bell of the regulator will rise, thus opening the blow-off valve, *B*, and permitting the surplus air to escape. When the various burners are shut off, the machine stops, but renews its operation automatically whenever gas is desired.

In the illustration the various parts of the apparatus have been disposed in a single room; but in practice they can be so distributed and arranged as to meet the conditions of the building in which they are placed.

The amount of steam used is trifling, as there is no large body of air or naphtha to be heated, but a very small amount of naphtha at any one time requires to be volatilized in the converter.

The inventors of this apparatus claim that the gas produced is of absolutely unvarying quality, and is supplied in accordance with the amount required by the burners. The demand may be very large or very small; the service may be constant or intermittent; but the apparatus will always conform with the requirements of the consumer.

They also claim that this apparatus does as well on the last gill of naphtha as when there is a full tank supply, and that the combination of air and naphtha is such as to insure against condensation. They claim further that the naphtha is kept underground with no pressure upon it whatever and is withdrawn and conveyed to the converter through a very small pipe. The apparatus has been favorably passed upon by the insurance authorities, and is allowed to be installed in city premises even having no yard space.

The inventors state that the fuel gas made by the apparatus produces an intense and extremely cheap illumination with incandescent burners, and is designed for lighting small towns, hotels, institutions, etc., and for fuel purposes for factories, etc.

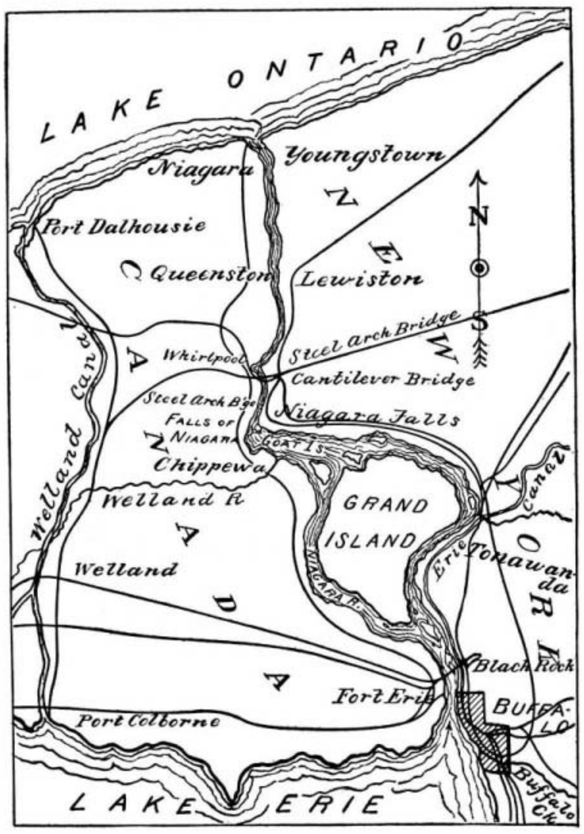
The manufacturers have other modifications of the apparatus adapting it to be operated by water service.

## NIAGARA AS AN INDUSTRIAL CENTER.

At the foot of the main thoroughfare in the town of Niagara, at a point on the edge of the gorge about midway between the American Falls and the new steel bridge, is shown the spot where the first white man (so says tradition) obtained a view of the majestic falls of Niagara. That was more than two centuries ago, and Father Hennepin was so impressed with what he saw that in his book "Louisiana," published in 1683, he gave the height of the falls as being over three times as great as it actually is, putting it down as 500 feet. In 1697 he wrote his quaint work, "New Discovery," in which he gives the following oft-quoted description: "Betwixt the Lakes Ontario and Erie, there is a vast and prodigious cadence of water, which falls down after a surprising and astonishing manner, insomuch that the universe does not afford its parallel." So profound is the impression of magnitude upon the mind of the worthy father, that in a later description he adds yet another 100 feet to his former estimate, making the total height of the falls 600 feet! Its actual height is 167 feet. Father Hennepin was the first of a host of word-painters who have attempted to portray this surpassing sight—and failed. Niagara must be seen and heard; moreover, its appeal to the spectators will be as infinitely diverse as there are diverse temperaments in the multitudes of pilgrims that gather yearly at its banks from the four corners of the earth.

