DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

W. E. WRATHER, DIRECTOR

INTERPRETING GEOLOGIC MAPS
FOR
ENGINEERING PURPOSES

BY

MEMBERS OF THE ENGINEERING GEOLOGY
AND GROUND WATER BRANCHES
UNITED STATES GEOLOGICAL SURVEY

HOLLIDAYSBURG QUADRANGLE

PENNSYLVANIA

WASHINGTON, D. C.
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1953

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INTERPRETING GEOLOGIC MAPS FOR ENGINEERING PURPOSES

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INTRODUCTION

This set of maps has been prepared to show the kinds of information, useful to engineers, that can be derived from ordinary geologic maps. A few additional bits of information, drawn from other sources, are mentioned below. Some of the uses of such maps are well known; they are indispensable tools in the modern search for oil or ore deposits; they are the first essential step in unraveling the story of the earth we live on. Less well known, perhaps, is the fact that topographic and geologic maps contain many of the basic data needed for planning any engineering construction job, big or little. Any structure built by man must fit into the topographic and geologic environment shown on such maps. Moreover, most if not all construction jobs must be based on knowledge of the soils and waters, which also are intimately related to this same environment. The topographic map shows the shape of the land—the hills and valleys, the streams and swamps, the man-made features such as roads, railroads, and towns. The geologic map shows the kinds and shapes of the rock bodies that form the land surface and that lie beneath it. These are the facts around which the engineer must build.

To be sure, orthodox geologic maps, prepared primarily for scientific purposes, do not show, as such, all the facts that are needed for engineering plans. Still, the facts that are on the maps or in the descriptive texts that accompany them are quite useful for preliminary studies, if properly interpreted. How these facts can be interpreted is demonstrated by the maps in this set. They are published in the hope that they will aid in an appreciation of the value of geologic maps and that they may be useful in teaching the practical applications of geology.

The set has two parts—basic data and interpretations. The basic data consist of a standard topographic map and a general-purpose geologic map of the Hollidaysburg 15-minute quadrangle in south-central Pennsylvania. The geologic map of the Hollidaysburg quadrangle is a redraft from the Hollidaysburg-Huntingdon folio;[1] the folio itself contains complete descriptions of the rocks shown on the map and of their relations to each other. These descriptions supplement the map and are considered part of the basic data. They must be consulted by those who wish a more complete understanding of the area.

The Hollidaysburg quadrangle was chosen for interpretation only because the folio was recently published, hence easily available by purchase. It can also be borrowed from or consulted in most public and university libraries. Too, the area contains a wide variety of rocks and geologic structures. Any other good geologic map, of any part of the country and showing any kind of geology, simple or complex, would have served the purpose equally well. All parts of the earth's surface are made up of geologic materials, and each of these has special characteristics that present problems to engineers.

The interpretations consist of four maps. On three of these the units shown on the basic map have been grouped according to certain of their physical properties. Thus, they summarize the essential information with regard to construction materials, foundation and excavation conditions, and water supply. A fourth sheet, titled "Site Selection," poses three hypothetical problems of the kinds that are met by engineers and shows the kind of answers that can be obtained from a geologic map.

Method. The interpretive maps were first drawn up in the office by a group of geologists who studied the geologic map, cross sections, and the descriptive text that accompanies them in the folio. They came to conclusions as to the engineering properties of the rock units and drew a series of simplified maps on which the formations are grouped according to these properties.

The interpretations were then field-checked and the maps and descriptions were revised to their present form. Only two additions of data that could not have been obtained from the basic data were made as a result of the field check. These were the scenic view points, described below and shown on the topographic map, and the observed slope angles of artificial cuts, shown on the foundation and excavation sheet. No attempt was made to bring the topographic base map up to date; many stone quarries have been opened since this map was drawn, but, aside from a few small airfields and one or two railroad spur lines, there have been surprisingly few changes, except in quality, in the roads and other man-made features. Likewise, no attempt was made to revise the basic geologic map. Indeed, this map is so excellent that any attempt at revision would quickly reach the point of diminishing returns.

The objective of the field check, then, was simply to check, on the spot, the validity of the interpretations. Some changes and corrections were necessary; virtually all of them were due to the single fact that the original descriptions were not as exact and definitive as was desirable. For example, the interpreters were often led astray because several formations had been described as shale, whereas one "shale" might be thin-layered and slippery when wet and another "shale" might consist of thick, massive layers and contain so much sand or limy matter as to form an excellent road bed even in wet weather.

A different method would have been used, of course, had the geologist started from the beginning to prepare engineering geologic maps of the Hollidaysburg quadrangle rather than to interpret an existing map. In this case, his first objective would have been exactly the same—to prepare as complete and detailed a map of the geologic relations as was permitted by the scale of his base map. In addition, however, he would have paid at least as much attention to the physical properties of the rocks as to their geologic ages and he would have subdivided the rocks accordingly on his map. He would also have mapped the unconsolidated materials in as much detail as the hard rocks, and would have based his conclusions as to physical properties on the results of laboratory tests and on experience records supplied by engineering organizations.

Conclusions as to water-supply problems should be made by specialists in hydrology and in the geology of underground water. They would base their conclusions on general-purpose geologic maps (made by themselves or by others), on specially directed field studies, and on stream-flow, climatological, and other records. The water-supply sheet in this report shows the extent to which information can be drawn from the basic geologic map. Such information is valuable as a preliminary to the more detailed investigation needed for any important water-supply development. It may be sufficient for smaller developments such as for rural domestic use.

Viewpoints. The only important additions made to the basic topographic map consist of symbols showing the location of scenic viewpoints. It can easily be argued that beauty is so subjective that few people would agree with the choice of scenic views. To this argument it can only be said that the topographer or geologist, trained in observation and in the appreciation of land forms, is at least as likely as the next visitor to notice and appreciate scenes of genuine beauty.

It can also be argued that such aesthetics have no place in an attempt to show the practical usefulness of geologic and topographic maps. This argument is not entirely valid. Landscape architects are a permanent part of the most modern highway departments. Modern highway planners pay as much attention to scenic attractions as they do to the technical factors of road construction. It follows that the maps used for planning should show these features, not only along existing highways but along the back roads and trails. These may one day be converted to highways—or they may be sought out by visitors simply because they have not been so converted. The geologist or topographer, who must penetrate all the nooks and crannies of his area in the course of his work, will probably see more of the attractive views than any other single observer. To show them on his map calls for little or no additional effort or expense.

Slopes for cuts. The map showing foundation and excavation conditions contains a series of profiles of slopes observed to be stable in artificial cuts in rocks of the different map units. They are based on observations of road and railroad cuts, and of cellar excavations and the like, throughout the Hollidaysburg region. Of particular interest to the engineer is recognition of the fact that the stability of a given slope depends in large part on whether the rock layers dip toward his cut or away from it. This is due, of course, to the usual presence of seepage water along bedding planes, which tends to cause slippage of the rocks if the water-lubricated surfaces dip into the cut face. Observations of slopes in cuts are not commonly recorded by geologists; because they are of very great importance to construction and maintenance engineers, and because the observations require so little extra effort, it is believed that they might well be included in the routine of geologic field mapping.

SUGGESTED PROBLEMS

An almost infinite number of problems can be answered, in general or in detail, by intelligent use of general-purpose geologic and topographic maps. The following examples indicate a partial range and are presented for possible classroom use. The specifications can be altered at will; for somewhat advanced students it would probably be well to assign problems in the adjacent Huntingdon quadrangle, described in the same folio as the Hollidaysburg, or in other areas for which adequate maps are available. In any event, it should be impressed on the students that their "solutions" cannot and must not be considered as final or accurate without field examination. Small-scale, general-purpose maps are adequate in themselves for general planning purposes; for any other purposes they can serve only to pinpoint the problem—to show where and what kind of detailed geologic studies are needed.

1. Find a site for a cemetery, 1 square mile in size, within 3 miles of Hollidaysburg. The site should be rolling, scenically attractive, and near to good roads but not crossed by major highways; subsurface material must be well-drained and easily excavated to depths of 6 feet or more.

