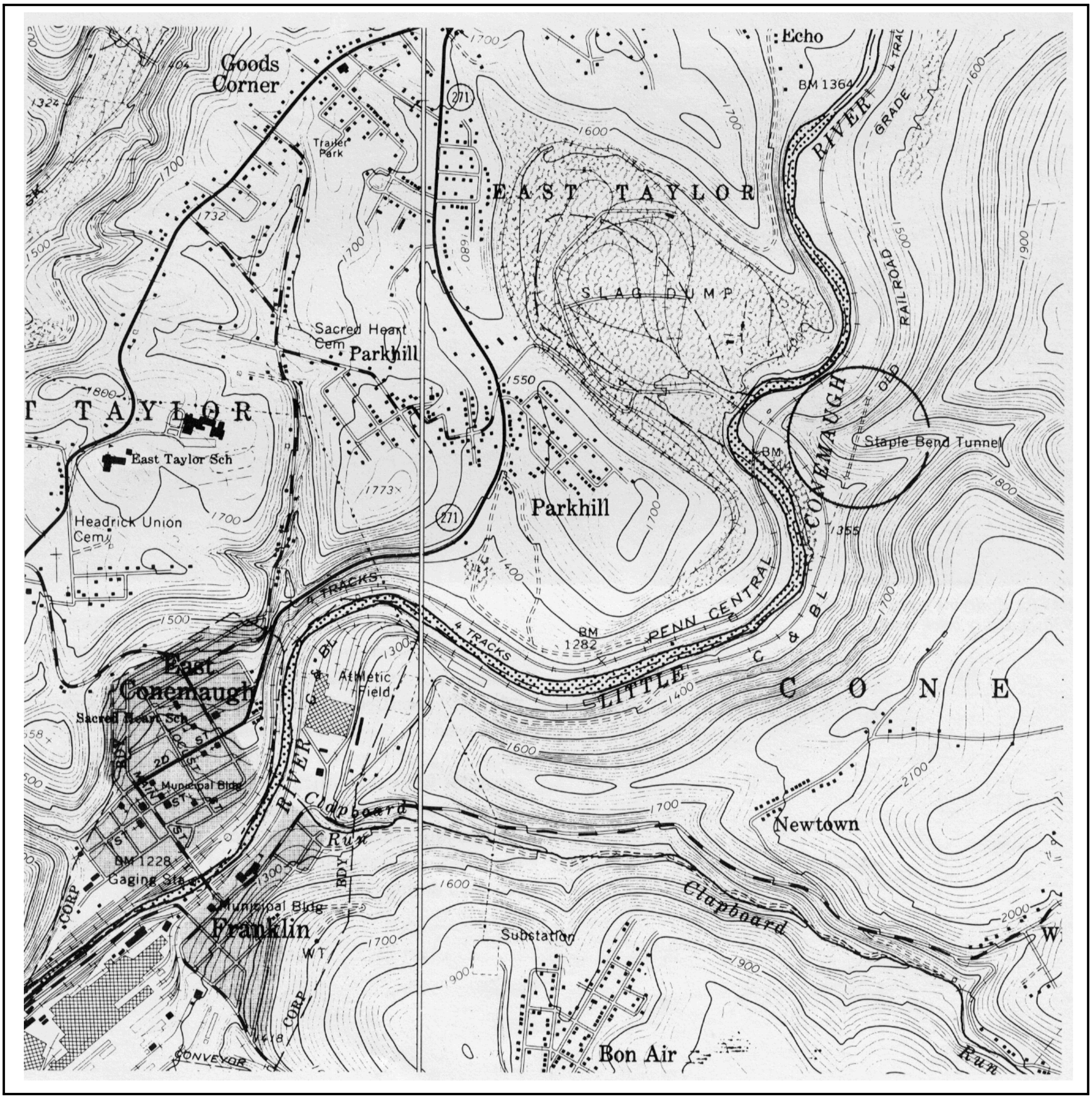
