SCIENTIFIC AMERICAN

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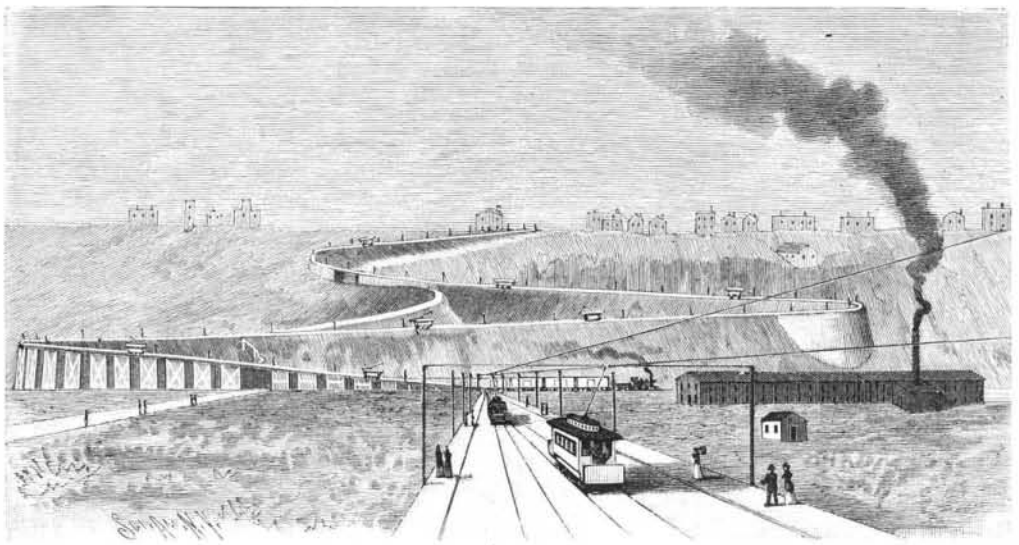
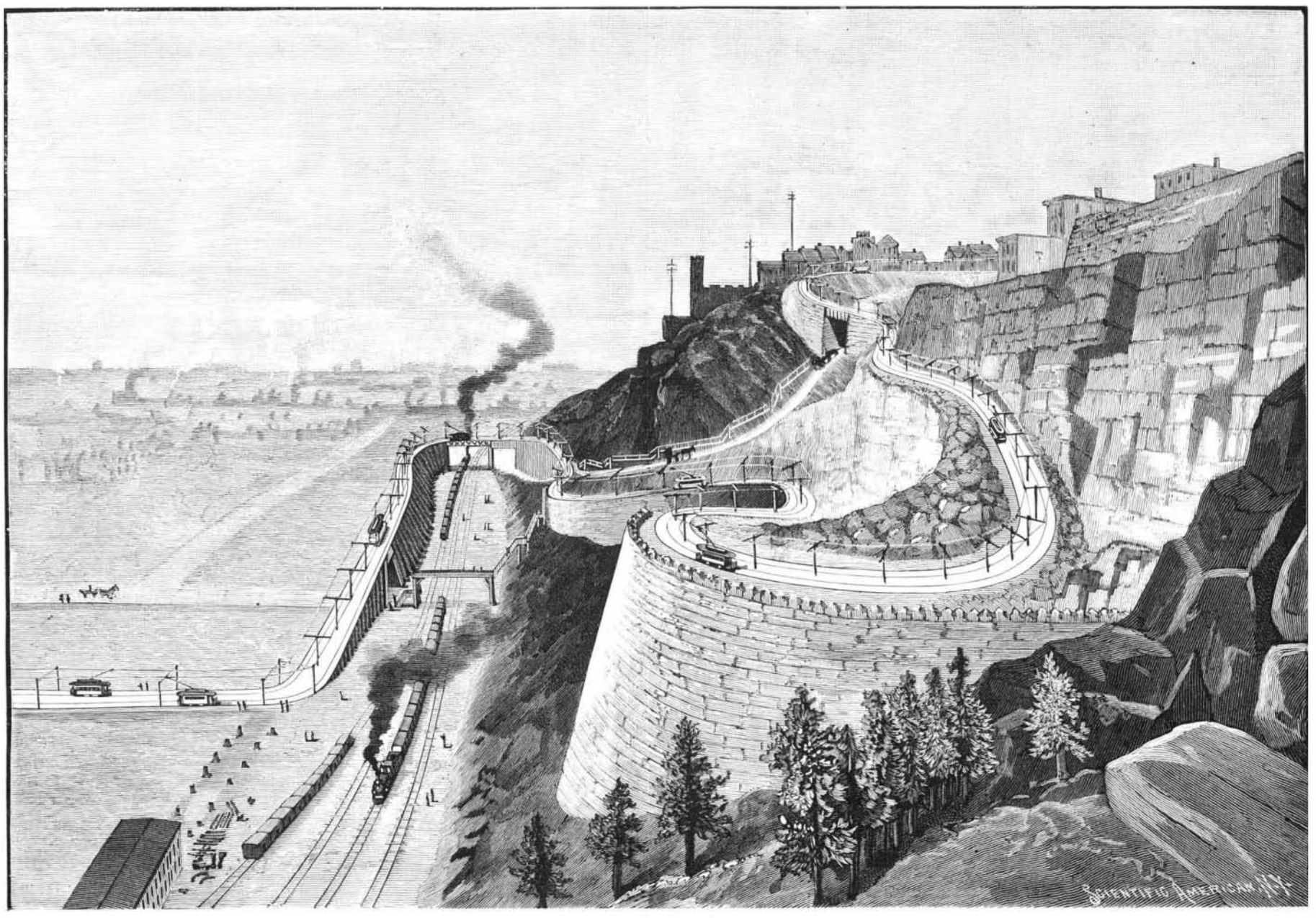
THE HILLSIDE LINE OF THE NORTH HUDSON COUNTY RAILWAY COMPANY.