2. Block out all areas where underground caverns are likely to be found.

3. Block out easily accessible areas where usable deposits of unconsolidated or very friable mortar sand should be found.

4. Locate a site for a ganister quarry to contain at least 500,000 cubic yards of material. Site must be within 2 miles of an existing railroad; beds must dip essentially parallel to hill slope. Lay out tentative access road or aerial tram. Justify your choice of site over other possible sites.

5. Lay out an airport within 5 miles of Martinsburg, providing for two 6,000-foot runways. Relief within runway area must not exceed 15 feet; nearest hill more than 75 feet high must not be closer than 1.5 miles. Describe excavation and drainage conditions and find adequate source of fill material.

6. Prepare and illustrate with maps and sections a geologic report on the feasibility of a proposed dam, 100 feet high, across Frankstown Branch just below mouth of South Poplar Run (near Claysburg). Include considerations of the foundations, the watertightness of the reservoir and spillway, and available construction materials for earth-fill or concrete dam. Outline necessary geologic studies and exploration needed for decisions as to whether concrete or earth-fill dam is preferable.

7. Prepare geologic section along a proposed highway tunnel, at 1,350-foot altitude, connecting East Sharpsburg with head of Oldtown Run Valley. Describe excavation and support problems to be encountered.

8. Lay out highway from Hollidaysburg up Oldtown Run to portal of tunnel proposed in problem 7. Describe and illustrate construction, maintenance, and bridging problems to be encountered and tell what further geologic data are needed.

9. Find a site for an underground factory, 100,000 square feet in area, near existing transportation and water supply. Minimum thickness of solid rock above factory must be 150 feet except within 200 feet of entrance. Rock should be easy to excavate by usual underground mining methods but should stand without artificial support. Heavy flow of underground water must be avoided.

10. Locate a water well within 2 miles of Altoona, estimate depth to water, and state whether or not it should flow under artesian pressure.

CALL THE SPECIALIST!

A good geologic map is packed with facts that can be applied to the solution of practical, everyday problems. Because he best understands the involved geologic history that has gone into making a part of the earth's surface as we see it today, the geologist can usually interpret the map better than a layman and can tell which of the facts shown will help solve a particular problem. Four main sources of help in interpreting geologic maps are available to everyone: the U.S. Geological Survey, the State Geological Survey, universities within the State, and private consultants. Help in interpreting the geologic map of the Hollidaysburg quadrangle, or of nearby areas, should be obtainable on application from one or more of the following:

1. State Geologist, Topographic and Geologic Survey, Department of Internal Affairs, Harrisburg, Pennsylvania.

2. Head, Department of Geology, Pennsylvania State College, State College, Pennsylvania.

3. Director, U. S. Geological Survey, Washington 25, D. C.

4. Consulting geologists, as listed in city directories.

Nothing in this set of maps is meant to imply that all of an engineer's geologic problems can be solved by interpretation of the usual small-scale geologic map, covering a large area, such as that presented here. Highly detailed geologic studies are nearly always needed at the site itself, both before and during construction. This is recognized by the larger Federal and other engineering organizations, and nearly all of them have geologists on their staffs to supply the needed information. The small-scale, large-area map does, however, answer many if not most of the questions that arise during the early planning stages of any construction program. Moreover, it contains many of the facts that the site geologist finds essential as background for his more detailed observations.

[1] Butts, Charles, Geologic Atlas of U. S., Folio 227, Hollidaysburg-Huntingdon, Pa., 1945. Available by purchase from the U. S. Geological Survey, Washington 25, D. C. Price $2.00.

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Principal contributors in the preparation of this material were the following:

Engineering Geology Branch
E. B. Eckel, E. Dobrovolny, J. M. Cattermole, G. R. Scott, L. P. Buck, D. E. Trimble, R. Van Horn

Ground Water Branch
H. E. Thomas

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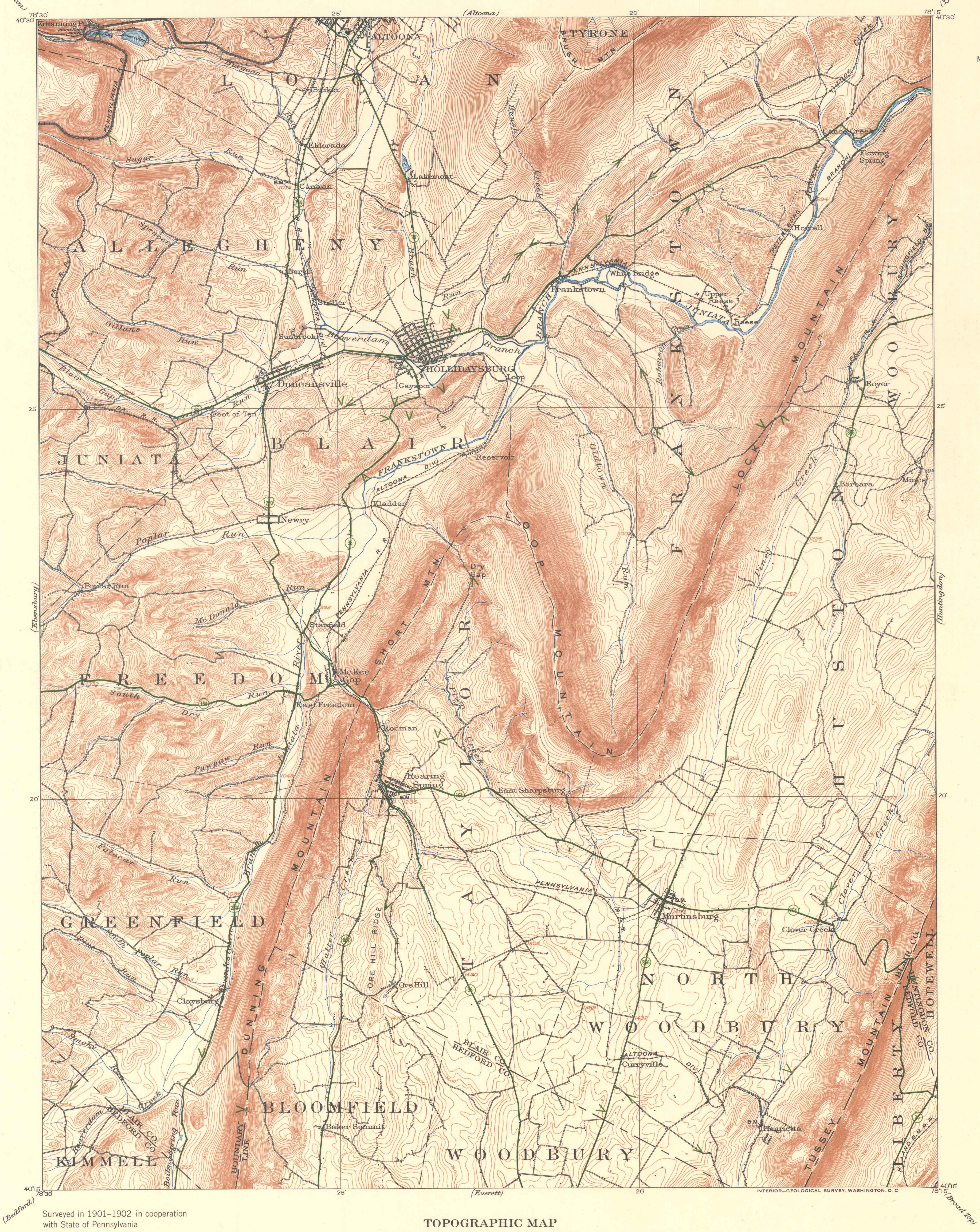
HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA



EXPLANATION

Main paved highways
Note: most other roads are also paved
Impressive scenic view
U.S. Route
State Route

RELIEF
Printed in brown

Altitude
Above mean sea level instrumentally determined

Contours
Showing height above sea, horizontal form, and steepness of slope of the surface

Depression contour

DRAINAGE
Printed in blue

Streams
Pond
Reservoir
Springs

CULTURE
Printed in black

City or town
Roads and buildings
Church or Schoolhouse
Private or poor roads
Railroads
Bridge
Dams
County line
State township line
City, village, or borough line
Triangulation or primary traverse monument
Bench mark giving precise altitude