The present series of articles will be devoted to a description of the topographical and engineering features which are included in and suggested by the term Niagara: the river, the fall, the gorge with its overarching bridges, and the scenic railways which line its crest and follow the shore line at its base, and above all the unprecedented hydraulic and electric works by which the outflowing drainage of our great inland seas is being subjected to the service of a growing industrial city.

By reference to the accompanying map, it will be seen that the Niagara Falls are situated on the river of that name and about midway between Lake Erie and Lake Ontario. The river, which is 33 miles in length, flows in a general northerly direction, and in that distance it has a total fall of 326 feet, almost the whole of which occurs in the last 17 miles of its course. It forms the channel by which the whole of the drainage of the four great lakes, Superior, Michigan, Huron and Erie, flows into Lake Ontario; and as the total drainage area is 90,000 square miles and the total flow 275,000 cubic feet per second, it can be understood that Niagara is a truly imposing river. The interruption to navigation presented by the falls and rapids has been overcome by two notable canals. On the Canadian side, the Welland Canal has been cut in a northerly direction from Port Colborne on Lake Erie to Port Dalhousie on Lake Ontario (see map), and communication with tide water on the American side is maintained by the Erie Canal, which extends from Buffalo, at the entrance to the Niagara River, to Cohoes, on the Hudson River.

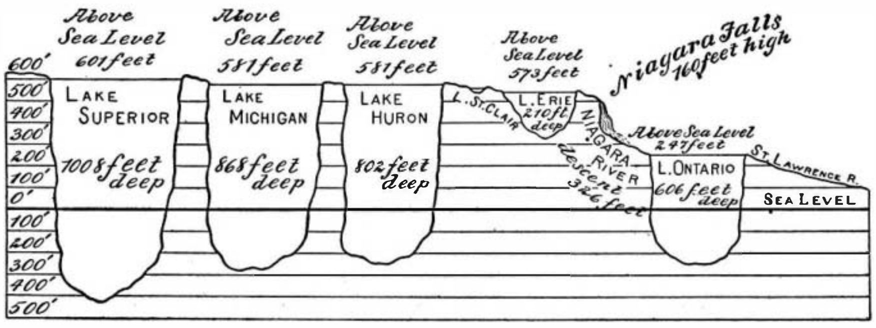



MAP SHOWING THE COURSE OF THE NIAGARA RIVER.

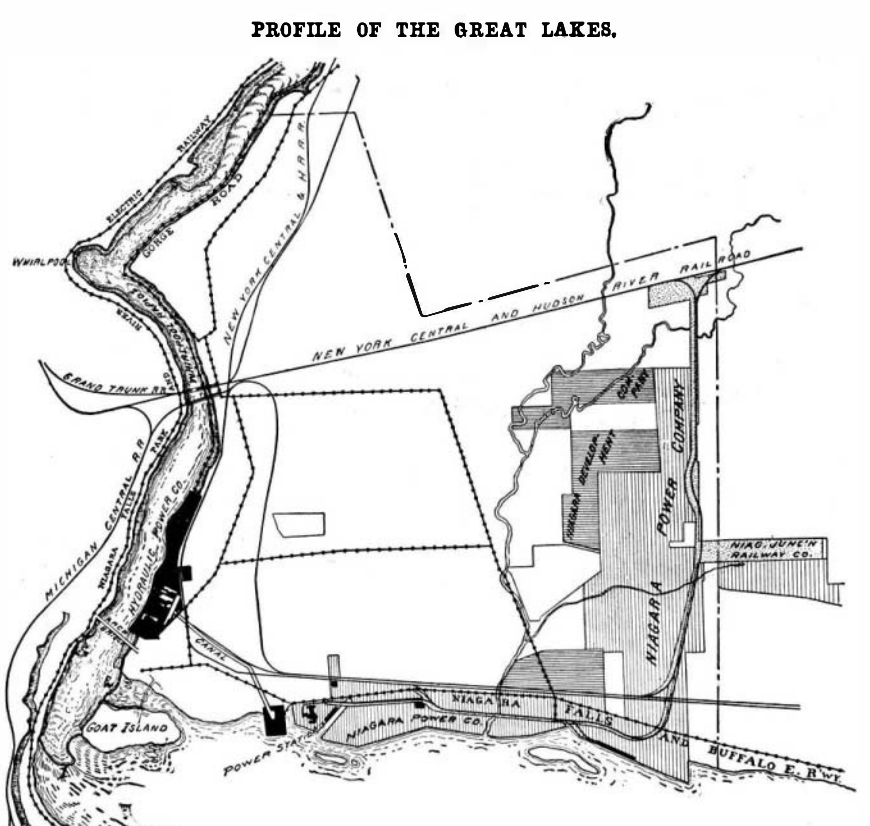
After leaving Lake Erie, the river flows somewhat swiftly for the first two miles, and then, with a slackening and widening current, divides to pass on either side of Grand Island (see map), below which it widens to its fullest breadth of 2½ to 3 miles, and flows sluggishly among numerous low-lying islands that make it look more like a lake than a river. Here the general course of the river is westerly, and it gradually narrows as it approaches the upper rapids, which extend about a mile above the falls. At this point the river enters the field of the bird's eye view embraced in our first page engraving. The total fall of the rapids is 52 feet, and, as the extreme width of the river is here 4,750 feet, the swift rush of the expanse of troubled water over its rocky bed forms a fitting introduction to the majestic falls below. About half a mile from the brink of the gorge the river is divided by Goat Island into two unequal streams, the one on the American side comparatively shallow and narrow, discharging over the precipice in what is known as the American Falls, while the major portion of the river swings around to the north and discharges over a crest of a general horseshoe form, from which it takes its name.

