one a half of such distance, being expressed by the formula

$$Dn = Dn-1+\frac{Dn-1}{2}$$

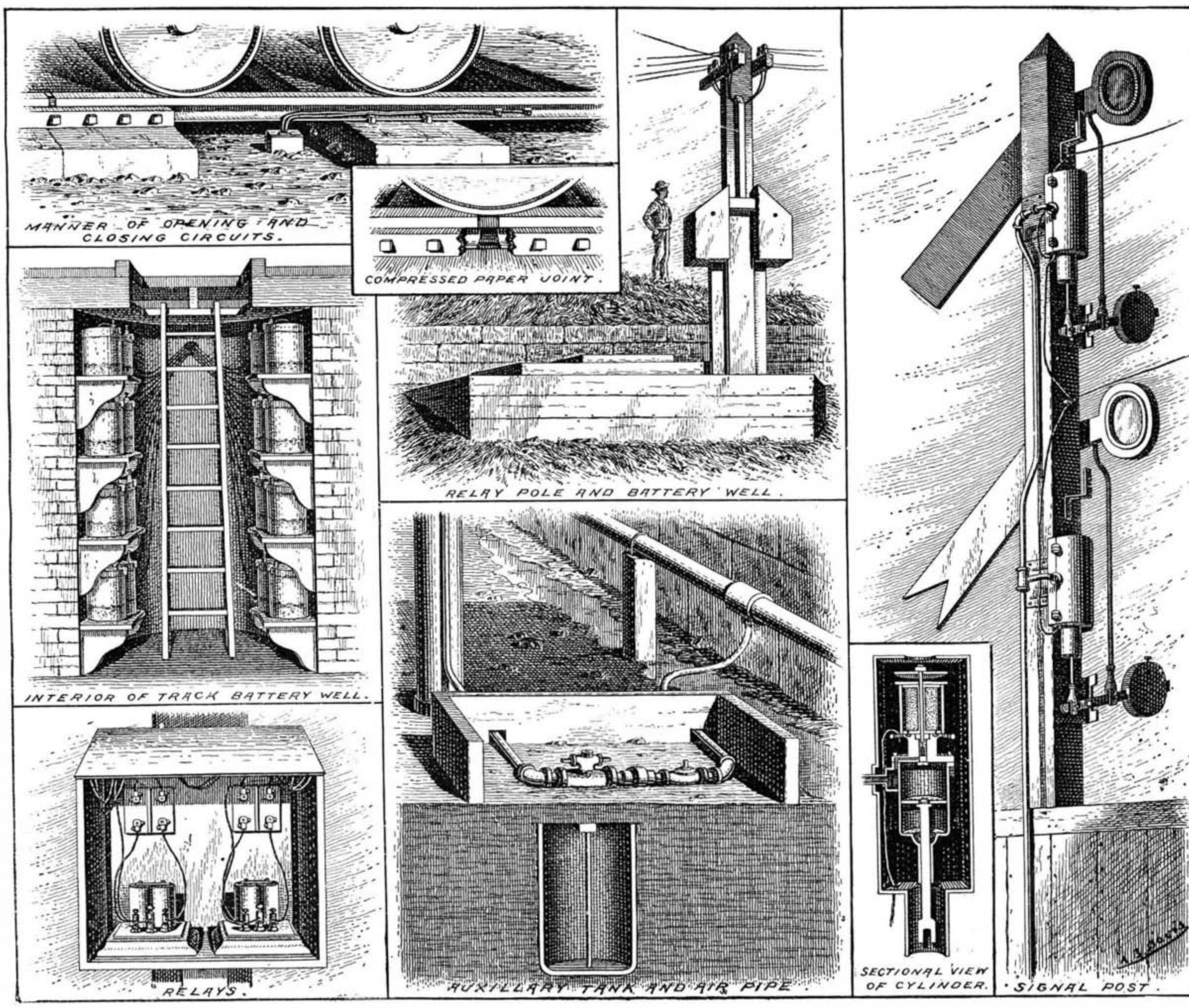
Thus the first turning loose being say 10 miles, the second will be 10 + 5 = 15 miles, the third will be 15 + 7½, and so on up to 120 or 180 miles, that is to say, up to the distance that the messengers are never to exceed.