The North Hudson County Railway Company is a corporation owning a number of miles of surface and elevated railroads in Hudson County, New Jersey, which extend in their operations from Jersey City to the northern line of the county. This part of the country is characterized by the beginning of the hill which eventually forms the basis of the Palisades. Between the river and the foot of the elevated ground is a large area of flat land. The North Hudson County Railway Company has to provide transportation from the ferries on the river side to the top of the hill, involving a rise in some cases of nearly 200 feet. There are three means of access to the hill top—one from Hoboken Ferry by elevated road operated by trolley; and another at the terminus of the West Shore ferries by elevator and elevated road. We illustrate in our present issue a third structure, by which the summit of the hill is reached by a trolley line, known as the Hillside Electric Road. The map and the two views show the general construction and line of the road, and its extreme picturesqueness, in addition to its engineering interest, will be obvious features not at all exaggerated in our illustration. The portion of the road which we illustrate commences at Madison Avenue and Fifteenth Street, at West Hoboken, a point nearly opposite Fifteenth Street in this city, and includes the interesting part, as from the ferry to this corner it is an ordinary surface trolley road. Here the ascent begins. By two loops it climbs the hill to Palisade Avenue, the horizontal distance in a straight line between these two points being 700 feet. By constructing the loops as shown a line 3,688 feet long is developed for the ascent of 160 feet. The rise begins with a wooden trestle running nearly parallel with and to the east of the railroad tracks of the New York, Lake Erie and Western Railroad and of the New Jersey Central Railroad, the cars as they ascend going almost directly south. A couple of blocks below is a curve of 90 degrees, with a radius of 75 feet, crossing the tracks of the railroads just mentioned on an iron truss. Going around another



GENERAL VIEW FROM FIFTEENTH STREET.

MAP.



VIEW LOOKING SOUTH.