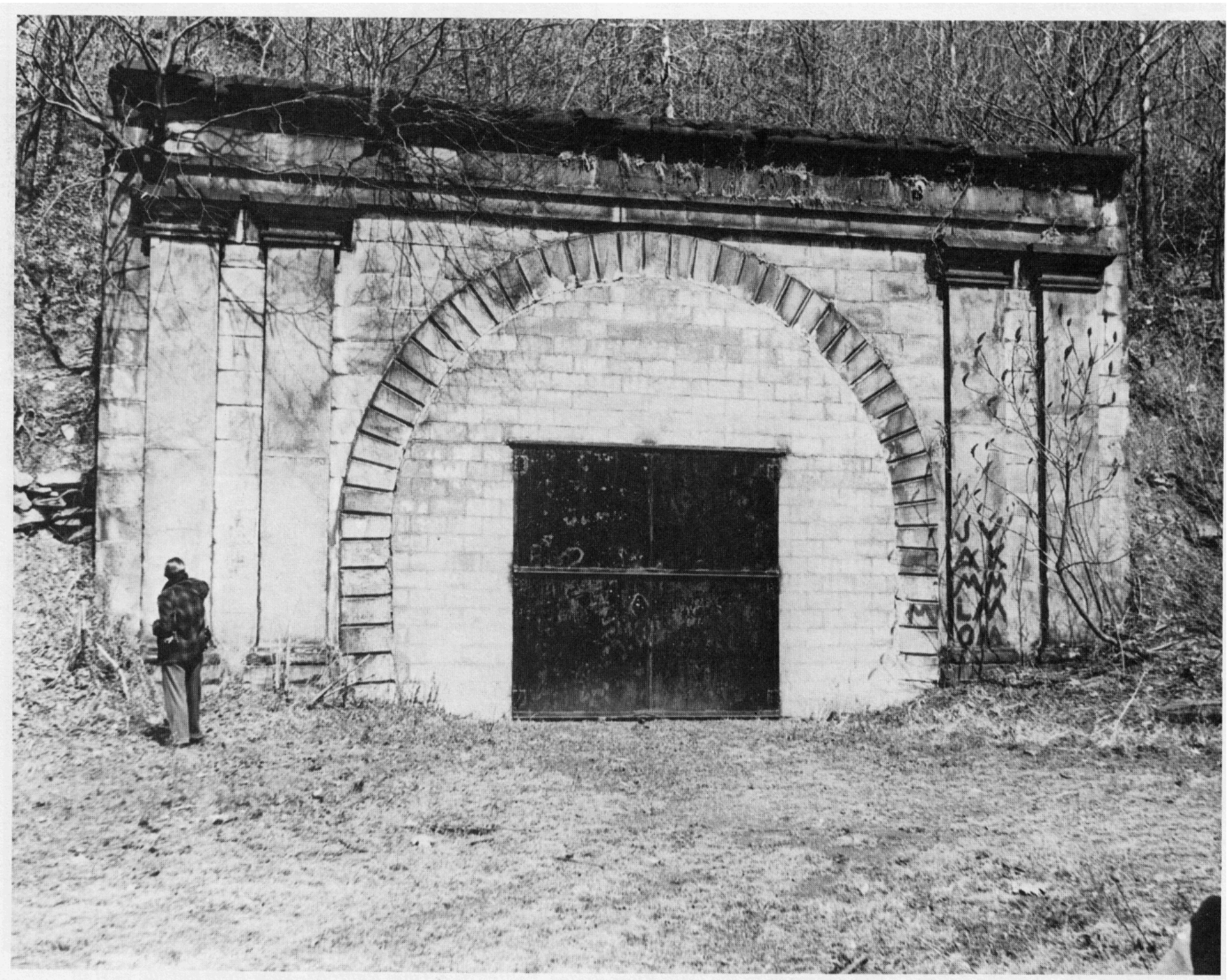