Surveyed in 1901–1902 in cooperation with State of Pennsylvania

TRUE NORTH
MAGNETIC NORTH
6½°
APPROXIMATE MEAN DECLINATION, 1953

TOPOGRAPHIC MAP
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

Scale 1:62,500
1 ½ 0 1 2 3 4 Miles
Contour interval 20 feet
Datum is mean sea level

1953

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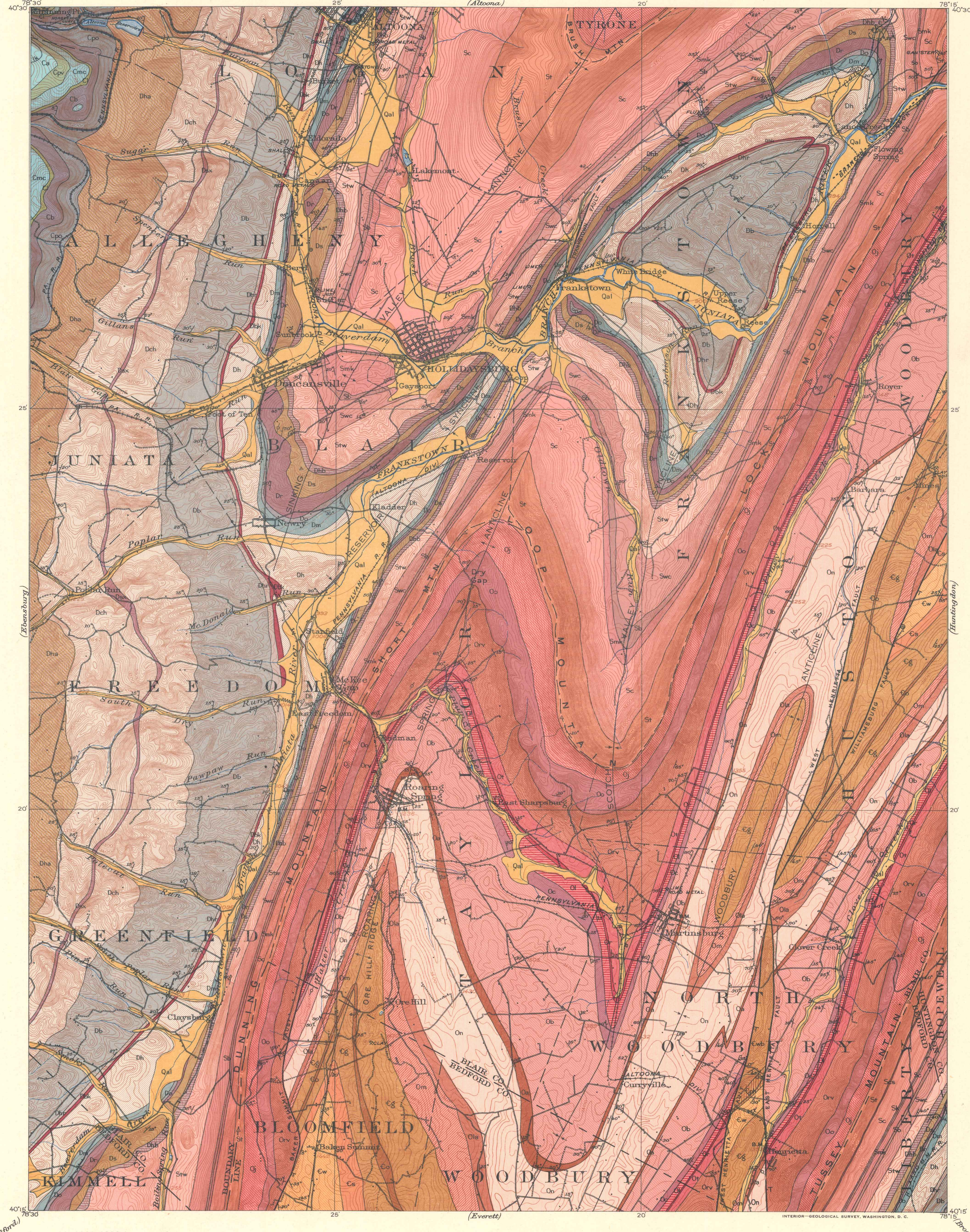
HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA

GENERAL-PURPOSE GEOLOGIC MAP



EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY — Recent

Qal — **Alluvium**
Silt, sand, and gravel constituting the flood plains of present streams.

CARBONIFEROUS — Pennsylvanian

Ca, lk — **Allegheny formation**
Shale and sandstone with beds of coal and clay; lk, *Lower Kittanning coal bed shown by blue line.*

Cpv — **Pottsville formation**
Sandstone, conglomerate, shale, and coal; Homewood sandstone member at top; Mercer shale member in middle; Connoquenessing sandstone member, coarse, thick-bedded sandstone and conglomerate, at bottom.

UNCONFORMITY

CARBONIFEROUS — Mississippian

Cmc — **Mauch Chunk formation**
Upper part mostly red shale and some green; lower part thick-bedded green sandstone.

Cl — **Loyalhanna limestone**
Siliceous limestone weathering to highly pitted and strongly cross-bedded sandstone.

Cb, Cpo — **Pocono formation**
Lower part red, gray, and olive-green shale with gray sandstone layers; Burgoon sandstone member, Cb, *at top, underlain by Patton shale member, sparingly fossiliferous.*

DEVONIAN — Upper Devonian

Dha — **Hampshire formation**
Predominantly red lumpy shale or mud rock and red sandstone; some gray and green shale and sandstone.

Dsx, Dch — **Chemung formation**
Chiefly green, gray, and chocolate-colored shale and thin beds of argillaceous fine-grained sandstone; fossiliferous throughout; includes Saxton conglomerate member, Dsx; *upper part largely chocolate-colored.*

Portage group

Db — **Brallier shale**
Micaceous, siliceous slaty green shale with some thin beds of fine-grained sandstone; sparsely fossiliferous throughout, mainly pelecypods of Gardeau type.

Dhr, Dbk — **Harrell shale**
Soft gray shale in upper part; Burket black shale member, Dbk, *in lower part; highly fossiliferous, small pelecypods and cephalopods of the Naples fauna.*

DEVONIAN — Middle Devonian

Dh — **Hamilton formation**
Principally olive-green shale with even-layered blocky-jointed sandstone and thin limestone at top; ridge-making sandstone at two horizons; sparingly fossiliferous; locally a foot or two of limestone at top with Tully fauna.

Dm — **Marcellus shale**
Black fissile clay shale, grading upward into olive-green shale.

Do — **Onondaga formation**
Gray shale, probably calcareous, and thin argillaceous limestone.

DEVONIAN — Lower Devonian

Oriskany group

Dr — **Ridgeley sandstone**
Thick-bedded calcareous sandstone weathering to coarse friable sandstone; locally a fine conglomerate at top with quartz pebbles; highly fossiliferous.

Ds — **Shriver limestone**
Thin-bedded siliceous limestone, weathering to fine-grained sandstone; black calcareous shale at bottom; sparingly fossiliferous.

Dhb — **Helderberg limestone**
Lower part is thick-bedded gray limestone with thin gray chert at top, chiefly Keyser limestone member; overlying Coeymans and New Scotland limestone members thin and locally absent; contains valuable quarry rock, called "calico rock"; fossiliferous throughout.

SILURIAN

Cayuga group

Stw — **Tonoloway limestone**
Thin-bedded finely laminated dark limestone; sparingly fossiliferous, chiefly Leperditia.

Swc — **Wills Creek shale**
Chiefly gray calcareous shale and some greenish limestone; fossils scarce.

Sb — **Bloomsburg redbeds**
Lumpy red shale and thick-bedded ridge-making red sandstone.

Smk — **McKenzie formation**
Blue thin-bedded fossiliferous limestone and soft gray and green shale; thin red shale east of Tussey Mountain and a little red shale west of Lock Mountain.

