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THE MANCHESTER SHIP CANAL.

We devote considerable space in our present number to illustrations of this remarkable enterprise, which justly ranks among the great engineering works of modern times.

The bird's eye view of the canal and the adjacent country through which it passes will give a fair idea of its locality and the difficulties which were encountered in its realization. We are indebted to *The Graphic*, London, for our bird's eye view and to *Black and White* for the other illustrations and many of the following particulars:

The cost, after various careful estimates, was origi-

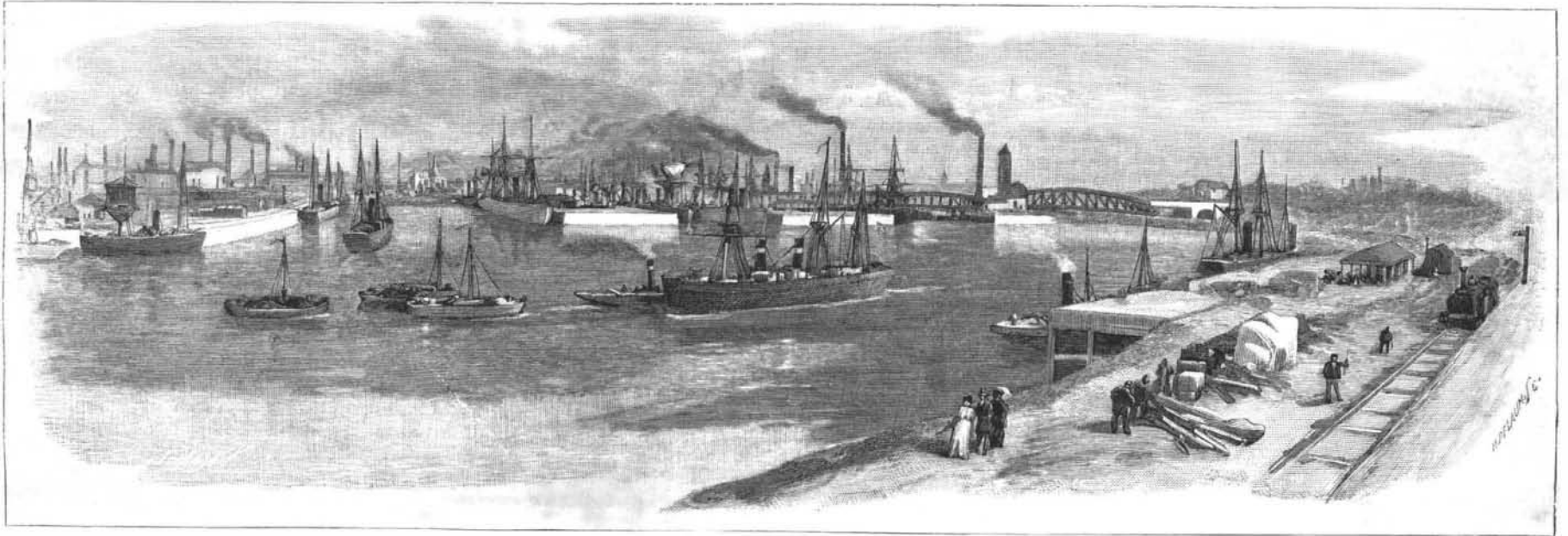
nally fixed at fifty millions of dollars—\$50,000,000; but the construction has actually required \$75,000,000. The work is now practically completed and was thrown open to the trade of the world on January 1, 1894.

The first turf was cut by Lord Egerton in 1887, and a little less than seven years have been occupied in the construction.