THE HILLSIDE LOOPS OF THE NORTH HUDSON COUNTY RAILWAY COMPANY.

curve of similar radius and of 93° 58′, the road curves along the face of the hill, gradually rising and crossing the Hillside wagon road, which course on the ascent is now in a general direction to the north, until at an elevation of 110 ft. it enters the northern loop, and with a radius of 60 ft. goes around a curve of 215° 16′. The course is now to the southwest, and, still climbing the hill, the line crosses near the 140 foot contour line for a second time the Hillside wagon road, and going through an arc of 100° 32′ with 100 ft. radius, it reaches its destination 160 feet above its commencement and connects with the rest of the system.

The road is built in the most substantial manner, parts being cut out of the face of the hill, other parts being filled and substantial retaining walls being applied when necessary. One of the latter is 70 feet high. Stone ballasting is used throughout, the material of the hillside supplying the best possible material, trap rock, for these purposes. The railroad tracks are crossed by a 92 foot lattice girder, the most considerable bridge on the line. Fifty-six pound steel rails are used for the cars to run on, and these rails are re-enforced with 32 pound guard rails laid close to them and inside. The cost of the work was $120,000 for the structural part alone. It was built by Mr. Miles Tierney as contractor, with Mr. C. B. Brush as chief engineer. The surfacing and finishing of the road is done under the immediate direction of Mr. Wm. H. Starr, formerly of the Erie Railroad, who is now general manager of the road and in charge of its operation. Mr. Tierney is now president of the North Hudson County Railway Company.

The power for the Hillside line is supplied by a 14,000 h. p. compound Corliss engine in the power station of the Hudson Electric Company.

The route involves maximum grades of 51½ per cent, and on the curves a grade of 1½ per cent is not exceeded. The road is reached by the Fourteenth Street Ferry, directly from this city. On reaching the top of the hill the passenger is put in communication at once, by means of the other lines of the company, with all of the elevated area beginning at Jersey City Heights on the south and ending with Guttenburg on the north. The North Hudson County Railway Company operates about fifty miles of road, including twenty-four miles of horse railroad, nineteen miles of trolley and seven miles of steam railroad. A very complete system of interchanging makes the entire area accessible. The road carries about 17,000,000 passengers per annum.

The Consumption of Artificial Manures.

An estimate has been made in the *Journal* of the American Chemical Society of the world's annual consumption of these fertilizers, which is put at a total of 5,500,000 tons, made up of the following items:

	Tons.
United States	1,550,000
Germany	1,300,000
France	1,000,000
Great Britain	1,000,000
Belgium and Holland	300,000
Scandinavia	100,000
Spain, Italy, and Austria	250,000

These figures are, necessarily perhaps, only approximate, but with regard to the one million tons estimated for this country, it is discoverable from another source that the quantity of manures imported into the United Kingdom in the three years ended 1891 averaged 600,000 tons annually, so that a considerable quantity for home consumption must have been supplied within the kingdom itself, in the shape of waste from gas works and chemical manufactures. Among commercial manures would be included guanos, nitrate of soda, sulphate of ammonia, potash salts, basic slag, and other mineral phosphates, together with additional sources of phosphatic fertilizers.

A hope has long been cherished by English wheat growers that as the necessity for applying manures to North American lands becomes more pressing, the cost of wheat growing will have a prohibitive influence upon the export of the bread cereal to this country. Apart from the possibility that before such a time arrives the wheat-exporting capacity of Argentina, and even of South Africa, will have greatly developed, it will nevertheless surprise many people to learn that in the United States the consumption of artificial manures is already half as large again as it is in the United Kingdom. On the other hand, there cannot be much doubt that the quantity of farmyard manure put upon the land is, in an ordinary year, much less in the United States than in this country. It appears that the consumption of commercial manures has grown very rapidly in the last twenty years in the Atlantic, and especially in the South Atlantic States. Their use, moreover, is steadily on the increase in the Central and Gulf States, and they are gradually passing into consumption in the less remote and more thickly populated of the Western States.—*Chem. Tr. Journal.*

What Becomes of All the Lumber.

It is estimated that, of the general lumber product, 35 per cent goes into building, 45 per cent into railroads and miscellaneous uses, and 20 per cent into boxes.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 955.

For the Week Ending April 21, 1894.