The American Falls are 1,060 feet in width, with an estimated maximum depth at the crest of 8 feet, and a vertical fall of 167 feet. The Horseshoe or Canadian Falls have a total width of 3,010 feet, a maximum estimated depth of 20 feet, and the vertical height is 158 feet. It is a singular fact that the amount of water which passes over the falls is practically constant, and what variations there are, are not caused by rainfall, snow, or changes of temperature, but are dependent upon the prevailing winds, which, if they blow strongly and alternately from certain opposite quarters, back up and then release the waters of Lake Erie and greatly increase the depth of the water at the falls for the time being. The normal flow, according to the gagings of the United States engineers, is 275,000 cubic feet per second, or about half a million tons per minute. The total fall available for power purposes from the commencement of the upper rapids, where the power companies have their intakes, to the river immediately below the falls is 216 feet, and this shows the theoretical horse power of the falls to be about 6,750,000. If we include the additional fall of 100 feet from the foot of the falls to Lewiston, 8 miles below, we find that the theoretical possibilities of Niagara must be put down at 10,000,000 horse power.

There is no great depth of water underneath the American Falls, indications being that its bed is full of massive and broken rock; but the enormous mass of water (estimated at from four-fifths to nine-tenths of the whole) that thunders over the Horseshoe Falls with a depth at the center of 20 feet, has excavated a basin and channel that is fully as deep as the falls themselves. The river maintains this depth, from shore to shore, for a mile and a half or more below the falls, shallowing gradually as it approaches the cantilever bridge of the Michigan Central Railroad. The enlarged cross section of the channel has the result of slackening the stream, so that it flows very sluggishly through this part of its course, so much so that small row-boats do not hesitate to cross from shore to shore. At the new steel arch railway bridge the river begins to fall with great rapidity over an extremely rocky and uneven bed, the fall extending for about a mile. As the gorge at this point narrows considerably, the confined waters rush down tumultuously at an estimated speed of 30 miles an hour, and the effect, as one stands at the bottom of the gorge and close to the edge of the mighty torrent, is even more inspiring than that of the falls themselves. The 10,000,000 horse power, the 30,000,000 tons per hour, and other figures of Niagara seem very conservative when one is standing on the edge of the Whirlpool Rapids.




PROFILE OF THE GREAT LAKES.




THE INDUSTRIAL DEVELOPMENT OF NIAGARA FALLS.

At the foot of the rapids is the Whirlpool, where the river takes a sudden turn of about 90 degrees to the right. The onslaught of the river against the opposing cliffs, assisted by a natural depression, has worn out a vast circular basin into which the waters of the rapids rush, and form the celebrated Whirlpool. From the Whirlpool the river flows through a broadening and less precipitous channel, until it passes between the picturesque towns of Lewiston and Queenston, to broaden into a wide channel for the rest of its journey to Lake Ontario. The fall in this last seven miles of the river is about half a foot to the mile.