Figure 7-A. *JOHNSTOWN and GEISTOWN, Pa. 1964/72*

the northeast, climbs a moderate hill (as shown by the number of contour lines crossing it at short intervals), makes a sharp bend to the southeast and immediately becomes an “unimproved” road through the woods, well above and paralleling the river and the C&BL Railroad (Bethlehem’s works line). This road continues along the river heading directly for the tunnel, but before reaching it it heads down hill, leaves the woods, and stops dead at the railroad. The would-be visitor apparently must count on going the rest of the way on foot, for about ¾ of a mile. ***So*** it is in practice. The unimproved road indeed is passable by car to about the point shown, and the tunnel easily reached by walking along the tracks, thence along the abandoned roadbed right up to the portal itself. Visualize trying to get clear oral instructions for all that from someone in Johnstown or even Franklin.



Staple Bend (Portage Railway) Tunnel (1832), south portal. 1962

B) Vantages for observing or photographing long structures such as major bridges frequently can be located from the quad by reading the contours for high, open ground that might not be evident from the structure's immediate vicinity because of obscured sight lines. The Baltimore & Ohio Railroad's crossing of the Ohio River south of Wheeling involved in magnificent stone approach viaduct, on a curve, at Bellaire, Ohio. Although all of the original iron work in the bridge has been replaced, the viaduct remains unaltered, in full service. The sweep of the structure and the trusses of the land and river spans can be fully seen and photographed only from the west, and from a considerable elevation. The quad indicates that the ground rises quite sharply on the west side of the city, just beyond the viaduct, and that the hillside is laced with small streets and buildings, presumably houses (from the pink "urban" screen). From this area—between the houses—any number of suitable vantages are, in fact, available. (The quad shows **also** the means by which the railroad gained the necessary elevation for the crossing on the Benwood, W. Va. side, within the narrow confines between the river's edge and the steep rise of the hill, by making a three-quarter loop on a [steel] viaduct.)

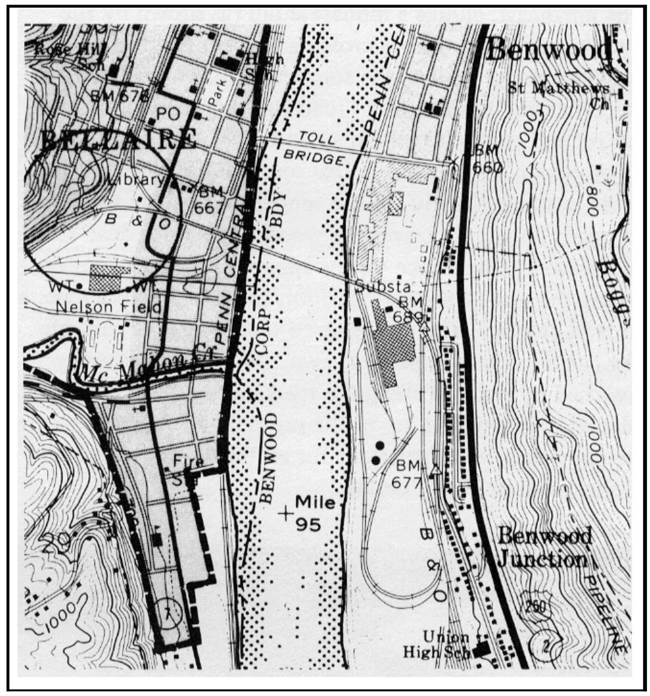
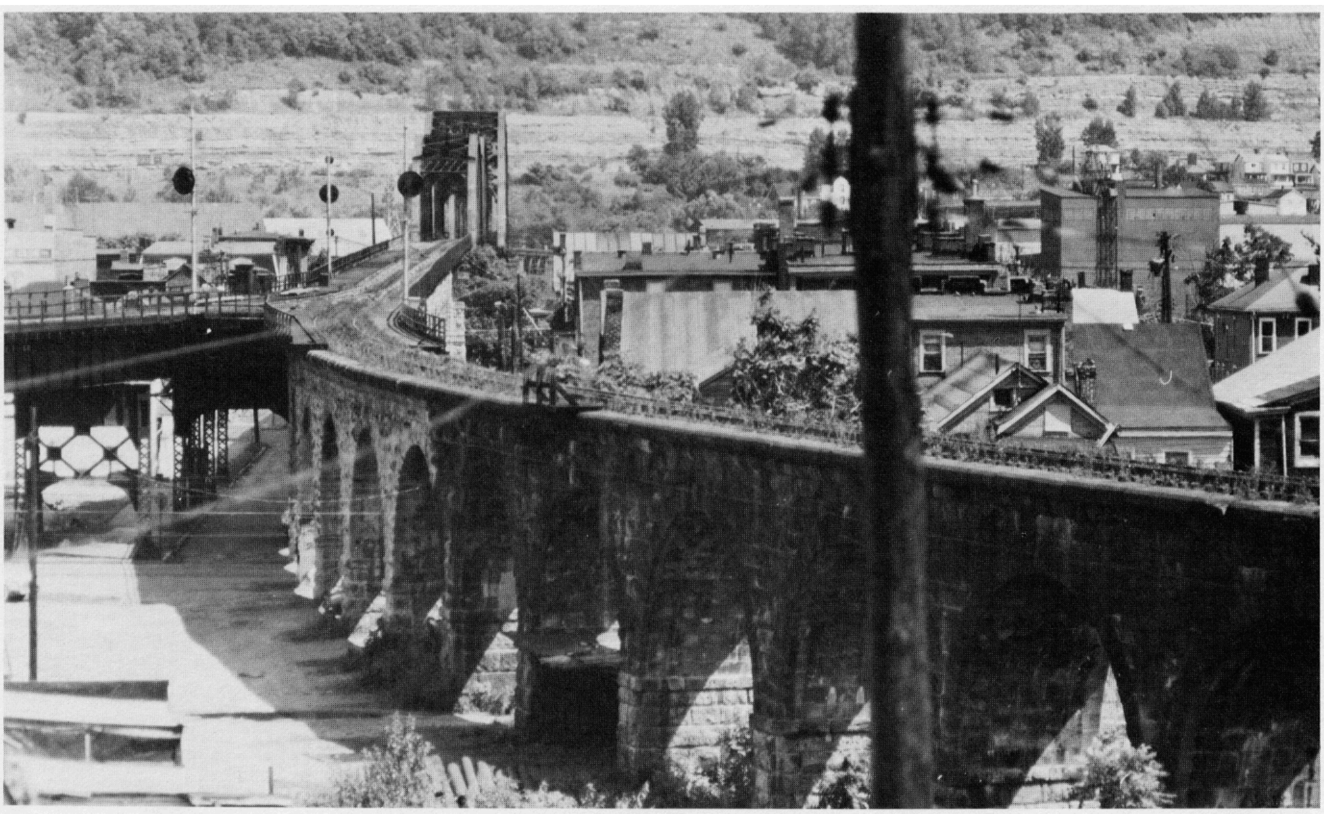


