The Great Railway Tunnel under the St. Clair River, between the United States and Canada.

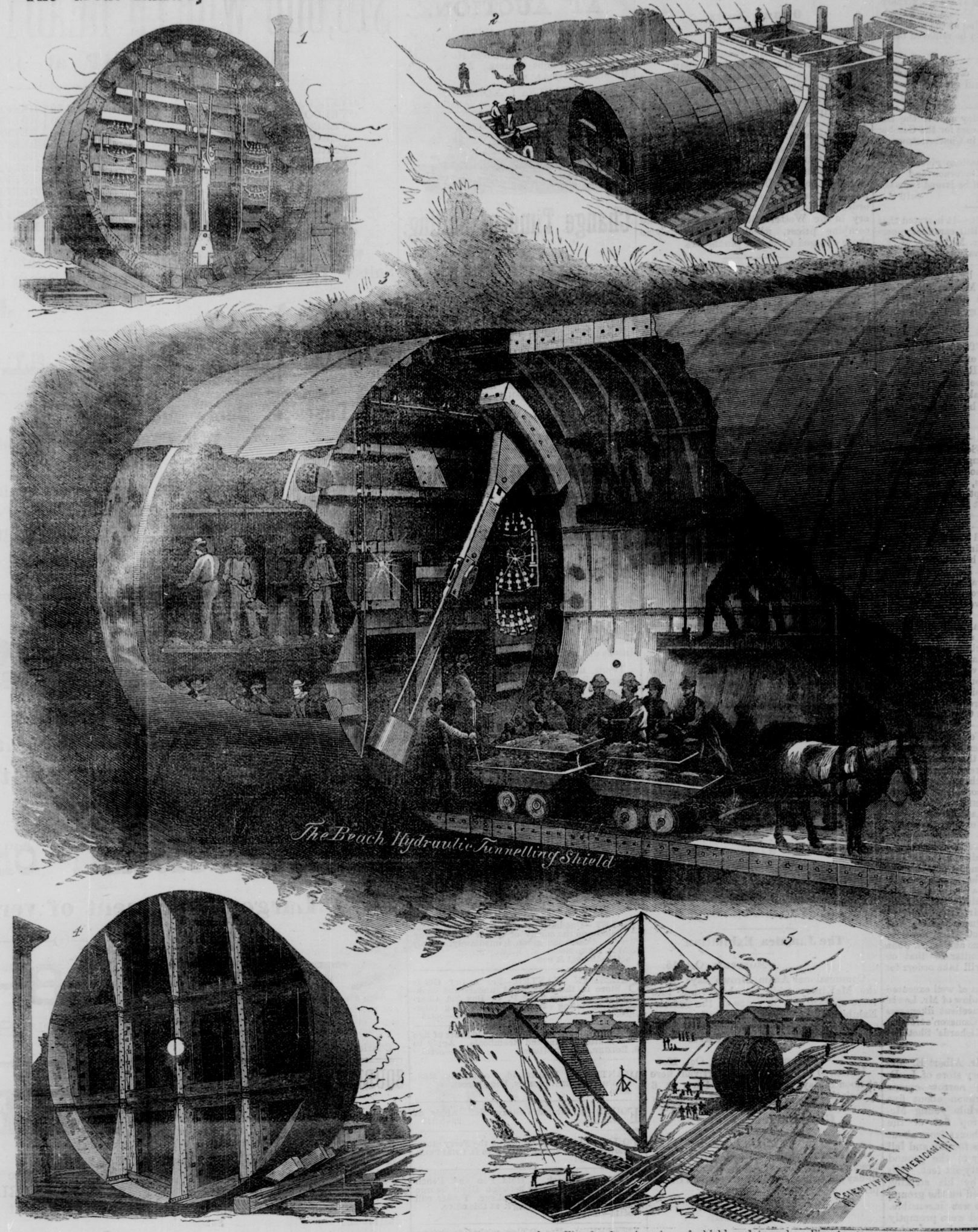

Fig. 1.—Rear view of the shield, showing hood and rams. Fig. 2.—The shield in place on grade. Fig. 3—Interior view of shield and tunnel. Fig. 4.—Front view of shield.
Fig. 5.—Lowering of the shield to the heading.