Niagara group

Sc, Sk, Scs — **Clinton formation**
Mainly green and blue shale, weathering purplish, and thin fine-grained green sandstone in middle; Keefer sandstone member, Sk, *near top; shale with thin limestone layers above Keefer sandstone member represent Rochester shale; Marklesburg iron-ore bed just beneath Keefer sandstone member; Frankstown iron-ore bed in lower half; hard quartzitic sandstone, red sandstone, and Levant Block iron ore,* Scs, *at base; generally fossiliferous.*

St — **Tuscarora quartzite**
Hard white quartzite and sandstone, largely thick-bedded; quartzite extensively quarried for ganister; contains Scolithus worm tubes and Arthrophycus at top.

EXPLANATION
(continued)

ORDOVICIAN — Upper Ordovician

Oj — **Juniata formation**
Chiefly red and some green fine-grained cross-bedded sandstone and red lumpy mud rock; nonfossiliferous.

Oo — **Oswego sandstone**
Gray fine-grained thick-bedded cross-laminated sandstone; contains a few small quartz pebbles in lower part; nonfossiliferous.

Orv — **Reedsville shale**
Chiefly olive-green shale, weathering to small slivers, upper part containing argillaceous and ferruginous limestone layers; thick-bedded dark sandstone with abundant brachiopods of the Orthorhyncula *zone at top, and a few feet of black shale containing graptolites at base.*

ORDOVICIAN — Middle Ordovician

Ot — **Trenton limestone**
Thin-bedded black argillaceous limestone weathering to small flat residual pieces; sparsely fossiliferous.

Black River group

Or — **Rodman limestone**
Thick- and thin-bedded dark crystalline limestone, weathering granular; fossiliferous.

Ol — **Lowville limestone**
Thick-bedded dark, fine, even-grained limestone, with conchoidal fracture; mostly high-grade limestone, the upper quarry rock.

UNCONFORMITY

Oc — **Carlim limestone**
*Thick-bedded, mainly fine-grained dark limestone, the lower quarry rock; sparsely fossiliferous; Lemont argillaceous limestone member, generally highly fossiliferous (*Maclurea magna *zone) at top, and separating the two quarry beds.*

UNCONFORMITY

ORDOVICIAN — Lower Ordovician

Beekmantown group

Ob — **Bellefonte dolomite**
Dark fine-grained dolomite, thick-bedded in lower part, dark shaly layers in upper part; contains heavy chert locally; sparingly fossiliferous.

Oa — **Axemann limestone**
Thin-bedded blue limestone with a few dolomite layers; abundantly fossiliferous.

On — **Nittany dolomite**
Thick-bedded light-gray fine-grained dolomite with some chert layers which weather to heavy chert at surface; chert commonly fossiliferous; a thin limestone, possibly Stonehenge, present near and southeast of Ore Hill.

Ola — **Larke dolomite**
Chiefly thick-bedded dark-blue coarsely crystalline dolomite, generally without chert but locally yields some chert at the surface; lower part is light-gray, fine-grained, and thinly banded by siliceous laminae that weather in relief; sparsely fossiliferous.

Om — **Mines dolomite**
Coarse- and fine-grained blue dolomite, largely oolitic; on weathering gives rise to great quantity of irregular platy scoriaceous chert, much of which is silicified oolite with black grains and contains two species of Cryptozoon.

CAMBRIAN — Upper Cambrian

Ꞓo, Ꞓg, Ꞓs — **Gatesburg formation**
Chiefly thick-bedded blue coarsely crystalline dolomite, with many layers of sandstone up to 10 feet thick; Stacy dolomite member, Ꞓs, *free of sandstone, at base; Ore Hill limestone member,* Ꞓo, *which contains rare trilobites, in middle.*

Ꞓw — **Warrior limestone**
Thin-bedded blue fine-grained magnesian limestone with shaly partings; some layers contain abundant rounded quartz grains; sparingly fossiliferous, including Cryptozoon *and trilobites.*

CAMBRIAN — Middle Cambrian

Ꞓph — **Pleasant Hill limestone**
Lower part argillaceous thin-bedded limestone weathering to shale; upper part pure thick-bedded dark limestone; contains trilobites, brachiopods, and Hyolithus.

CAMBRIAN — Lower Cambrian

Ꞓwb — **Waynesboro formation**
Yellowish arkosic sandstone, fine quartz conglomerate, red and green shale, and calcareous sandstone; contains Hyolithus *and trilobites.*

Known fault

Probable fault

Concealed fault
Covered by younger deposits.

T
Overthrust side of thrust fault

35
Strike and dip of beds

Strike of vertical beds

Horizontal beds

Quarry

Axis of anticline

Axis of syncline

Surveyed in 1901–1902 in cooperation with State of Pennsylvania

Geology mapped in 1908 by Charles Butts

6½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1953

GENERAL-PURPOSE GEOLOGIC MAP OF THE HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

By Charles Butts

Scale 1:62,500

1 ½ 0 1 2 3 4 Miles

Contour interval 20 feet
Datum is mean sea level

1953

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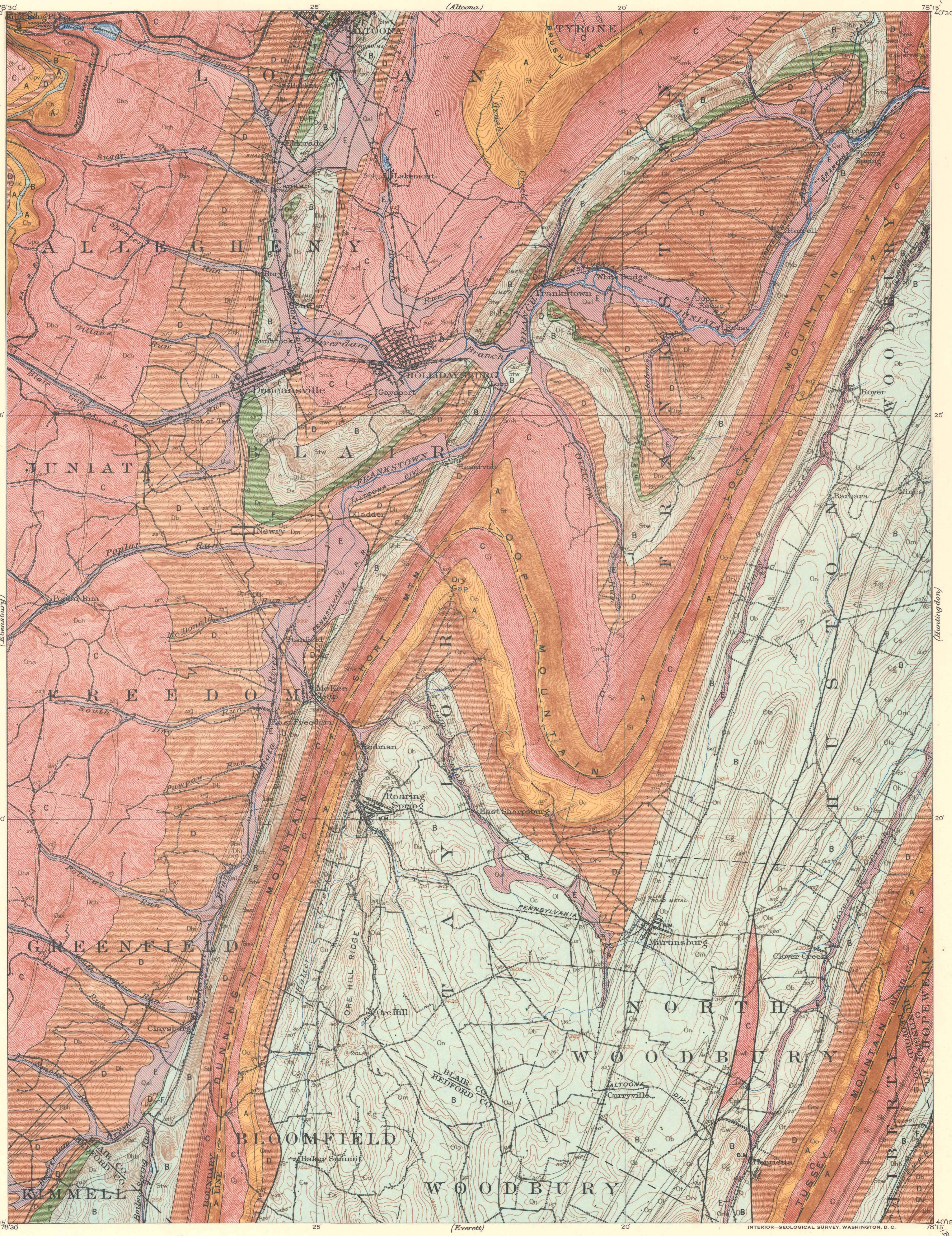
HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA