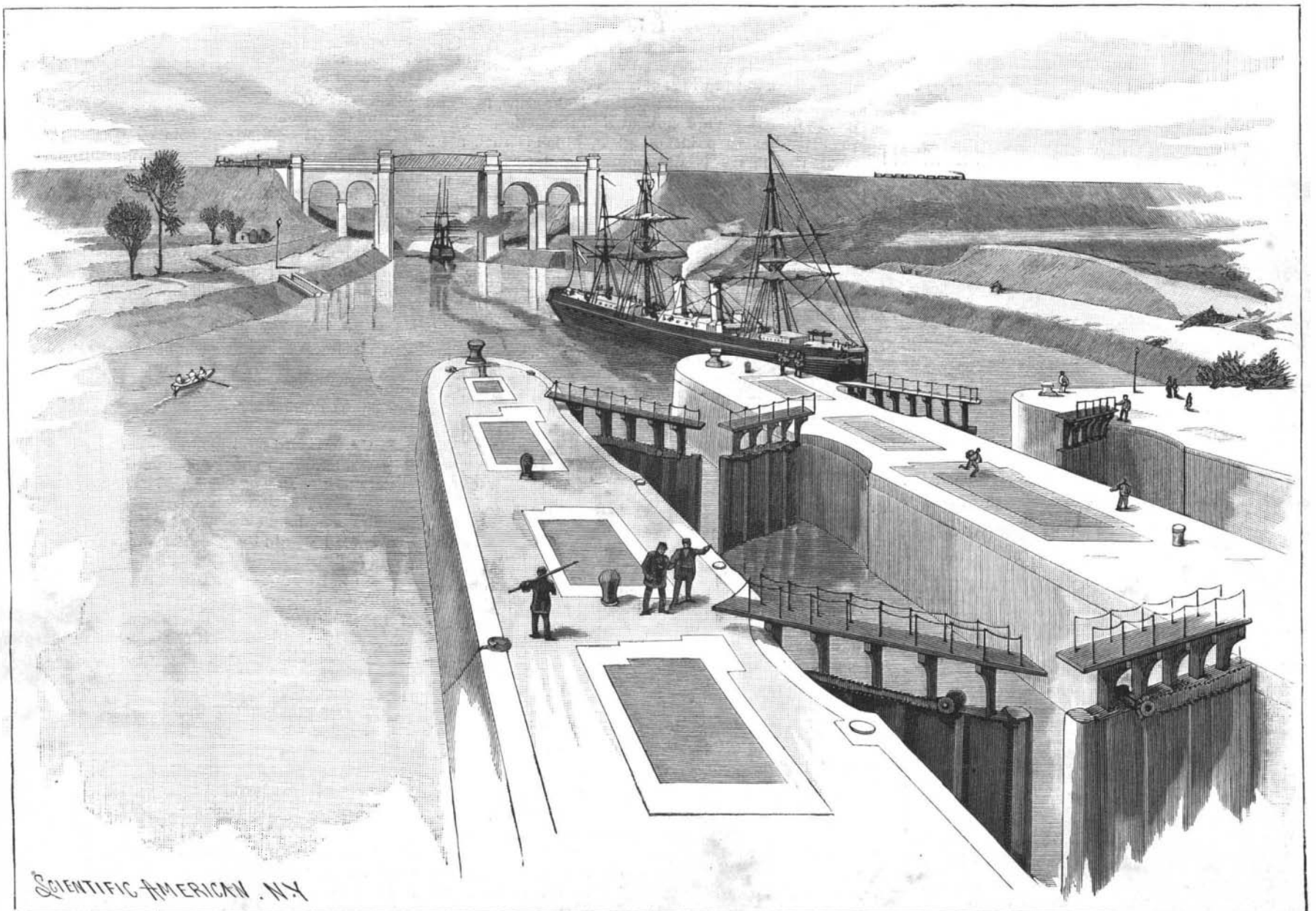
The Manchester ship canal is 35½ miles in length and will have a minimum depth of 26 feet. The minimum width at the bottom is 120 feet, and the average width at water level is 172 feet, so that two large vessels could easily pass each other on the way. All bridges that are not swing bridges have a clear head-

way of 75 feet, so that the largest vessels may easily pass up and down. The canal emerges from the Mersey estuary at Eastham, and in its course to Manchester rises 71½ feet. To accomplish this there are five sets of locks. (Our illustrations, we should mention, are from photographs by Mr. H. Garside, of Manchester.) As far as Runcorn the canal skirts the estuary of the Mersey, a distance of about fifteen miles in a direct line; thence it strikes inland and the nature of the work becomes more that of canal engineering proper, while in the lower reach it more resembles harbor work, consisting largely of sea wall.

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THE MANCHESTER SHIP CANAL—THE NEW DOCKS AT MANCHESTER.



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THE MANCHESTER SHIP CANAL—THE LOCKS AND RAILWAY VIADUCT AT IRLAM.

THE MANCHESTER SHIP CANAL.

(Continued from first page.)

Above Warburton the canal absorbs the river altogether, that is to say, it follows the course of the river bed. For a distance of 20 miles beyond Latchford, at which point are situated the first locks above the entrance locks, the canal will be semi-tidal, in order that the "scour" of the tide in the lower part of the Mersey estuary may not be diminished. This is accomplished by openings in the wall dividing the canal from the estuary which admit all tides rising over 14 feet above the Liverpool datum. Just above Eastham locks the canal is broadened sufficiently to allow ships to lie for passing. The small rivers along the estuarial part of the course are carried under the ship canal by inverted siphons, an interesting piece of engineering, into the details of which space forbids us to enter. The river Weaver, which is one of the most important pieces of river navigation in the kingdom, also necessitated some very difficult engineering.