Figure ***I-B. WHEELING, W. Va.-Ohio 1968178***



Stone viaduct (1870) of the Bellaire, Ohio approach to the Ohio River Bridge, Baltimore & Ohio Railrood–view from hillside west of the city. 1979

TOPOGRAPHIC MAP SYMBOLS

VARIATIONS WILL BE FOUND ON OLDER MAPS

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Road under construction, alinement known
Proposed road
Dual highway, dividing strip 25 feet or less
Dual highway, dividing strip exceeding 25 feet
Trail

Railroad: single track and multiple track
Railroads in juxtaposition
Narrow gage: single track and multiple track
Railroad in street and carline
Bridge: road and railroad
Drawbridge: road and railroad
Footbridge
Tunnel: road and railroad
Overpass and underpass
Small masonry or concrete dam
Dam with lock
Dam with road
Canal with lock

Buildings (dwelling, place of employment, etc.)
School, church, and cemetery ... Cem
Buildings (barn, warehouse, etc.)
Power transmission line with located metal tower
Telephone line, pipeline, etc. (labeled as to type)
Wells other than water (labeled as to type) ... Oil ... Gas
Tanks: oil, water, etc. (labeled only if water) ... Water
Located or landmark object; windmill
Open pit, mine, or quarry; prospect
Shaft and tunnel entrance

Horizontal and vertical control station:
Tablet, spirit level elevation ... BM Δ 5653
Other recoverable mark, spirit level elevation ... Δ 5455
Horizontal control station: tablet, vertical angle elevation ... VABM Δ 95/9
Any recoverable mark, vertical angle or checked elevation ... Δ 3775
Vertical control station: tablet, spirit level elevation ... BM × 957
Other recoverable mark, spirit level elevation ... × 954
Spot elevation ... × 7369 ... × 7369
Water elevation ... 670 ... 670

Boundaries: National
State
County, parish, municipio
Civil township, precinct, town, barrio
Incorporated city, village, town, hamlet
Reservation, National or State
Small park, cemetery, airport, etc.
Land grant
Township or range line, United States land survey
Township or range line, approximate location
Section line, United States land survey
Section line, approximate location
Township line, not United States land survey
Section line, not United States land survey
Found corner: section and closing
Boundary monument: land grant and other
Fence or field line

Index contour
Intermediate contour
Supplementary contour
Depression contours
Fill
Cut
Levee
Levee with road
Mine dump
Wash
Tailings
Tailings pond
Shifting sand or dunes
Intricate surface
Sand area
Gravel beach

Perennial streams
Intermittent streams
Elevated aqueduct
Aqueduct tunnel
Water well and spring
Glacier
Small rapids
Small falls
Large rapids
Large falls
Intermittent lake
Dry lake bed
Foreshore flat
Rock or coral reef
Sounding, depth curve ... 10
Piling or dolphin
Exposed wreck
Sunken wreck
Rock, bare or awash; dangerous to navigation