CONTINUOUS COMMUNICATION

With the Mainland.

CAN IT BE ACCOMPLISHED?

Hints from the St. Clair Tunnel.

HOW IT WAS SUCCESSFULLY DONE.

Some Illustrations.

Two principal objections have been raised against the proposed Tunnel or Subway recommended by Senator Howlan, as a means by which the Dominion Government may fulfil its agreement with Prince Edward Island, and this Province obtain the great boon of "continuous communication with the railway system of the Mainland." The first of these is, "it cannot be done;" the second, "if it can, the cost will be too great." We can now point to the St. Clair Tunnel or Subway, which is now *au fait accompli*, as a proof, beyond the peradventure of a doubt, that it can be done. This tunnel has been made through a strata of brick clay similar to that which lies under the Strait of Northumberland, at a cost less than the estimate, though hundreds of thousands of dollars were paid for experiments with new and untried machinery, applied under conditions of which there was no precedent. Its construction was carried on at a surprising rate of progress; and its prosecution accompanied by fewer casualties than those of any other similar work.

The illustrations in THE EXAMINER today will convey a clear idea of the means by which this great work—the pattern of the greater work to be accomplished under the Strait of Northumberland—was accomplished.

The chief instrument used is known as The Beach Seield.

The mode of operating this boring machine, which has obviously revolutionized the art of river tunneling, is graphically portrayed by the main illustration accompanying this description.

The shield, which is operated simultaneously from each end of the tunneling, consists of a strong cylinder somewhat resembling a huge barrel with both heads removed. The front end of the cylinder is sharpened, so as to have a cutting edge to enter the earth. The rear end of the cylinder, for a length of two feet or so, is made quite thin, and is called the hood. Arranged around the main walls of the cylinder and longitudinal therewith are a series of hydraulic jacks, all operated from a common pump, each jack having cocks whereby it may be cut off from the pump whenever desired.

Within, the shields are vertical and horizontal braces and shelves. When at work the iron plates or the masonry of which the tunnel is composed are first built up within the thin hood of the shield; the hydraulic jacks are then made to press against the end of the tunnel plates or masonry, which has the effect to push the shield ahead into the earth for a distance equal to the length of the pistons of the jacks, say two feet, or not quite the length of the hood; and as the shield advances men employed in the front of the shield dig out and carry back the earth through the shield. By the advance of the shield, the hood, within which the iron or masonry tunnel is built, is drawn partly off from and ahead of the constructed tunnel, thus leaving the hood empty. The pistons of the hydraulic jacks are then shoved back into their cylinders, and a new section of tunnel is built up within the hood, as before described. The shield is then pushed, ahead and so on. The extreme end of the tunnel is always within and covered and protected by the hood. In this manner the earth is rapidly excavated or bored out, and the tunnel built without disturbing the surface of the ground.

Each shield is circular, 21 feet 7 inches in diameter, 16 feet long, and is built of plate steel one inch thick. It is divided into twelve compartments by means of two horizontal and three vertical stays, which are built up to a thickness of two inches. These stays have a knife edge in front, and extend back ten feet, leaving six feet of clear cylinder, into which the end of the tunnel extends. Ten of the compartments are permanently closed and braceingsof angle iron placed across them. The other two are provided with heavy iron doors, which can be closed at once in case of accident or danger. These doors are situated at the bottom in the centre, and through them is passed all the excavated matter. Flush with this heading (with their cylinders extending forward into the compartments) are twenty-four hydraulic rams at equal distances around the shield. These rams are eight inches in diameter, and have a stroke of twenty-four inches.