There are five sets of locks on the direct line of the canal, and fine, massive structures they are. Those at Eastham, which may be taken as typical, consist of three locks placed side by side. The largest is 80 feet wide and 600 feet long, the center lock is 50 feet wide and 350 feet between the gates, and the smallest lock is 30 feet wide and 150 feet long. Stormgates protect the lower end of the locks, and prevent the lock gates proper being forced open by water or wind. The lock gates, which in common with the sluices will be worked by hydraulic machinery, are worthy of special notice, as they are remarkable pieces of work. They are made of greenheart timber, clamped and fastened with steel, each leaf containing no less than 180 tons of timber, the steel work bringing the total weight of the leaf to 210 tons. The gates are 5 feet thick in the middle and 45 feet 5 inches high.

The locks are capacious enough for nearly the largest ocean-going steamers, and when the tide rises 14 feet over the old dock sill at Liverpool the water flows

another fine bridge of the cantilever type. The arms are respectively 140 feet and 98 feet long, it measures 25 feet wide inside the girders, and the swinging weight is about 700 tons. The diversion of the Bridgewater Canal is another remarkably interesting piece of engineering. The canal crosses the Irwell at Barton upon the aqueduct which was considered such a triumph of engineering skill when it was built a century ago. The level of the Bridgewater Canal is some feet above that of the Manchester Ship Canal, and as it is impossible either to lower the former to the level of the latter, or to raise it some seventy feet, Mr. Leader Wil-

end, has been built to the Bridgewater Canal. The vessels are floated into this, the gates are shut, and the whole thing is lowered by hydraulic machinery to the level of the Ship Canal, into which the vessels are then floated. By the reverse process vessels can be lifted from the Ship Canal into the Bridgewater Canal. The dock work, not only at the terminus at Manchester, but along the route, is very extensive, and includes large docks at Warrington, Salford, and a coal basin at Irlam.

Works and jetties are being rapidly constructed along the banks, and it is not difficult to imagine, as Mr. E. Leader Williams (engineer-in-chief) aptly pointed out, that before many years have passed the canal will be practically converted into one long dock.

The Bridgewater Canal is carried over the ship canal by means of a steel aqueduct 235 feet long, 6 feet deep, and 19 feet wide, and weighing 1,900 tons. It swings on its pivot as quickly and as easily as could be imagined.

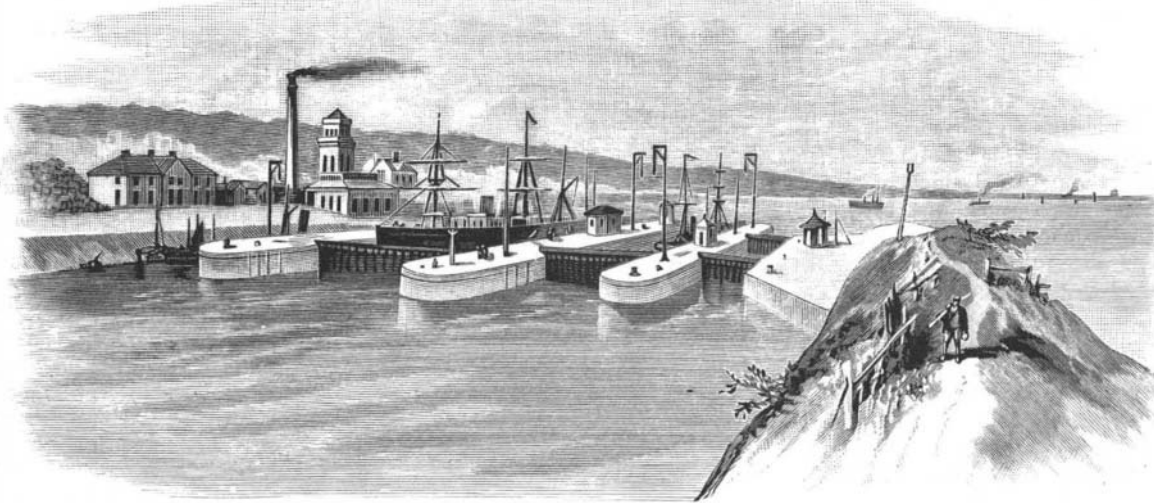
The Salford docks, which, like those of Manchester, are fitted up with every appliance for the speedy loading and unloading of vessels, have 71 acres of water space, divided into three immense arms, 1,350 feet, 1,177 feet, and 828 feet long and 225 feet wide.

The Manchester docks have been built on the site of the old Pomona Gardens. These docks have a water space of 33½ acres, have four arms, one 620 feet long, and three 571 feet long, and the Ordsall dock opposite is 980 feet by 750 feet.