FOUNDATION AND EXCAVATION CONDITIONS



Surveyed in 1901–1902 in cooperation with State of Pennsylvania

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FOUNDATION AND EXCAVATION CONDITIONS
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

Scale 1:62,500

1 ½ 0 1 2 3 4 Miles

Contour interval 20 feet
Datum is mean sea level

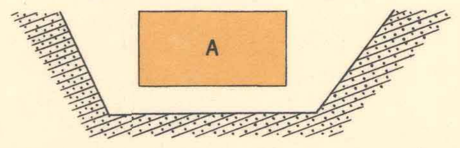
1953

EXPLANATION

Material to be used in place, as for road beds or building foundations.

Profiles show slopes observed to be stable in artificial cuts.

1:2 1½:2

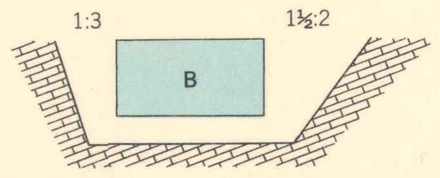


Excellent foundations, difficult excavation
Sandstone and quartzite

Orv in the top 50 feet, Oo, St, Cb, Cmc in the lower half, Cpv*

Requires blasting and power tools for removal. Strong, durable, well-drained foundations. Cut slopes at angles shown above observed to be stable. Seepage to be expected along bedding planes; may cause minor slides and sloughing unless diverted. Fresh rock forms very rough, rocky surface for unimproved roads, but only need for base course is to provide smoothness. Sandy soil cover generally less than 2 feet thick but outcrop areas (as well as considerable areas downslope from these outcrops) thickly covered with coarse rubble and talus.

1:3 1½:2



Excellent foundations and difficult excavation except in weathered zone.
Limestone and dolomite

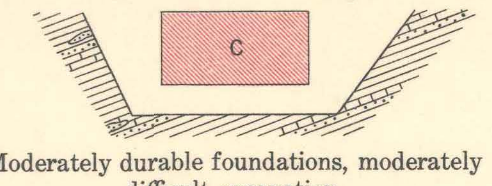
Ꞓph, Ꞓw, Ꞓs, Ꞓg, Ꞓo, Om, Ola, On, Oa, Ob, Oc, Ol, Or, Ot, Stw, Dhb, Ds, Cl

Requires blasting and power tools for removal. Fresh rock forms excellent, durable foundations, well drained. Seepage along joints and bedding planes will cause slipping of blocks unless all loose ones are removed during construction. Solution cavities are to be expected anywhere but cannot be predicted without drilling or cleaning of foundations. Forms very rough, rocky surfaces for unimproved roads where unweathered, but only need for base course is to provide smoothness.

Weathers to clayey soil in most places (except Ꞓg, which yields sand). Weathered zone very irregular, ranging from 1 to 30 feet or more in depth. Depth of weathering cannot be foretold from map, but fresh rock is usually close to surface on ridges, with deeper soils in lower, more level areas.

Cuts in fresh rock at angles shown are stable, but where rocks dip into the cut, slope depends partly on dip because joint blocks tend to slip out. Cuts in clayey soil overburden must be 1:1 (45°) or flatter.

1:2 1½:2

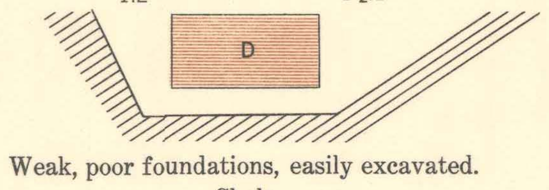


Moderately durable foundations, moderately difficult excavation.
Mixed shale and sandstone, some limestone

Ꞓwb, Oj, Sc, Smk, Sb, Dch, Dha, Cpo, Ca

Hardness is variable but rocks generally difficult to excavate; require drilling and blasting and use of power equipment. Soil overburden varies in character but usually thin. Partly weathered rocks can be excavated by hand tools. Good foundations where layers are horizontal or are supported laterally; may slump or landslide if inclined layers are undercut. Drainage fair to excellent. If sandstone and shale are in distinct smooth layers and dip toward a cut, slopes should be less than 1:1 (30°-40°) to prevent slipping due to seepage.

1:2 1½:1

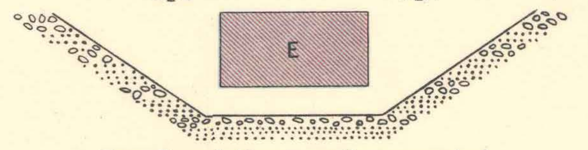


Weak, poor foundations, easily excavated.
Shale

Orv in the lower part, Swc, Do, Dm, Dh, Dbk, Dhr, Db, Cmc in the upper half

Weak material throughout; very poorly drained except in uppermost weathered zone. Partly weathered and disintegrated to depths of 5 to 40 feet. Clay soil very thin to absent. Easily excavated with hand tools, even when entirely unweathered. Roads require permeable base course to provide drainage and eliminate frost heave. Where layers dip into a cut, slopes must be as low as the dip angle for real stability. Best known example of this treatment is on back road between Smoky Run and Beaverdam Creek at Blair County line, southwest corner of quadrangle.

1½:1 1½:1

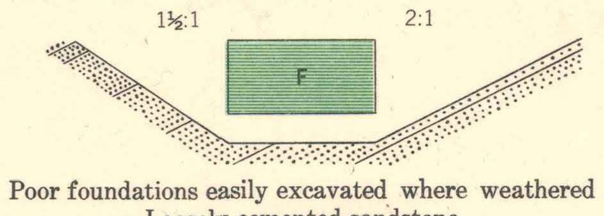


Poor foundations, easily excavated
Floodplain alluvium

Qal

Irregular layers and lenses of gravel, cobbles, sand, and silt; natural bank surfaces generally give exaggerated impression as to quantity of cobbles. Excellent drainage where above water table but low topographic position makes materials subject to floods. Irregular distribution of materials and lack of compaction make it a poor foundation; surfaced roads require excessive maintenance because of differential settling; heavy base course, well-laid and compacted, would obviate this difficulty.

1½:1 2:1



Poor foundations easily excavated where weathered
Loosely cemented sandstone

Dr

Sand cover is weathering residue. Unweathered rock is generally friable and easily crushed. May require power shovel for removal but some can be worked by hand. Weak foundations but good drainage in most places.