As soon as a mobilization of the army has been decreed, there will be taken from each cote all the pigeons that are carried in the direction of the neighboring places, and these will be conveyed respectively to such places along with the men who are accustomed to care for them, and who must remain there until the cessation of hostilities.

All these permutations must be effected on the same day, so that every lot of pigeons shall find the place free on arriving.

In a succeeding article I shall give a few as complete details as possible as to the systems of military dovecotes of the principal powers of Europe.

Such data, however, will be merely approximate, since it is for the interest of every state not to allow its neighbors to become too accurately informed as to what is going on within its borders, and not to divulge its processes.—*Lt. Col. De Rochas, in La Nature.*



PNEUMATIC SIGNALING ON THE CENTRAL RAILROAD OF NEW JERSEY.

PNEUMATIC SIGNALING UPON THE CENTRAL RAILROAD OF NEW JERSEY.

The Westinghouse automatic signaling system, now in daily operation upon the Central Railroad of New Jersey, has already been described in our columns. We illustrate in the present issue some further features of its operation, touching more especially upon the details of its electric and pneumatic connections.

The line of road operated by it is divided into blocks. From motives of safety these blocks should be as long as possible, but in the present case the number of trains which pass over the road necessitate short blocking, each block being from 1,000 to 2,500 feet long. Two semaphore signals are used at the beginning of each block. One indicates "caution" when the next block but one has a train upon it; the next indicates "danger" when the next block has a train upon it. The semaphore indicating danger is termed the "home" signal, the other the "distant" signal. The upper one is the home signal, the lower is the distant one.

The system in general terms operates by pneumatic pressure. The operating valves of the air pressure pipes are opened and shut by the agency of an electric current. The rails are used as part of the circuits for the current. To them the wires are connected by pins driven into holes drilled in the web of the rail. This method of connection is shown in one of the cuts. Where the rails abut, if they are to be connected electrically, a short piece of copper wire is carried across the joint and connected in like manner by two pins, one driven into a hole in the web of each rail.

Each block has to be insulated from its neighbor. In order to secure this, compressed layers of paper are inserted between the ends of the rails, as shown in the cut.

The electric batteries are established in little cisterns or wells, underground, along the side of the road. The gravity battery is used, and as it is on closed circuit much of the time, it is maintained in good condition. Over each well is the relay pole, whence wires run to the semaphore poles. The relays, battery and well, and a relay pole are also shown. The well is large enough to give ample room for an operative to clean, refill, or charge the batteries as required.

A semaphore pole is placed near the beginning of each block. It carries two semaphores. Each is raised to "danger" or "caution" by a counterweight. A pneumatic cylinder and piston is connected to the arm of the counterweight in such a way that as long as the air pressure is maintained the signal remains at safety. The air pressure is turned on by an electrically controlled valve, which, with its solenoid and armature, is seen in the cut immediately above the piston. Hence for air pressure to act upon the piston the solenoid must be excited. To secure quick action of the pneumatic cylinders, air reservoirs are established at intervals along the track. These obviate the necessity of air passing through long lines of pipe, with attendant friction and "wire drawing." Thus prompt action is secured.

The trains by bridging the tracks operate the electric circuits. As long as everything is intact and the tracks are empty the solenoids are excited, their armatures are depressed, and the air valves are open. The air depresses the piston and forces the semaphores into the safety position. If an engine or train enters upon a block it short-circuits the solenoids, affecting the danger signal for its own and the caution signal for the block behind it. The air valves move and the air escapes from the pneumatic cylinders, and the semaphores drop into "caution" and "danger" positions respectively. As the train leaves the block, the distant caution signal circuit ceases to be short-circuited, the air valve is shifted, and the signal is forced by pneumatic pressure into safety again. The danger signal immediately back of the block it is leaving is affected in like manner, and the two semaphores next in advance drop into the position of warning.