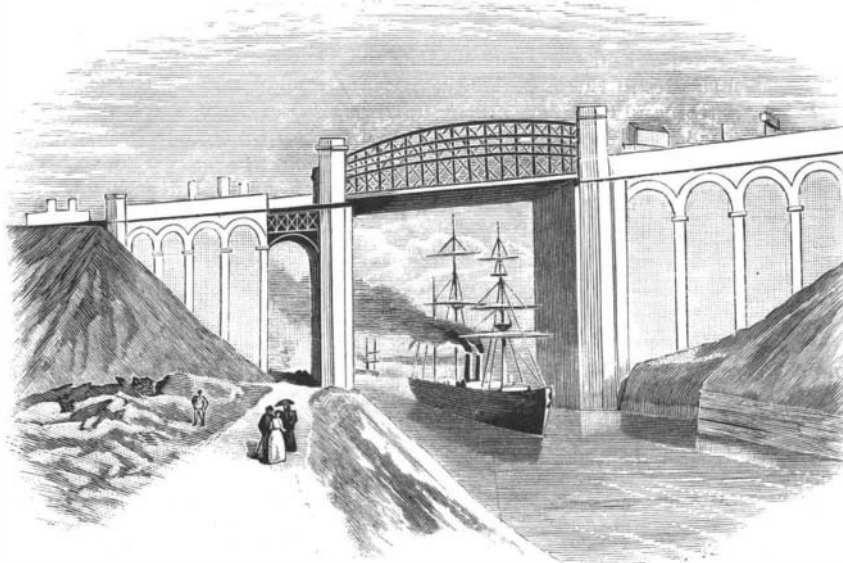
The late Mr. Daniel Adamson, it is now generally conceded, was the originator of the present scheme for the building of the great canal. The chief engineer of the work was Mr. E. Leader Williams. The enterprise was financed and supported by many of the leading merchants and men of enterprise in Manchester.

How to Cover Pulleys with Paper.

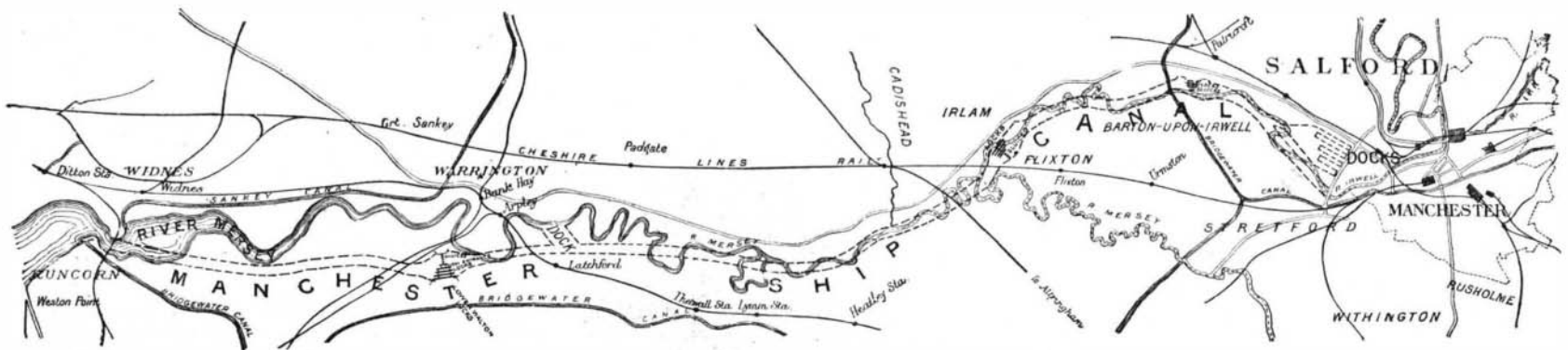
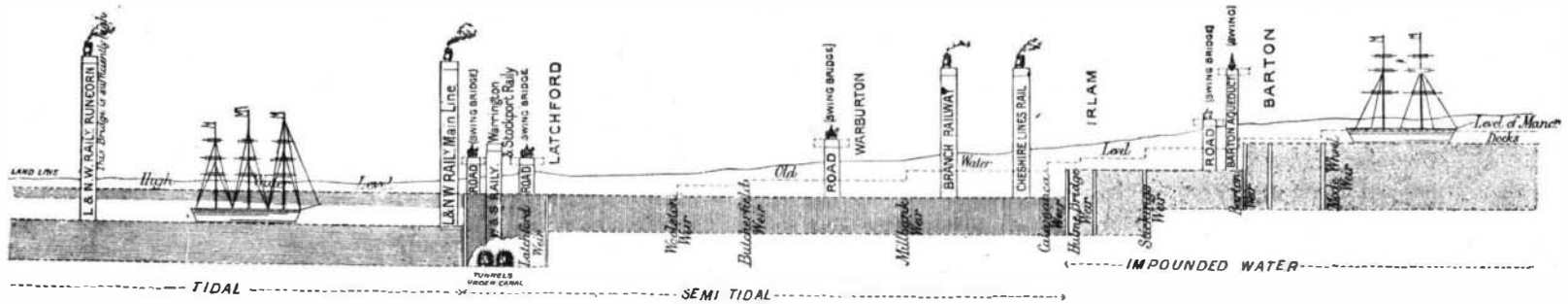
Paper pulp of the ordinary kind is made into sheets about one-half inch thick. The sheets are cut up into strips, each strip being the width of a pulley, probably six inches. Of course, there are