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THE UTILIZATION OF THE WASTE ENERGY OF THE WORLD.

The solicitude displayed by the individuals of the human race of one generation for those of subsequent generations is a very variable quantity. Many who claim great enlightenment profess to regard the lot of the twentieth or the twenty-first century man with considerable solicitude, fearing that the consumption of accumulated stores of terrestrial energy by the present generation will result in leaving to our successors a very impoverished globe indeed for their habitation. It is assumed that a day will come when the wealth of fuel accumulated in preceding geological eras, and consolidated into usable shape by the metamorphoses of ages, will be exhausted, and mankind will be without fuel. By the best geologists this is regarded as no fancy sketch. Coal is not forming, the natural growth of wood is quite insufficient to supply the demand for fuel, and the coal mines will eventually be emptied.

Curiously enough, a parallel occurrence is now going on before us. But a few years ago the natural gas industry took great dimensions. The almost uncontrollable flow of gas from gas wells was the basis for the most extensive operations; gas and steel furnaces in the industrial world, street lamps, house service, both for fuel and illumination, were supplied by natural gas, and the entire gas region became the scene of a prodigality on nature's part never equaled in impressiveness. The general assumption was that the future might take care of itself; hardly a thought was given to economizing the supply, and it now appears as if that future has come upon us, for, in accordance with the predictions of one of our most eminent geologists, the end seems in sight. Natural gas in a very few years will be virtually a thing of the past.

It is an open question how long after the extensive application of the steam engine economy of fuel began to be considered. Certain it is that a comparatively early type of engine to-day is in use as one of the most economical. The Cornish engine has some very fine examples in the most modern practice. The early steamships were almost failures on account of their coal consumption, and steamship constructors, having a double inducement to save fuel, both to get rid of a non-paying cargo and to save coal bills, have done their utmost to effect economy. Hydraulic engineers have taken a professional pride in reducing coal consumption, the "duties" of the great pumping engines of the country being quoted far and wide.

Good work has been done, the steam engine being gradually brought, perhaps, as near perfection as its inherent defects will permit. But simultaneously with this the horse power of the world's engines is increasing, and coal is being burned in greater and greater quantities. It seems clear that natural sources of energy must in the near future assume a greater importance than they have hitherto. Electricity, whose powers are as apt to be overestimated by the public as underestimated by the professional world, will be an important factor in this. The operations at Niagara Falls will be an illustration of a return to the principles of olden times, with appliances of the day. For it is a striking fact that our forefathers utilized the powers of nature to a vastly greater scale proportionately than we do. The horse power hours of wind energy utilized by windmills and sailing vessels was proportionately great for the era before steam; to-day the aggregate is very large, but the proportional amount compared with steam is small. The farmers throughout the country a hundred years ago took their grain to grist mills driven generally by water power, sometimes by wind power. Modern improvement has replaced those sources of energy by steam—the future generation may yet have to return to them.

The amount of energy as far as we are concerned absolutely wasted in wind and tidal motions and in evaporation by the sun exceeds the imagination of man. Suppose a waterway such as Long Island Sound to be white with the sails of vessels. Each one utilizes a portion of the energy of the wind which its sails intercept. But remembering how high the wind prism may be, and comparing the sail area with the probable cross sectional area of the prism in question, the absolute insignificance of the proportion used in driving a fleet of ships may be realized.

The wind expends some of its energy in producing waves, which, besides making a sea voyage a misery to many, and besides foundering many a ship in open water, absolutely impede the progress of a vessel. But when we see these waves rising and lowering successively, wave after wave, a six or eight thousand ton mass, making it uselessly roll and pitch, the waste of energy exhibited by a million square miles of stormy water exceeds computation. The same applies to the tides. If the power of the tons of water that rise and fall forty to sixty feet in the Bay of Fundy could be utilized and distributed, it would replace a vast quantity of steam energy.

Electricity is often spoken of as a possible method of heating, but the fact is overlooked that the energy in almost all cases is originally produced at an enormous waste by the steam engine. But were it produced by natural causes, then this objection would disappear,