By studying our front page view of Niagara, our readers will see that the river appears to have cut its way back from Lewiston through an elevated and generally level country, and this impression is confirmed by a study of the actual locality. Coming up the river from Lake Ontario, one notices that the surrounding country is low and fairly level, but at Lewiston there is a lofty and somewhat precipitous escarpment or bluff, the ground rising to a height of 374 feet above the lake level. This high level is maintained with slight undulations up to the falls. The indications are that the latter were originally located at Lewiston and Queenston, and have, in the course of ages, cut their way back to their present position. The depth from the crest of the gorge to the river varies from 200 to 300 feet, and its width from 1,500 feet at the falls to 220 feet at the lower end of the Whirlpool rapids.

In subsequent articles we shall deal with the engineering and industrial features of Niagara Falls, and it will be sufficient at this time to briefly indicate these features as shown on the accompanying bird's eye view of the river and its environs. The depth and turbulence of the river have necessitated some costly and difficult bridge work. About a quarter of a mile below the American Falls is the Niagara Falls and Clifton arch bridge, built last year to replace the suspension bridge which for many years was a familiar feature of the landscape. This is the longest arch bridge in existence (868 feet span), and to our thinking is the most beautiful of its kind in the world. A mile and a half below we come to the cantilever bridge which carries the tracks of the Michigan Central Railroad, and forms a link in the great trunk system of the New York Central Railroad between New York and the West. Closely adjoining it is the new steel arch bridge completed last year, replacing the old railroad suspension bridge on the same site. It carries the tracks of the Grand Trunk Railroad, and so forms a link in the route of the Canadian Pacific system. A few miles further down the river the new Lewiston and Queenston suspension bridge is in course of erection; and when completed it will form an important element in an electric belt line which will extend the full length of the gorge on either side, crossing it to the north at Lewiston and to the south by way of the Niagara Falls and Clifton bridge already referred to. Fuller details and illustrations of these bridges will be given in a subsequent issue.

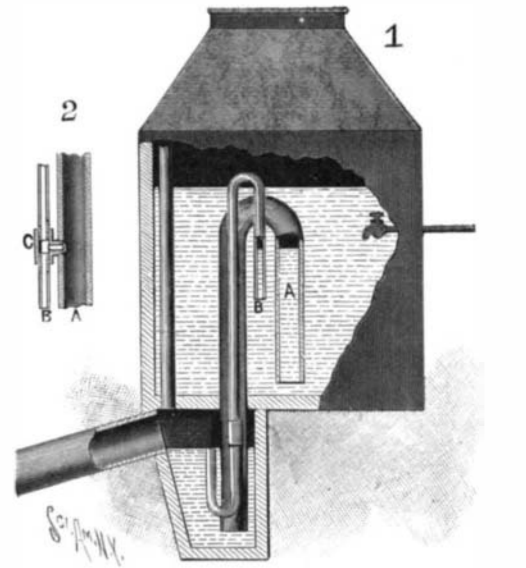
Ever since the year 1725, when a small sawmill was erected at the falls, their vast store of energy has appealed to the mechanical instincts of man and invited his co-operation; but it is only of late years that any serious attempt has been made to utilize this energy on a large scale. By far the largest modern plant is that of the Niagara Falls Power Company, whose canal and power house is situated about a mile above the American Falls, and therefore above the upper rapids, as shown in our front page engraving. The water is led in from the river by a canal which is 12 feet deep by 180 feet long, and of sufficient capacity to deliver water for the generation of 100,000 horse power. At the side of the canal is a huge wheel pit, 30 feet wide by 200 feet long and 180 feet deep. Water is led from the canal to the bottom of the pit by eight steel penstocks, each 8 feet in diameter, and at the base of each penstock is a 5,500 horse power vertical turbine. Each main shaft carries at its upper end, within the power house, a 5,000 horse power generator, the total capacity of the plant, as now established, being 40,000 horse power. Provision is made within the pit for two more turbines, the total proposed capacity of this house being 50,000 horse power. Another power house of equal capacity is shortly to be built on the opposite side of the canal, and the company has franchises which will allow it to erect a 250,000 horse power plant on the Canadian side when it is prepared to do so. The tail race of the present power house is carried through a tunnel 7,000 feet in length, which was driven from the bottom of the wheel pit in a straight line beneath the town of Niagara Falls to an outlet at the base of the cliffs just below the abutments of the upper arch bridge. The outlet is marked on the bird's eye view on the front page. The Niagara Falls Paper Company, whose works adjoin the power house of the Niagara Falls Power Company, utilize 7,200 hydraulic horse power, taking the water from the canal and discharging into the tunnel.