THE MANCHESTER SHIP CANAL—EASTHAM LOCKS AT THE ENTRANCE OF THE CANAL.



THE ACTON GRANGE VIADUCT OVER THE MANCHESTER SHIP CANAL.



THE MANCHESTER SHIP CANAL.

in as far as Latchford locks, a distance of twenty-one miles.

The railway diversions are a very important part of the work; indeed, the four viaducts in themselves constitute an engineering enterprise of considerable magnitude, as it is necessary to run a long distance inland with the work to get a gradient when the line has to be raised 75 feet. Where it was impracticable to raise the line to give headroom for large vessels, swing bridges have been built, and this is no child's play. The swing bridge at Old Trafford is the heaviest of its kind ever constructed. The Moore Lane bridge is

Williams adopted the bold idea of building a swing aqueduct. The work was rendered still more difficult by the fact that the Bridgewater Canal crosses diagonally, thus introducing the complication of a "skew" aqueduct. The Ship Canal is widened at this point to make room for the center pier upon which the aqueduct pivots. The swinging aqueduct is not the only complication at this part of the Ship Canal. It was very desirable to have communication between the Bridgewater Canal and the Ship Canal, and this is accomplished in the following curious manner: A kind of siding, or backwater, with water-tight gates at either

pulleys of all widths, but the experiments have been tried with six inch pulleys. Next the precise diameter of the pulley is obtained, and the strip of paper board, which is yet not thoroughly dry and so is pliable, is cut off about four inches longer than that. Now comes a little delicate work. With a sharp, broad-bladed knife one end of the board is opened like a V and the other is shaved down to fit into it.

ROME was supplied from twenty-four large aqueducts, which brought 50,000,000 cubic feet of water daily into the city.

The Private Palace Car.

It costs about \$50 a day, says the *Philadelphia Times*, to hire a completely furnished and palatial dwelling house on wheels, containing seventeen beds. In front is an "observation room." Next come two drawing rooms, both fairly spacious. Behind these is a dining room twelve feet long. The middle part of the car is occupied by berths, which are comfortable sofas during the day. In the rear are a good-sized kitchen, a china closet, a pantry, a bathroom and a cold storage closet. All linen for table and beds, tableware, crockery and every other necessary are supplied. Three servants are provided, also without extra charge—a skilled cook, a waiter and a porter, who are under the orders of the tenant. Heating and lighting are thrown in. After ten days the rental is somewhat less per diem.

Thus luxuriously housed, the occupant can travel wherever he wishes all over the continent by paying the railways eighteen fares for transportation. However, if more than eighteen passengers are carried in the car, so many extra fares must be paid. He can stop at whatever points he desires and have his car side-tracked.