The first illustration will give a popular understanding of the proportions of the different sections of this tunnel, of the difficulties overcome in its completion, and of the magnitude of the work. From the American cutting to the river's edge is 1,800 feet; from the Canadian cutting 1,950 feet; under the river 2,300 feet. The subterranean approaches are on the Canadian side 13,000 feet, on the Michigan side 9,000 feet. For the tunnel proper 2,196,400 feet of soil have been excavated. The cast iron lining has required 55,962,500 pounds. There have been used in securing this lining 859,242 bolts.

The walls of the tunnel are formed of thirteen cast-iron segments and a key. These segments are cast with thirty-two holes in them, twelve in each side flange and four in each end. The inside diameter of the tunnel is twenty feet. The idea of substituting these segments for brickwork was suggested by Mr. Joseph Hobson, of Hamilton, Ont., the chief engineer of the St. Clair Tunnel Company, and also chief engineer of the Great Western division of the Grand Trunk Railway.

The tunnel will drain itself of the surface water entering by the approaches into an intercepting tunnel or vertical shaft 112 feet in depth, extending to bed rock, which is reached at that point. This well will be cleared by the highest pumping engine of its kind in existence, which Henry R. Worthington, of New York City, is now erecting. It will be over one hundred feet in height. The pump of the engine will be on the bottom of the tunnel, while the cylinders will be on the level of the ground.

The lower third of the tube is being lined with brick and cement to prevent deterioration of the casing by the brine that leaks from meat cars. One railway track will be planked on both sides. The ties will be of iron, conforming in their curve to the bottom of the tunnel.

Coke engines will be used for motive power, in order to avoid as much as possible gas and smoke. An electric light station will be maintained on the Port Huron side, and the tunnel will be at all times as light as day.

As soon as the present tunnel is in running order another alongside of it will be begun, using the same machinery, with the exception of the shells of the pairof shields, which it was impossible to remove.

It is little more than one year since the tunnel proper was begun, the steel shields having been lowered down inclines into the cuttings in August, 1889. Work on the cuttings, however, was begun in January, 1889.