Marsh (swamp)
Submerged marsh
Wooded marsh
Mangrove
Woods or brushwood
Orchard
Vineyard
Scrub
Land subject to controlled inundation
Urban area

1 0 1 2 3 4 5 MILES

MILE SCALE 1:62 500

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TOPOGRAPHIC
MAP INFORMATION AND SYMBOLS
MARCH 1978

QUADRANGLE MAPS AND SERIES

Quadrangle maps cover four-sided areas bounded by parallels of latitude and meridians of longitude. Quadrangle size is given in minutes or degrees.

Map series are groups of maps that conform to established specifications for size, scale, content, and other elements.

Map scale is the relationship between distance on a map and the corresponding distance on the ground.

Map scale is expressed as a numerical ratio and shown graphically by bar scales marked in feet, miles, and kilometers.

NATIONAL TOPOGRAPHIC MAPS

Series	Scale	I inch represents	I centimeter represents	Standard quadrangle size (latitude-longitude)	Quadrangle area (square miles)
7½-minute	1:24,000	2, m feet	240 meters	7½×7½ min.	49 to 70
7½× 15-minute	1:25,000	about 2,083 feel	250 meters	7HX 15 min.	98 to 140
Puerto Rico 7½-minute	1:20,000	about 1,667 feet	200 meters	7½×7½ min.	71
15-minute	1:62,500	nearly I mile	625 meters	15× 15 min.	197 to 282
Alaska 1:63.360	1:63,360	I mile	nearly 634 meters	15×20 to 36 min.	207 to 281
Intermediate	1:100,000	nearly 1.6 miles	I kilometer	30×60 min.	1568 to 2240
U. S. 1:250,000	1:250,000	nearly 4 mils	2.5 kilometers	1°× 2° or 3°	4,580 to 8,669
U. S. 1:1,000,000	1:1,000,000	nearly 16 miles	10 kilometers	4°× 6°	73,734 to 102,759
Antarctica 1:250,000	1:250,000	nearly 4 miles	2.5 kilometers	1°× 3° to 15°	4.089 to 8,336
Antarctica 1:500,000	1:500,000	nearly 8 miles	5 kilometers	2°× 7½°	28,174 to 30,462

CONTOUR LINES SHOW LAND SHAPES AND ELEVATION

The shape of the land, portrayed by contours, is the distinctive characteristic of topographic maps.

Contours are imaginary lines fallowing the ground surface at a constant elevation above or below sea level.

Contour interval is the elevation difference represented by adjacent contour lines on maps.

Contour intervals depend on ground slope and map scale. Small contour intervals are used for flat areas; larger intervals are used for mountainous terrain.

Supplementary dotted contours, at less than the regular interval, a n used in selected flat areas.

Index contours are heavier than others and most have elevation figures.

Relief shading, an overprint giving a three-dimensional impression, is used on selected maps.

Orthophotomaps, which depict terrain and other map features by color-enhanced photographic images, are available for selected areas.

COLORS DISTINGUISH KINDS OF MAP FEATURES

Black is used for manmade or cultural features, such as roads, buildings, names, and boundaries.

Blue is used for water or hydrographic features, such as lakes, rivers, canals, glaciers, and swamps.

Brown is used for relief or hypsographic features—land shapes portrayed by contour lines.

Green is used for woodland cover, with patterns to show scrub, vineyards, or orchards.

Red emphasizes important roads and is used to show public land subdivision lines, land grants, and fence and field lines.

Red tint indicates urban areas, in which only landmark buildings are shown.

Purple is used to show office revision from aerial photographs. The changes are not field checked.

INDEXES SHOW PUBLISHED TOPOGRAPHIC MAPS

Indexes for each State, Puerto Rico and the Virgin Islands of the United States, Guam, American Samoa, and Antarctica show available published maps. Index maps show quadrangle location, name, and survey date. Listed also are special maps and sheets, with prices, map dealers, Federal distribution centers, and map reference libraries, and instructions for ordering maps. Indexes and a booklet describing topographic maps are available free an request.

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INTERIOR—GEOLOGICAL SURVEY RESTON VIRGINIA—1978

MILE SCALE 1:24 000

FOOT SCALE 1:24 000

FOOT SCALE 1:62 500