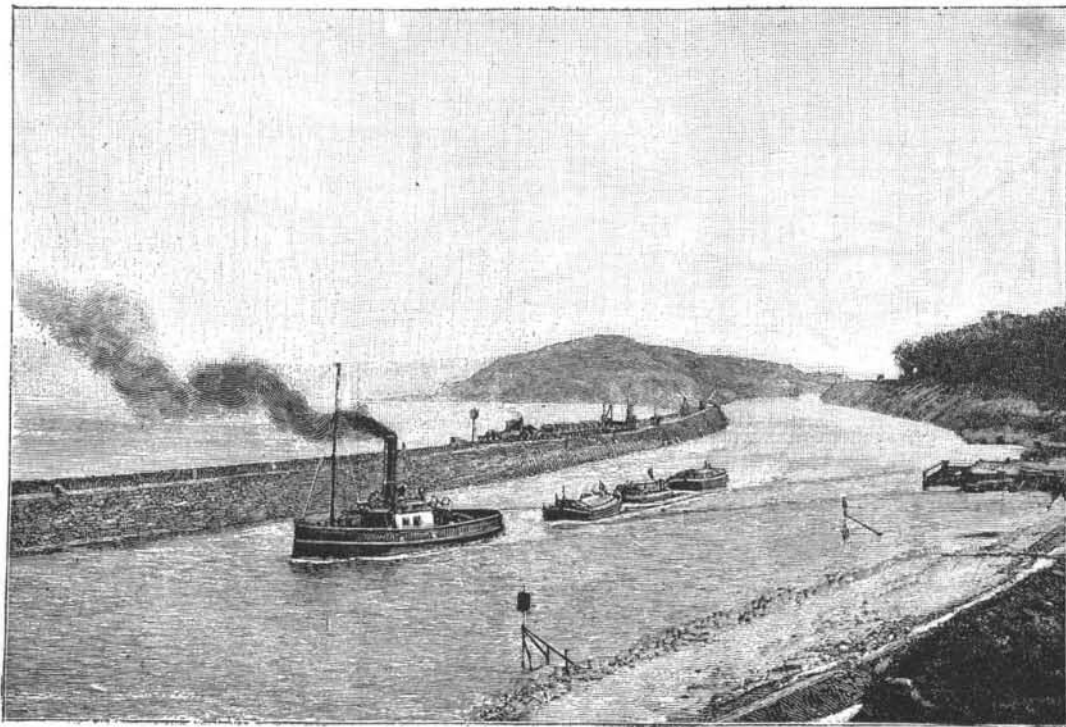
If he chooses he can bring along his own servants, linen, tableware and wines. He is at liberty to furnish the commissariat himself, or the company will supply everything in that way for him, charging only 15 per cent over and above cost and rendering to him the bills. The latter is by far the better plan, inasmuch as trouble is saved and affairs are attended to more satisfactorily by the company.

The cook is always a capable person, and, having a time schedule for a journey across the continent, he will telegraph ahead to various points for such luxuries as may be obtainable at the markets in different cities, thus arranging for fresh fruits, butter and eggs, and even for a newly cut bouquet to be put on the table.

All this is susceptible of variation. One can engage

Dining cars are usually owned by the railways and are managed by the palace car companies. Ordinarily they are run at a considerable loss, being attached to trains merely as an attraction to passengers. The ex-

cause many dishes have to be prepared at once and without delay. The head cook gets \$75 and the other three are paid respectively \$55, \$40 and \$30 a month. The five waiters get merely nominal wages, depending



VIEW OF CANAL NEAR EASTHAM.

pendence of conducting them is enormous. To begin with, there are ten servants attached to each car. There is a steward, who has full charge—superintends every-

chiefly upon tips for remuneration. For food the expenditure varies from \$1,000 to \$1,500 a month for each car.

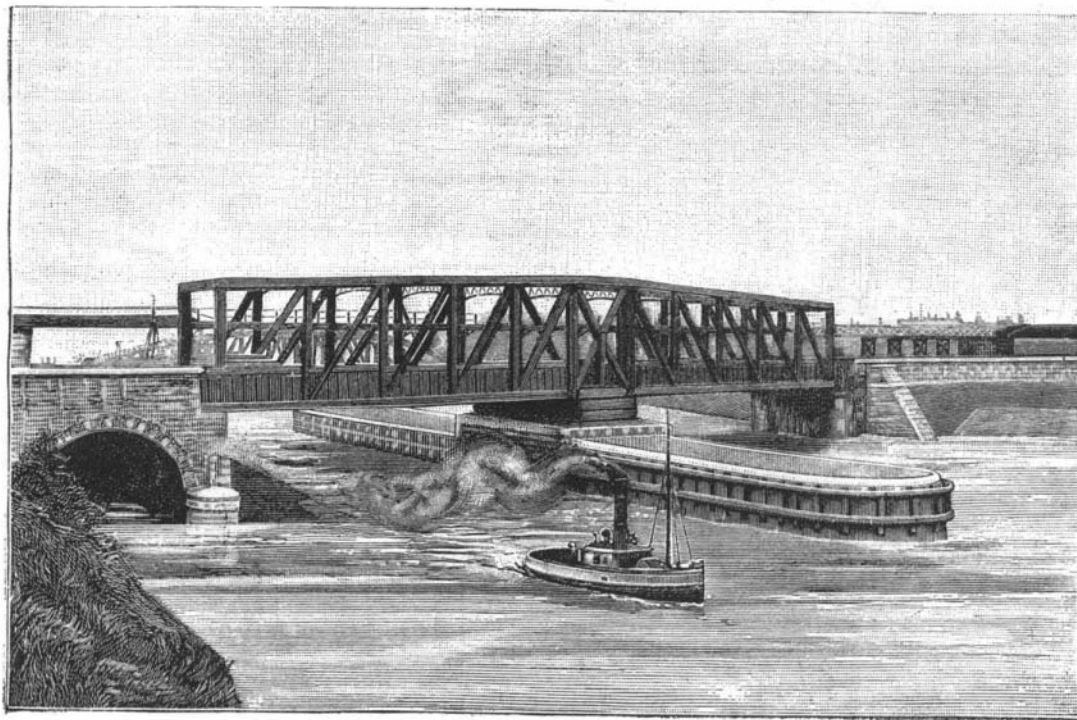
In different cities all over the country there are dealers from whom the company regularly buys provisions. The steward attends to this, paying cash always and rendering the receipted bills to his employers. At principal points, however, the company has salaried buyers, who supply the cars at starting, so that the stock of provisions need only be supplemented by the steward with perishable articles and in case that anything runs short. These buyers go to market every morning at 4 o'clock.