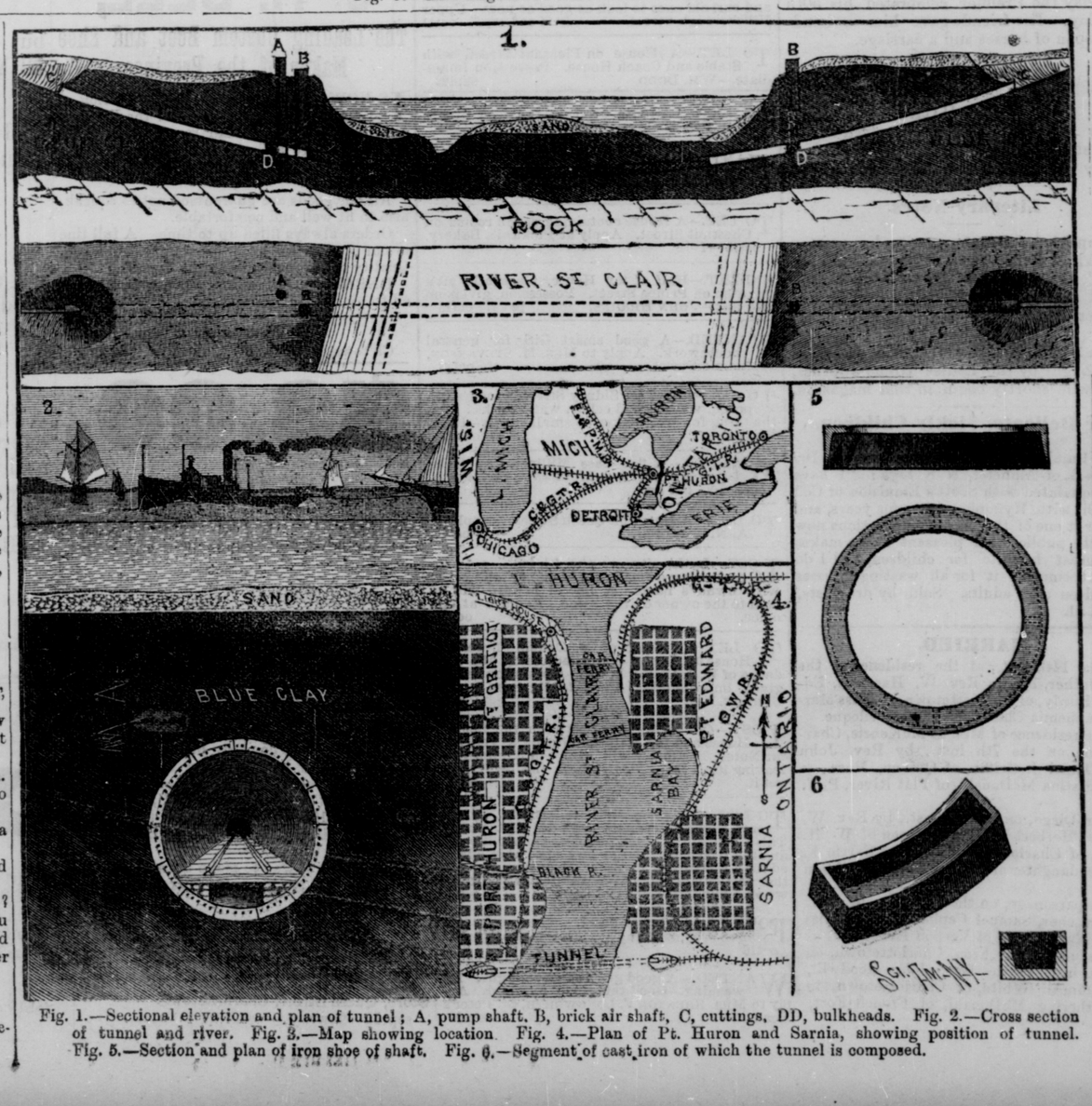

Fig. 1.—Sectional elevation and plan of tunnel; A, pump shaft. B, brick air shaft, C, cuttings, DD, bulkheads. Fig. 2.—Cross section of tunnel and river. Fig. 3.—Map showing location. Fig. 4.—Plan of Pt. Huron and Sarnia, showing position of tunnel. Fig. 5.—Section and plan of iron shoe of shaft. Fig. 6.—Segment of cast iron of which the tunnel is composed.

Freeing His Mind.

"I believe I'll sit down," said Stanton, "and give that man a piece of my mind."

"Do so," said Lincoln; "write him now while you have it on your mind. Make it sharp; cut him all up."

Stanton did not need a second invitation. It was a bone-cruncher which he read to the President.

"That's right," said Abe; "that's a good one."

"Whom can I get to send it by?" mused the secretary.

"Send it?" replied Lincoln; "send it? Why, don't send it at all. Tear it up. You have freed your mind on the subject, and that is all that is necessary. You never want to send such letters; I never do."

A Paste That Will Stick Anything.

A paste which will stick anything is said by Prof. Winchell to be made as follows: Take two ounces of clear gum arabic, one and a half ounces of fine starch, and half an ounce of white sugar. Dissolve the gum arabic in as much water as the laundress would use for the quantity of starch indicated. Mix the starch and sugar with the mucilage. Then cook the mixture in a vessel suspended in boiling water until the starch becomes clear. The cement should be as thick as tar, and kept so. It can be kept from spoiling by the addition of camphor or a little oil of cloves.

To cure a felon, says a correspondent, mix equal parts of strong ammonia and water, and hold your finger in it for fifteen minutes. After that withdraw it and tie a piece of cloth completely saturated with the mixture around the felon and keep it there till dry.