The great point about the system is that the work of the whole apparatus is holding the signals at safety. If anything happens to break a connection, if the air pipes leak or are fractured, or if any interference is suffered so that the apparatus ceases to act, every signal falls at once into "caution" and "danger." It is in this respect that the perfection of the system appears in the strongest light. An accident, which makes it inoperative at once, signals a full stoppage to every train upon the road.

The Steel Steamer Roman.

The steel steamer Roman, built to the order of the Menominee Transit Co. by the Globe Iron Works Co., Cleveland, O., was lately launched from the yards of her builders.

The Roman is the last of a fleet of six high classed, full powered steel steamers built by the "Globe" for the same owners, and named respectively the Norman, Saxon, German, Briton, Grecian, and Roman.

The dimensions of the Roman are as follows: 312 feet 6 inches over all; 296 feet 6 inches keel; 40 feet beam and 24 feet 6 inches moulded depth. Engines, triple expansion, with cylinders 24, 38, and 61 by 42 inch stroke; two Scotch type boilers 12 feet 6 inches in diameter by 14 feet in length, for a working pressure of 160 pounds; her propeller wheel is 14 feet in diameter, with a lead of 17 feet. She is estimated to carry 3,000 tons on a 15 foot 6 inch draught. Her coefficient of fineness is 0·81, which proves that her machinery is very superior to obtain the maximum speed which she is guaranteed for. It is estimated that she will consume 1·70 pounds of coal, developing an I. H. P. of 1,870. She has four water tight compartments, including the collision bulkheads; her upper deck is of steel, lap-plated with thwartship seams and double riveted butt straps of three-eighths steel; her stringer plates are also double strapped and triple riveted; main deck of four inch pine.

THE law of the United States is that bridges over navigable streams must be built under the sanction of the War Department. The law is to be more vigorously enforced than formerly.

The Sandstone Industry.

Mr. Robert P. Porter, Superintendent of Census, reports that census *Bulletin* 73, in relation to the sandstone industry, was prepared by Dr. William C. Day, special agent, under the supervision of Dr. David T. Day, special agent in charge of the division of mines and mining of the Census Office.

The amount of sandstone produced in the United States in 1889 was 71,571,054 cubic feet, valued at $10,816,057, while for 1880 the value was only $4,780,391, an increase during the decade of $6,035,666, or 126·26 per cent. There were 16,925 workmen employed, to whom were paid in wages $6,257,580. The total expense of producing sandstone in 1889 was $8,130,295, and the total capital invested $17,776,467, of which $11,501,100 was invested in land.

The name "sandstone" is applied to stone which has been formed by sedimentary deposit from water of granules which have resulted from the disintegration of older rocks by various kinds of dynamic action, weathering, and erosion. Naturally, therefore, grains of quartz, the hardest essential component of the older rocks, are vastly more abundant in sandstone than all other minerals; indeed, most sandstones are almost entirely made up of particles of quartz. Other minerals, however, occur. Various varieties of feldspar and mica are frequently found, while small amounts of still other minerals are occasionally observed, but there is by no means the variety which characterizes the constitution of granitic and volcanic rocks.

The size of the granules composing sandstone is quite variable, giving rise to the distinction between the fine and coarse grained varieties.

The granules constituting sandstone are usually held together by some cementing material, and the nature of the latter is an all-important consideration bearing upon the strength, durability, and beauty of the stone, and, consequently, upon its value as a structural material. Some sandstones are apparently without this cementing or binding material, and are particularly desirable as abrasive material, although they may also form good building stone.

Lithologically considered, the different kinds of sandstone are classed with reference to the cementing material rather than to the mineralogical nature of the component granules. Argillaceous sandstone is one in which the cementing material is clay, and in cases where the clay has not been subjected to metamorphic action, such stone is subject to disintegration under the influences of weather.

In calcareous sandstone the cementing material is calcium carbonate, and when the latter is present in great excess, the stone is called siliceous limestone. Limestone being readily acted upon by acids, disintegration may easily result from atmospheric agencies.