Fault

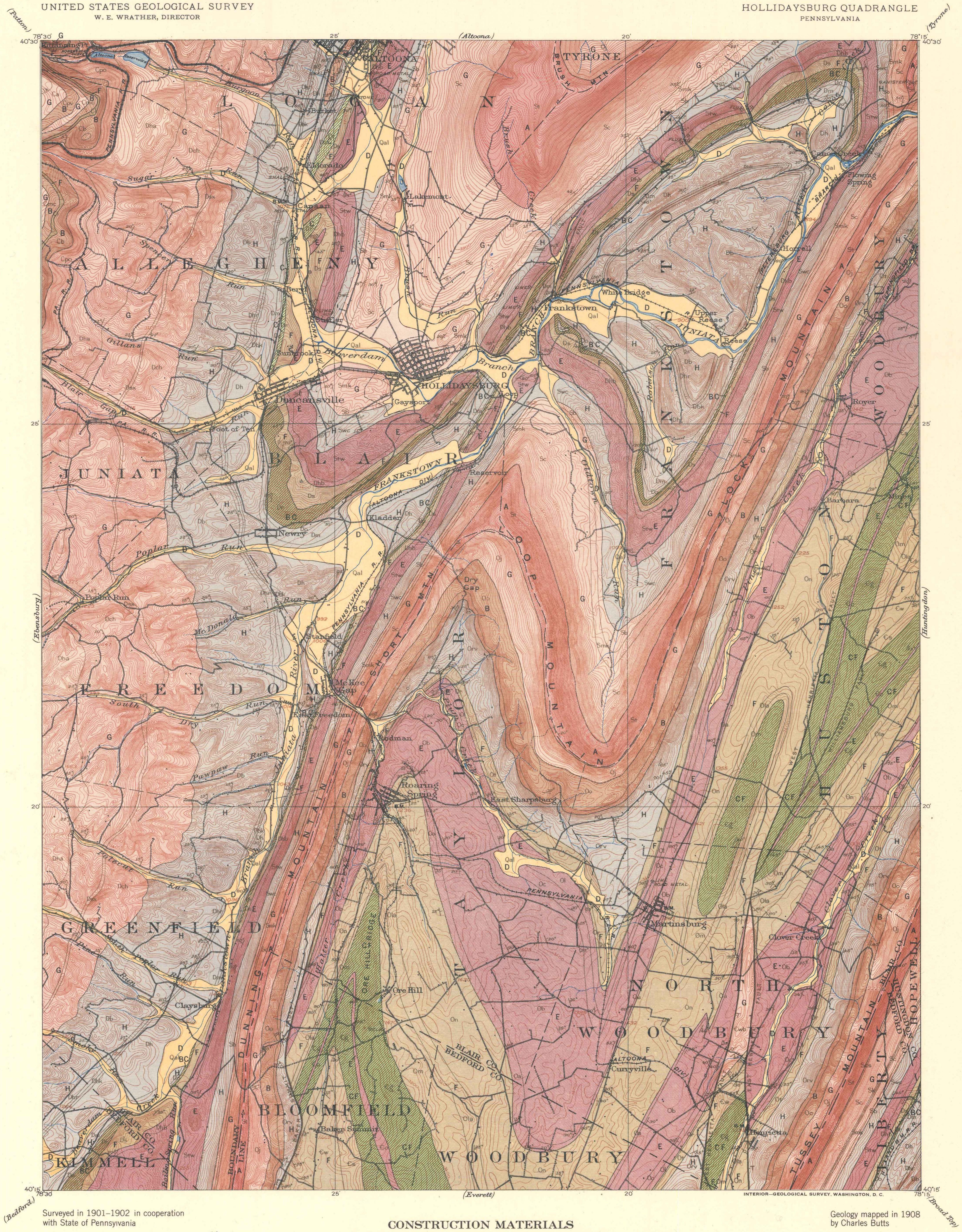
Major dislocation of rocks. Some faults may be tight and unnoticeable except for sudden change in character of rock from one side to the other. Others may be marked by wide zone of crushed rock; unsuitable for foundations.

**LETTER SYMBOLS REFER TO FORMATIONS SHOWN ON GENERAL-PURPOSE GEOLOGIC MAP.*

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
W. E. WRATHER, DIRECTOR

HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA

CONSTRUCTION MATERIALS



Surveyed in 1901–1902 in cooperation with State of Pennsylvania

Geology mapped in 1908 by Charles Butts

CONSTRUCTION MATERIALS
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

Scale 1:62,500

1 ½ 0 1 2 3 4 Miles

Contour interval 20 feet
Datum is mean sea level

1953

TRUE NORTH
MAGNETIC NORTH
6¾°
APPROXIMATE MEAN DECLINATION, 1953

EXPLANATION

Material to be excavated and moved to construction job; to be used with or without treatment.

A

Quartzite (ganister)

St*

Very hard, tough, durable fine-grained quartzite, known to trade as ganister. Quarried extensively for manufacture of refractory silica brick. Used locally to minor extent as rough building stone, for walls, and when crushed, as road metal; would form excellent riprap or ballast but too difficult and expensive to work for any of these uses. Requires blasting and power equipment for removal.

B

Sandstone

Orv in the top 50 feet, Oo, Dr, Cb, Cmc in the lower half, Cpv

Medium-hard, durable sandstone, mostly in massive beds more than a foot thick. Contains layers of shale in places. Used locally as building stone. Quarried and crushed rock makes fairly durable fill, base course, or ballast. Could be used for riprap. Requires blasting and power equipment for removal.

C

Sand

Ꞓg, Dr, weathered portions

By far the best sources of sand for mortar, fine aggregate, molding, and glass manufacture. Sand is residue from weathering of limy sandstone, fine conglomerate, and sandy dolomite. Partly weathered material soft and easily quarried and crushed; in many places completely weathered to loose sand to depths of 20 to 40 feet. Only other sources of sand-size material are unit D and crushed limestones from units E and F (see below).

D

Gravel, cobbles, sand, and silt

Qal

Flood-plain deposits, consisting of irregular layers and lenses of gravel and cobbles from harder rocks of surrounding hills; mixed with muck, silt, and loam, with a few small lenses of clean sand. Used locally as source of cobbles and coarse aggregate; very poor source of gravel or sand because of spotty size distribution, variation in durability of different pebbles and cobbles, and high water table. Easily dug with hand tools. Nearly all concrete aggregate and road metal used in this area consist of crushed limestone and dolomite (see units E and F below).

E

Pure limestone and dolomite

Ꞓo, Oa, Ob, Oc, Ol, Stw, Dhb

Hard, durable limestone and dolomite in beds of varying thickness. Excellent source of fine and coarse aggregate, riprap, ballast, road metal, filler, and base course. Also quarried extensively in many places for blast-furnace flux, for agricultural and mortar lime, and for use in glass and paper industries. Parts of several formations would be excellent for portland cement making (see chemical analyses in Hollidaysburg-Huntingdon folio). A few cherty beds included in this unit should be avoided for certain concrete aggregate uses (see unit F below). Requires blasting and heavy equipment for quarrying and crushing.

F

Cherty limestone and dolomite

Ꞓph, Ꞓw, Ꞓs, Ꞓg, Om, Ola, On, Or, Ot, Ds, Cl

Hard, durable limestone and dolomite for most part but contains chert nodules, finely distributed silica, or layers of quartzite Equal to unit E above for use as riprap, ballast, base course, fill, and rough building stone. Too impure for most chemical uses. Should not be used as concrete aggregate without thorough laboratory tests. Chert and siliceous matter react with certain high-alkali cements, weakening the resultant concrete and causing it to deteriorate.

G

Mixed shale and sandstone

Ꞓwb, Oj, Sc, Smk, Sb, Dch, Dha, Cpo, Cmc in the top half, Ca

Moderately hard and durable mixture of shale and sandstone; mostly "red beds," in which shaly material is massive and lacks usual platy character. A few of thicker sandstone beds make attractive building stone for limited local use. Moderately good to excellent riprap and ballast. Nearly all material forms excellent, well drained fill and base course and reasonably good, nonslippery surfacing material. Locally soft enough for hand tools, but most requires power equipment and some blasting.

H

Shale

Orv, except in the top 50 feet, Swc, Do, Dm, Dh, Dbk, Dhr, Db

Thinly layered shale of varying hardness with very little sandy material either as grains in the shale or as separate beds of sandstone. Plastic or slippery when wet, especially in weathered portions; makes weak, poorly drained fill and very poor surfacing material unless mixed with sandier and tougher material from other units. Many shales included here are excellent material for common brick; some of the more carbonaceous may be useful for lightweight aggregate (see below).

DEPOSITS NOT SHOWN ON MAP

Lightweight aggregate

Two of the shale formations included in unit H, above, deserve investigation as possible sources of lightweight aggregate for cinder blocks and other uses for light, strong concrete. These are the Marcellus shale, Dm, and the Burket black shale member, Dbk, of the Harrell shale, both shown on the general-purpose geologic map and described in the folio text. Both are black, very thinly laminated, and relatively hard; they are the kind of shale that frequently yields high-grade light-weight aggregate when properly heat-treated.