They select whatever is best, just as the steward for a hotel would do, purchasing at a considerable discount from regular prices. Each car has a kitchen like a hotel kitchen in miniature; also a pantry, a cold storage closet, a closet filled with wines and various liquors and an ice cream locker. Beneath is an ice box for meats which will hold 700 pounds.

According to the regulations, the steward is personally responsible for all dishes prepared. He must see to it that they are properly cooked and neatly garnished before serving. No chipped dish is to be used under any circumstances, nor any piece of table linen with a hole in it. In short, everything must be managed as in a first class hotel. As a rule, the meals provided on dining cars are better than can be got for the same prices at stationary restaurants. The charge for dinner is \$1, and 75 cents for breakfast or supper.

On the basis of expenditure above given, it costs from \$16,000 to \$22,000 a year to run a dining car merely for food and wages, to which must be added wear and tear on the property and many incidentals besides. Thus it is not surprising that the business is a losing one.

Arrangements made between the palace car companies and the railways regarding sleeping cars vary very



BARTON SWING AQUEDUCT AS SEEN FROM THE CANAL.

an ordinary sleeping car for \$40, a sleeping car with buffet for \$45, or dining and observation car combined for \$40. A hunting car, provided with kennels for dogs, racks for guns, fishing tackle, etc., costs only \$35 a day. Service and all incidentals are thrown in.

But one can do better than this if he has plenty of money to spare. He can hire a complete traveling hotel for \$210 a day, in the shape of an entire train, consisting of four sleeping cars, a dining car and a "buffet smoker." An observation car may be added at an expense of \$40 more. The buffet smoker represents in some respects the highest development of the modern parlor car. It includes a bar, a barber shop, a bathroom and a library, wherein can be found books, writing materials and the newest magazines and pictorial and daily papers.

In short, it is a small club on wheels. There is no other country in the world where luxury in traveling is so highly appreciated as it is in the United States. Abroad it is said that the only people who go by rail "first class" are the nobility and the Americans. Of course, the person who charters a whole train must pay the railways for transportation at least eighteen fares per car, though west of the Mississippi the minimum rate is usually fifteen fares. No car can be rented for the prices above given for less than three days.

It has recently become the fashion for actresses to travel in private cars. Nowadays a conspicuous star usually insists on being provided with such a conveyance as part of the contract for a tour which she signs with her manager. Bernhardt always carries a small managerie with her, which could not very well be accommodated in a public vehicle. Theatrical companies very commonly hire cars while traveling.

thing, looks after the comfort of the guests, takes in the money for meals and makes reports to the company. He receives \$100 a month. There are four cooks, be-



THE MANCHESTER SHIP CANAL—BARTON SWING AQUEDUCT, CARRYING THE OLD BRIDGEWATER CANAL ACROSS THE SHIP CANAL.

much. Sometimes the latter pay as much as two or three cents a mile for the use of each sleeper, where, as is particularly apt to be the case in the South, the passenger traffic is not sufficient to pay the car companies. In such cases a railroad is often obliged to provide the necessary convenience at a loss to itself. The item of washing is a very costly one in the running of sleeping cars, as no piece of linen is ever used twice without going to the laundry.