Ferruginous sandstone is one in which the cementing material consists of oxides of iron, which determine the color of the stone when it is pink, red, brown, or shades intermediate between those named.

Siliceous sandstone is that in which the cementing material is silica, so that the rock consists of almost pure silica. Such stone is usually hard, durable, capable of withstanding great crushing strength, and is not subject to alteration in color, and as a consequence of its extreme hardness it is naturally difficult to work. This kind grades into quartzite, which has been hardened by heat and pressure.

Freestone is a name of popular origin, and is applied to such sandstones as work well in any direction. The terms "arkose," "conglomerate," and "breccia" are names which have special reference to the character of the granules present. Arkose is composed of the constituents of granitic rocks which have been disintegrated and reconsolidated into sandstone, and conglomerate is a sandstone in which the granules are rounded pebbles instead of small grains. When these fragments are angular instead of rounded, it is called breccia.

The terms "quartzose," "feldspathic," and "micaceous" sandstone refer to the presence of the minerals implied by these names.

The commercial names of sandstone are usually found by reference to the places at which they are quarried, as Portland brownstone, Berea grit, etc.

The stone commercially known as bluestone, in so far as it comes from certain sections of the States of New York, New Jersey, and Pennsylvania, is not included here.

The table following shows the relative standing of productive States according to the last census; while eighteen States only were productive in 1880, the number has now reached forty. Ohio is first. According to the eleventh census, Colorado holds third place, while ten years ago it held sixteenth place among the productive States. The vast increase in the sandstone production of this State, namely, from $9,000 to $1,224,098, is due largely to the operations of the Union Pacific Railway Company. This company is not only one of the most extensive producing concerns, but the facilities for shipment which they afford to other large producers account in a great measure for the striking increase in production. Enormous shipments of sandstone are now made from Colorado to remote parts of the United States, and the business is in a most flourishing condition. Another notable change is the appearance of California as a productive State, holding eleventh place.

OUTPUT OF SANDSTONE IN 1889.

1. Ohio	$3,046,656	20. Utah	$48,306
2. Pennsylvania	1,609,159	21. Indiana	43,983
3. Colorado	1,224,098	22. Alabama	43,965
4. Connecticut	920,061	23. Montana	31,648
5. New York	702,419	24. Arkansas	25,074
6. Massachusetts	649,097	25. Illinois	17,896
7. New Jersey	597,309	26. Wyoming	16,760
8. Michigan	246,570	27. Texas	14,651
9. New Mexico	186,804	28. North Carolina	12,000
10. Wisconsin	183,958	29. Virginia	11,500
11. California	175,598	30. Maryland	10,605
12. Missouri	155,557	31. Arizona	9,146
13. Kansas	149,289	32. Oregon	8,424
14. West Virginia	140,687	33. New Hampshire	3,750
15. Minnesota	131,979	34. Tennessee	2,722
16. Kentucky	117,940	35. Idaho	2,490
17. South Dakota	93,570	Other States	26,199
18. Iowa	80,251		
19. Washington	75,936	Total value	$10,816,057

The general purposes to which sandstone is applied are as follows:

FOUNDATIONS, SUPERSTRUCTURES, AND TRIMMINGS.

Solid fronts.	Kiln stone.
Foundations.	Capping.
Cellar walls.	Belting or belt courses.
Underpinning.	Rubble.
Steps.	Ashlar.
Buttresses.	Forts.
Window sills.	Dimension.
Lintels.	Sills.

STREET WORK.

Paving blocks.	Road making: Macadam. Telford. Concrete.
Curbing.	
Flagging.	
Basin heads or catch basin covers.	Sledged stone.
	Crushed stone.
Stepping stones.	

ABRASIVE PURPOSES.

Grindstones.	Shoe rubbers.
Whetstones.	Oilstones.

BRIDGE, DAM, AND RAILROAD WORK.

Bridges.	Capstone.
Culverts.	Rails.
Aqueducts.	Ballast.
Dams.	Approaches.
Wharf stone.	Towers.
Breakwater.	Bank stone.
Jetties.	Parapets.
Piers.	Docks.
Buttresses.	Bridge covering.