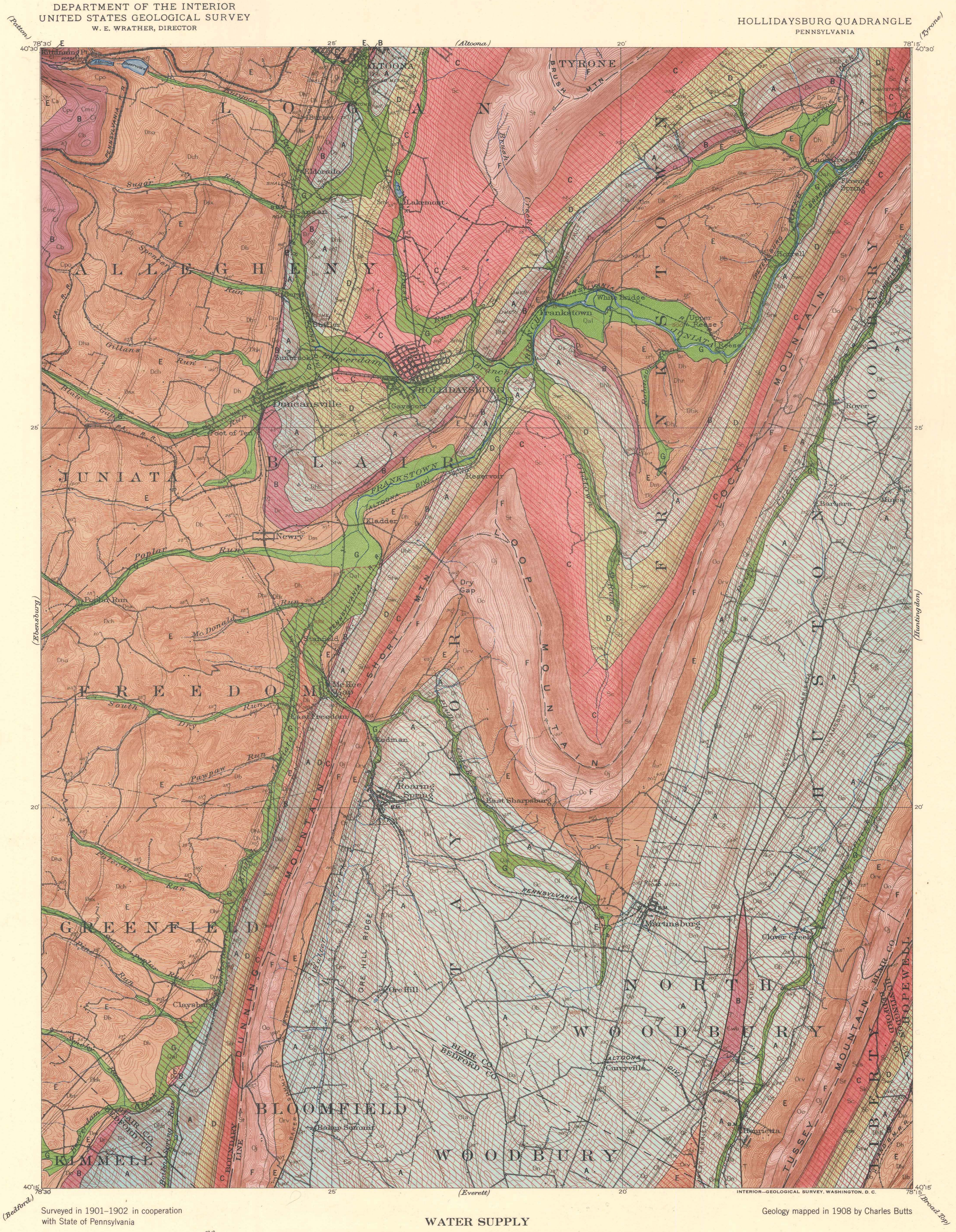
Fire and pottery clay

The Gatesburg formation, Cg, included with units C and F on this map, but shown separately on the general-purpose map, contains a few sizable deposits of high-grade clay used for fire brick, converter linings, and pottery. Deposits are near surface and easily dug by hand; they fill sinks and basins in weathered dolomite. Two have been worked. One is at Mines, the other near Ore Hill; similar deposits doubtless occur elsewhere within the Gatesburg belt of outcrop.

**LETTER SYMBOLS REFER TO FORMATIONS SHOWN ON GENERAL-PURPOSE GEOLOGIC MAP.*

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
W. E. WRATHER, DIRECTOR

HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA



Surveyed in 1901–1902 in cooperation with State of Pennsylvania

Geology mapped in 1908 by Charles Butts

WATER SUPPLY
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1953

Scale 1:62,500
1 ½ 0 1 2 3 4 Miles
Contour interval 20 feet
Datum is mean sea level

1953

INTRODUCTION

A knowledge of the geology is an essential element in understanding the water supply of an area, but it is only one of the hydrologist's tools. Other important items in hydrology, such as climatology, infiltration, and characteristics of flow in streams or in rock formations, cannot be deduced from geologic or topographic maps but must be determined by other means. Wherever the water requirements exceed the limited needs of small domestic users, such hydrologic information is prerequisite to a determination of the adequacy and sustained yield of the water supply. For the purpose of this folio, the interpretations given below, then, are those based only on geologic and topographic maps.

EXPLANATION

A

Excellent water-producers
Limestone, dolomite

Ꞓph, Ꞓw, Ꞓs, Ꞓo, Ꞓg, Om, Ola, On, Oa, Ob, Oc, Ol, Or, Ot, Stw, Dhb, Ds*

Yield to wells that strike solution channels. Water moderately hard to very hard. These rocks underlie broad valleys except in north-central part of area, where they form steep ridges. Underground drainage is characteristic of these areas, and only the lowest valleys contain perennial streams.

B

Excellent water-producers
Sandstone

Ꞓwb, Dr, Cb, Cl, Cmc, Cpv

Supply many domestic wells and yield large supplies to a few industrial wells; several large springs. Water quality good; soft and iron-free. Rocks loosely cemented and fairly permeable; form low ridges in most places.

C

Good small producers
Shale with some sandstone and limestone

Sc

Shale has low permeability but yields small supplies to many domestic wells. Sandstone permeable and abundantly water-bearing. Water quality good. Rocks form moderate to steep slopes. Some perennial streams rise in the outcrop areas of these relatively impermeable rocks.

D

Fair producers
Shale with some impure limestone

Smk, Sb, Swc

Shale relatively impermeable but yields small supplies to domestic wells. Wells ending in limestone may yield moderately large supplies. Water very hard. Rocks form steep to gentle slopes.

E

Poor producers
Alternations of shale, sandstone, conglomerate, clay, limestone, and coal

Orv, Do, Dm, Dh, Dbk, Dhr, Db, Dch, Dsx, Dha, Cpo, Ca

Mainly rather poor water-bearers. Yield small supplies for domestic use; some sandstone beds may be moderate producers. Quality of water generally good, soft to medium hard; but some, especially in coal beds, contains much iron. Rocks form hills and slopes which are drained by numerous perennial streams. The stream pattern indicates a higher proportion of surface runoff than from other areas in the quadrangle, which is to be expected because of the generally low permeability of the rocks.

F

Poor producers
Hard sandstone and quartzite

Oo, Oj, St

Yield small supplies to a few domestic wells and hillside springs. Quality of water good. Rocks form mountains and steep ridges. Perennial streams rising along the lower flanks of these ridges suggest that there is some infiltration of precipitation at higher levels, movement of ground water down the slope, and discharge where water is forced to the surface by less permeable rocks, notably those in unit E.

G

Capabilities unknown
Alluvial sand, gravel, silt, and clay

Qal

The alluvium along the Juniata River, Frankstown Branch, and Beaverdam Branch, and possibly some other tributaries may be thick enough and permeable enough to yield large supplies to wells, with replenishment by infiltration from the perennial stream. However, the thickness and permeability of alluvium are not known for any point in the area, and would need to be determined by test drilling.