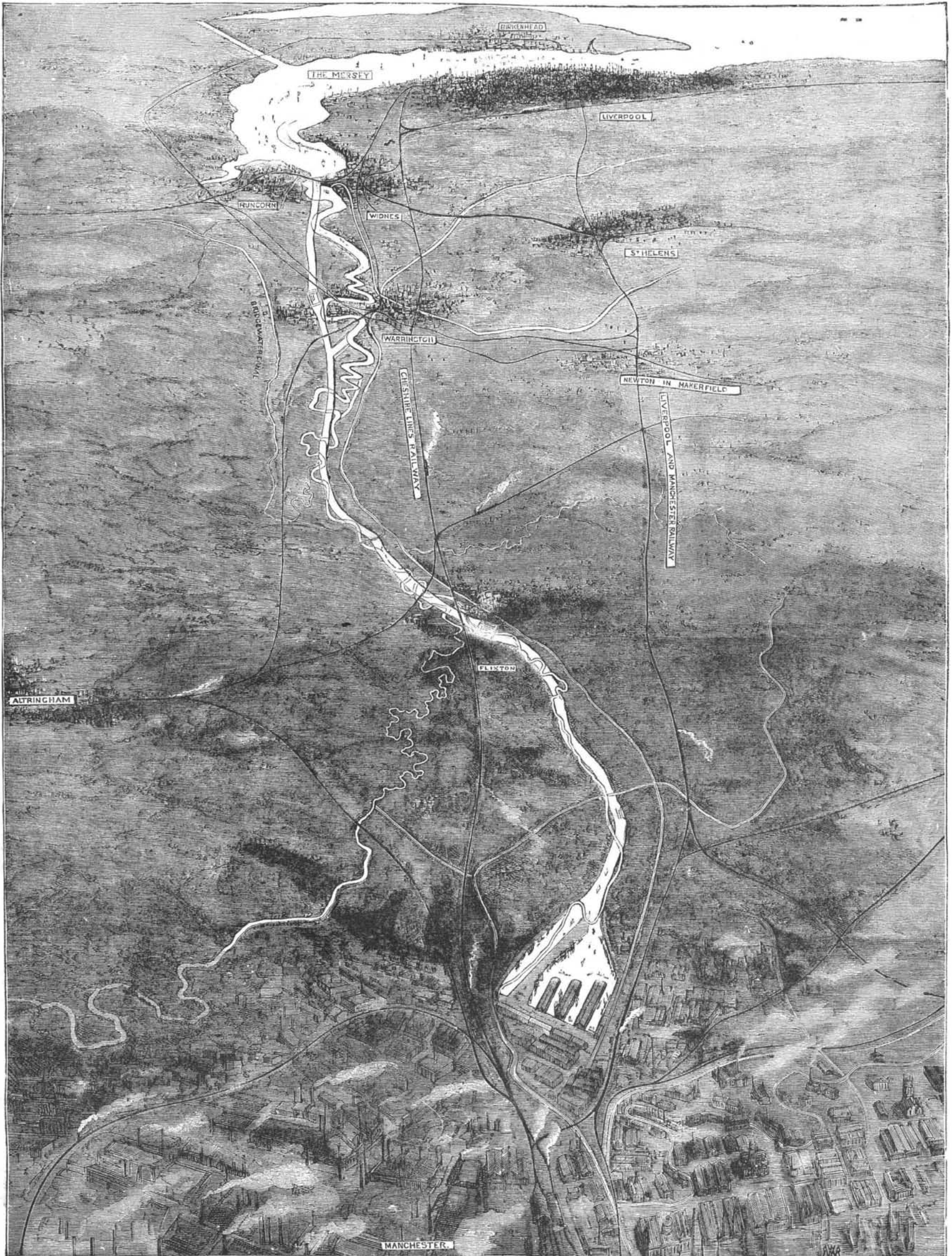
A sleeper, on leaving New York for Chicago or St. Louis, receives a "stock" of 120 linen sheets, 120 pillow slips and 120 towels. This gives change for two nights. Fifteen or twenty clean towels are always kept on the

washstand. The washing is done in New York, Boston, Buffalo, Chicago, St. Louis and other cities, being given out in great quantities at the low rate of \$1 per hundred pieces. An equipment of linen lasts about one year, at the end of which it must be renewed. It is purchased by wholesale, \$50,000 worth at a time.

A Peculiar Accident.

A peculiar accident occurred at the Mt. Tacoma Manufacturing Company's mill in Tacoma on the morning of February 6, which is reported in the *West Coast Lumberman* as follows: Charles E. Tuttle, a

logger in the employ of the mill, was directed to split a large cedar log lying upon the carriage, as it was too large for the saw. Tuttle stood on top of the log and drove a number of wedges into it, when the log suddenly parted and the unfortunate man in endeavoring to get out of the danger, slipped and fell into the opening between the halves. Before he could escape the pieces closed in upon him, leaving only his head outside. A number of workmen saw the accident, and the unconscious man was released by prying the log apart. At first it was thought that he had suffered internal injuries, but after a few days of rest he was able to resume work again.



THE MANCHESTER SHIP CANAL—BIRD'S EYE VIEW.