MISCELLANEOUS.

Grout.	Cemetery work.
Hitching posts.	Watering troughs.
Fence wall.	Fluxing.
Sand for glass.	Ganister.
Sand for plaster and cement.	Fire brick, silica brick.
Furnace hearths.	Lining for steel converters.
Lining for blast furnaces.	Glass furnaces.
Rolling mill furnaces.	Core sand for foundries.
Adamantine plaster.	Random stock.
Millstones.	

METHODS OF QUARRYING.

The work of quarrying sandstone is greatly facilitated by the ease with which parallel top and bottom beds may be obtained. In most cases good natural beds or partings parallel to the stratifications may be taken advantage of by the quarryman, and the rock is said to be thick-bedded or thin-bedded owing to the thickness of these sheets. The beds in the majority of quarries are horizontal or nearly so, and the object desired is to cut or break the sheets into rectangular blocks through to the bedding planes below. Much of this work was formerly accomplished by gunpowder used in the ordinary way or by heavy charges of powder contained in tin canisters and exploded in specially large drill holes. These processes have been supplanted in the larger quarries by the Knox patent system of blasting rock and by the more extended use of steam channeling machines, such as are used in quarrying marble. The Knox system is particularly efficacious in thick-bedded sandstone, and the channelers are specially serviceable where the sheets are thinner. Vertical joints in the rock are a great aid in quarrying, and where they are numerous channelers are not required, and but little powder is necessary in loosening the blocks.

In some quarries the Knox system is used also in blocking up or subdividing the rock after the initial cuts have been made. Ordinarily, however, the plug and feather method is used, or in a rather soft variety, like the Connecticut brownstone, grooves are cut with pickaxes and the stone is broken by driving iron wedges into the grooves thus formed.

Dyeing Recipes.

Black on 100 *lb. Cotton Knit Cloth.*—First, run cloth for one hour at boil through a bath of 20 lb. logwood extract, 1 lb. soda ash. Second, run for one-half hour through a cold bath of 4 lb. blue vitriol. Third, run for one-half hour through a cold bath of 2 lb. bichromate of potash. Wash and extract. Repeat through the spent baths of logwood extract and blue vitriol, and sadden with 2 lb. copperas. This is a very handsome black on cotton Jersey cloth, and the recipe given above will no doubt engage the attention of many dyers. Great care must be exercised in dyeing black on this class of goods, in order to obtain perfect evenness, and, although this process is long, requiring six operations, evenness as well as fastness of color is secured.

Bluish Magenta on 100 *lb. Wool Yarn.*—Make up dye kettle containing 8 oz. acid magenta, 2 oz. nigrosine, 3 lb. oil of vitriol, 10 lb. Glauber's salt. Enter yarn at 140° F., bring to boiling point while turning, and turn to shade at that heat. The dyer who needs rich purplish reds finds in this recipe and sample an easy and quick method of obtaining them by using acid magenta in combination with nigrosine, either in larger porportions to make bluer or heavier effects, or decreasing it for redder and lighter shades.—*Journal of Fabrics.*

The following is a list of prominent structures built of sandstone in some of the principal cities of the United States:

Locality.	Name of structure and date of erection.	Commercial name of stone.	Locality of quarry.
Albany, New York	All Saints' Cathedral	Potsdam sandstone	Potsdam, New York.
	Cathedral of the Immaculate Conception, 1852.	Brownstone	Portland, Connecticut.
	First Presbyterian Church, 1884		East Longmeadow, Massachusetts.
	Albany Academy, 1815	Nyack sandstone	Nyack, New York.
Albuquerque, New Mexico	Territorial University (wing)		Rio Puerco, New Mexico.
Baltimore, Maryland	First Presbyterian Church		New Brunswick, New Jersey.
	Mount Vernon Methodist Episcopal Church	Berea sandstone	Berea, Ohio.
Boston, Massachusetts	Second Unitarian Church	Red sandstone	Newark, New Jersey.
	New Old South Church	Pudding stone	Roxbury, Massachusetts.
	Tremont Street Methodist Episcopal Church	Pudding stone	Boston, Massachusetts.
	Hotel Brunswick	Buff Amherst sandstone	Amherst, Ohio.
Brooklyn, New York	Saint Ann's Protestant Episcopal Church		——, New Jersey.
	Academy of Design	Brownstone	Portland, Connecticut.
Carson City, Nevada	United States Mint	Sandstone	Canon City, Nevada.
Chicago, Illinois	Union League club house	Brown sandstone	Springfield, Massachusetts.
	Palmer House	Buff Amherst sandstone	Amherst, Massachusetts.
	Public Library	Berea sandstone	Berea, Ohio.
Cincinnati, Ohio	City Hall	Brownstone	Houghton, Wisconsin.
Cleveland, Ohio	Garfield Monument, Lake View cemetery	Berea sandstone	Berea, Ohio.
Colorado Springs, Colorado	First National Bank building	Peachblow sandstone	Peachblow, Colorado.
Columbus, Ohio	United States post office and court house	Berea sandstone	Berea, Ohio.
Denver, Colorado	Arapahoe county court house		Canon City, Colorado.
	Tabor Grand Opera House	Buff Amherst sandstone / Manitou sandstone	Amherst, Ohio. / Manitou, Colorado.
	Barclay block	Coal Creek sandstone	Coal Creek, Colorado.
Dover, Delaware	United States post office and court house	Berea sandstone	Berea, Ohio.
Grand Rapids, Michigan	City Hall	Blue Amherst sandstone	Amherst, Ohio.
Indianapolis, Indiana	Hotel Denison	Berea sandstone	Berea, Ohio.
Lansing, Michigan	State Capitol	Buff Amherst sandstone	Amherst, Ohio.
Leavenworth, Kansas	United States post office and court house	Blue Amherst sandstone	Amherst, Ohio.
Milwaukee, Wisconsin	Chamber of Commerce building	Blue Amherst sandstone	Amherst, Ohio.
Minneapolis, Minnesota	Westminster Presbyterian Church, 1881 to 1883.	Brown sandstone	Fond du Lac, Minnesota.
	United States post office and court house	Blue Amherst sandstone	Amherst, Ohio.
Newark, New Jersey	Old custom house and post office, 1859		Little Falls, New Jersey.
New York City	Columbia College	Red sandstone	Potsdam, New York.
	Trinity Church, 1846		Little Falls, New Jersey.
	United Bank building		East Longmeadow, Massachusetts.
	Broadway Bank building		Portland, Connecticut.
	Collegiate Reformed Church, 1872		Newark, New Jersey.
	Fulton National Bank building		Hummelstown, Pennsylvania.
	Dutch Reformed Church	Berea sandstone	Berea, Ohio.
	College of Surgeons	Buff Amherst sandstone	Amherst, Ohio.
Philadelphia, Pennsylvania	Saint Mark's Protestant Episcopal Church, 1849	Brownstone	Portland, Connecticut.
	Bank of North America, 1850	Brownstone	Portland, Connecticut.
	Young Men's Christian Association building, 1868	Buff Amherst sandstone	Amherst, Ohio.
Providence, Rhode Island	New Catholic Cathedral	Brownstone	Portland, Connecticut.
	Grace Church		Little Falls, New Jersey.
Salt Lake City, Utah	Mormon Tabernacle (piers)	Red sandstone	Red Butte, Utah.
San Francisco, California	Bank of California, 1865	Blue sandstone	Angel Island, California.
Santa Fe, New Mexico	Federal building	Cerrillos sandstone	Los Cerrillos, New Mexico.
Trenton, New Jersey	State Capitol		Trenton, New Jersey.
Washington, District of Columbia.	Smithsonian Institution, 1847 to 1856	Seneca sandstone	Seneca Creek, Maryland.
	United States Capitol, old portion, 1793		Aquia Creek, Virginia.
	Executive Mansion (painted)		Aquia Creek, Virginia.
	Treasury, old portion, 1836 to 1841		Aquia Creek, Virginia.