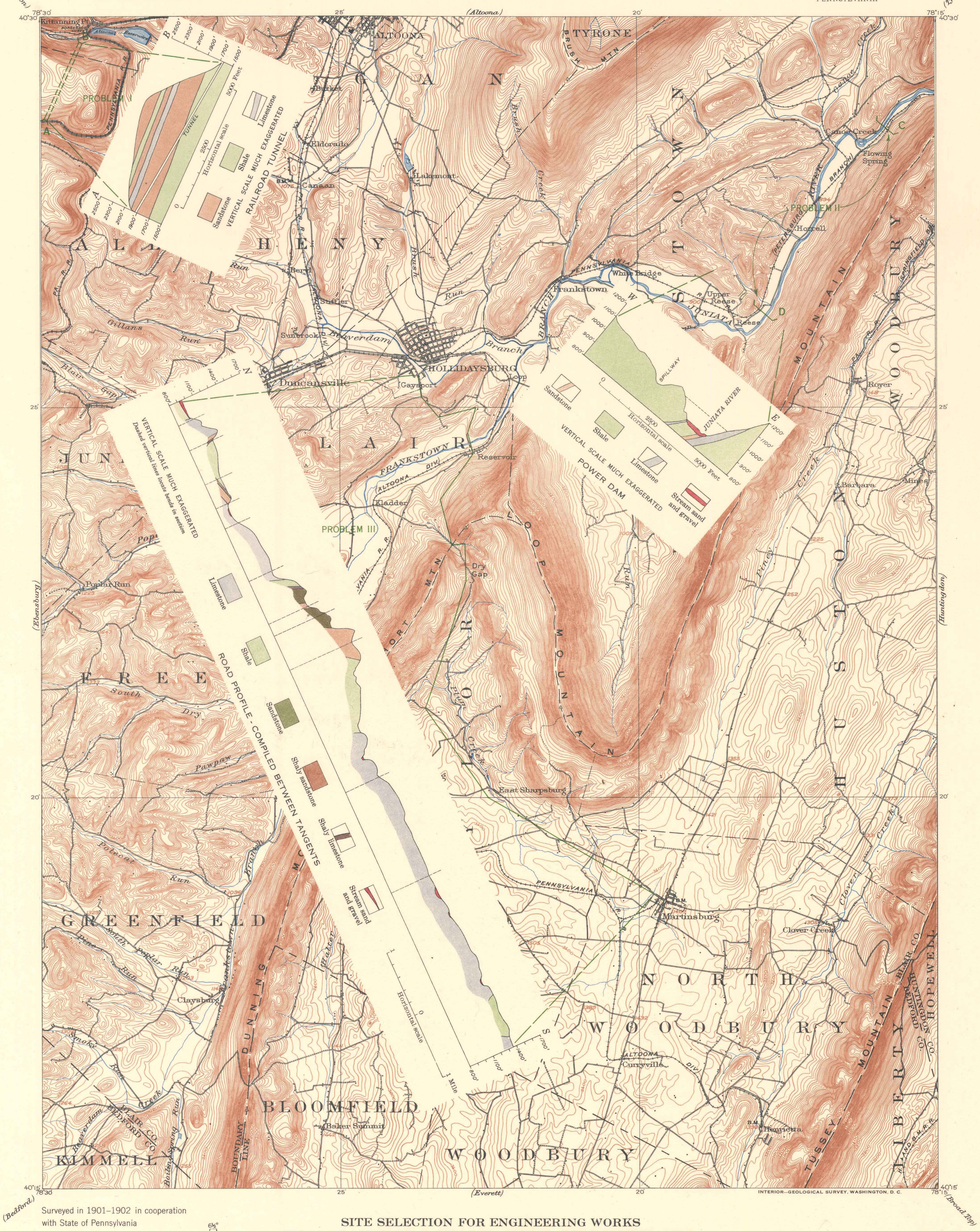
Recharge areas

Much of the water falling on these areas soaks into openings in the underlying rocks, thus recharging the ground-water supplies and storing water for recovery by wells or for spring discharge or seepage to principal streams.

*LETTER SYMBOLS REFER TO FORMATIONS SHOWN ON GENERAL-PURPOSE GEOLOGIC MAP.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
W. E. WRATHER, DIRECTOR

HOLLIDAYSBURG QUADRANGLE
PENNSYLVANIA



Surveyed in 1901–1902 in cooperation with State of Pennsylvania

APPROXIMATE MEAN DECLINATION, 1953

SITE SELECTION FOR ENGINEERING WORKS
HOLLIDAYSBURG QUADRANGLE, PENNSYLVANIA

By Members of the Engineering Geology Branch

Scale 1:62,500

Contour interval 20 feet
Datum is mean sea level

1953

The general-purpose geologic map can be used in site selection and preliminary planning of engineering structures. Several hypothetical problems are given below. The answers are based entirely on interpretation of the all-purpose geologic map. Much more detailed geologic study, based on field work, is, of course, necessary before final plans and designs are made.

PROBLEM I

Problem: Report on conditions to be expected in constructing large railroad tunnel 7,400 feet long, connecting points A and B, on Pennsylvania Railroad main line just south of Horseshoe Curve.

Solution: At portal A, tunnel will enter massive gray sandstone. It will continue in this rock 3,650 feet, where soft varicolored shale, nearly flat bedded, will be met. Remaining 3,750 feet of tunnel will be in this shale. Rocks at both portals are badly weathered to depth of 50 feet.

Recommendations:

1. Heavy lining required for first 50 feet at both portals.
2. Both portals should be protected against landslides and rock falls.
3. Sandstone in first 3,650 feet will be easy to drill and blast; will require no support except at portal. Adequate drainage should be provided, as sandstone is porous and will probably yield much water.
4. Shale in at least 3,750 feet of tunnel will be easily excavated. Cave-ins are likely to occur; continuous support of walls and roof is essential during construction. Most of shale portion will require permanent lining.

PROBLEM II

Problem: Compare feasibility of alternate sites C and D for power dams on Juniata River. (Assume sites to be equally desirable from engineering standpoint.)

Solution: Rocks at both sites are similar—alternating shale, sandstone, and limestone beds that are steeply inclined to west. At site C, geologic map shows that rocks are displaced by a fault that passes through proposed dam. Large springs exist along this fault on upstream side of site C. The fault denotes a zone of weakness and of crushed rock that is undesirable beneath a dam. Moreover, when reservoir is filled, water now coming from springs may be forced down along fault and issue as new springs beneath dam structure or farther downstream.

Recommendations:

1. Choose site D and abandon site C.
2. Plan impermeable cut-off wall to bedrock across entire valley floor. This probably need not be more that 35 feet deep, as river alluvium is nowhere more than 25 feet deep, and rocks beneath alluvium are unweathered.
3. Landslides are to be expected on east abutment as rocks dip steeply toward valley floor.
4. Drill a number of holes in valley floor along dam axis to determine whether limestone beds beneath dam contain solution caverns. If caverns are found, extensive grouting will be necessary.
5. Plan to line spillway with riprap or concrete; it is in soft shale that will erode rapidly if unprotected.

PROBLEM III

Problem: Evaluate feasibility of a road connecting Hollidaysburg (N) with Martinsburg (S) through Dry Gap.

Solution:

Interpretation from topographic map:

Approaches to the divide at Dry Gap will require four short-radius (hairpin) curves to attain a 6-percent grade. Curves throughout the rest of the alignment will have wide radii and the grade can feasibly follow land surfaces.

Interpretation from the general-purpose geologic map:

1. Heavy rock excavation anticipated in the following areas:

(a) About 3/4 mile south of Hollidaysburg. Limestone and some sandstone will be encountered on the cut slope near or above ditch line

(b) Dry Gap area, where sandstone will be encountered in construction of short-radius curves.

2. Internal drainage of limestones and sandstones, in area of heavy construction, adequate to eliminate hazards of landslides in fill sections and cut slopes.

3. Rock footings are near surface at all stream crossings except on Frankstown Branch of Juniata River, where rock support can probably be reached by piles; detailed investigations needed to determine presence or absence of filled or open solution cavities.