Next in importance is the Niagara Falls Hydraulic Power Company. It owns a canal, shown on our engraving, which leaves the river at a point above the rapids and 2,000 feet below the canal of the Niagara Power Company, and runs through the town to a basin situated near the edge of the gorge and a quarter of a mile below the upper bridge. Here it is led by two penstocks, one 8 feet and the other 11 feet in diameter, to a power house 200 feet below at the edge of the river, where its energy is developed in a series of horizontal turbines. The present installation represents a capacity of 10,500 horse power, and this is to be increased shortly to 20,000 horse power. By extending the terminal basin northward along the cliffs, enlarging the canal and building another power house at the river level, below the present small users of the canal water, it is proposed to develop 100,000 horse power. The franchise allows the company to develop 125,000 horse power from the river.

The canal, which was built in 1858, also supplies a number of industrial works which utilize only a part of the available head of 210 feet. Most of the turbines operate under a head of from 60 to 100 feet, and about 7,500 horse power is developed in this way. The tail race discharge is through a tunnel or through an open cut in the face of the cliff.

On the Canadian side, the Niagara Falls Park and River Railway has a power house opposite the Horseshoe Falls in which are two turbines working under a 68 foot head, with a combined capacity of 2,000 horse power.

Including then all the various users of the Niagara River waters for power purposes, we find that at the present writing, of the total theoretical horse power of 7,500,000, less than 50,000 horse power is being actually developed and turned to useful account. The contracts already made by the two great power companies call for an increase upon this of about 60 per cent.



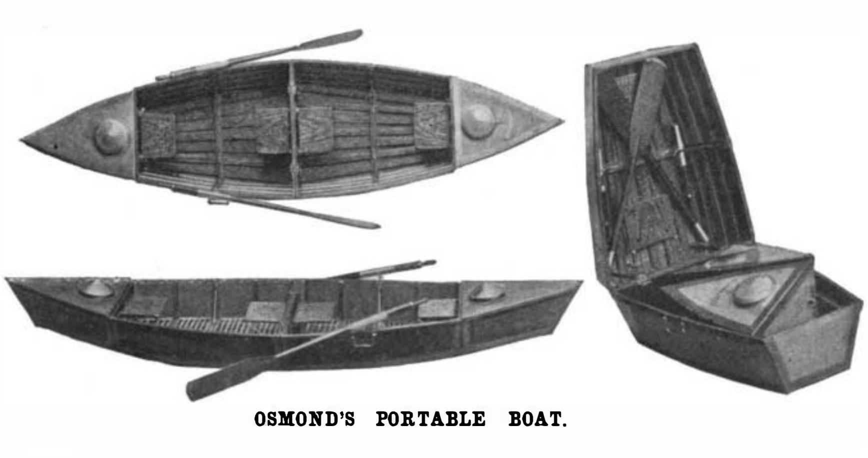

McQUISTION'S AUTOMATIC SIPHON.

The accompanying map of Niagara shows the various lands acquired by the companies, which they propose to rent out to such industrial concerns as wish to locate on their property and use the companies' power. Of these companies, the Niagara Falls Power Company alone own 1,071 acres, while the Niagara Falls Hydraulic Power and Manufacturing Company own 70 acres, as indicated on the map. The industries already established and using the electrical power are very numerous, and include the manufacture of paper, aluminum, carborundum, calcium carbide, peroxide of sodium, and other chemical industries. The street railway systems of Niagara, the Gorge railways and the railway to Buffalo, 22 miles distant, are operated by electricity generated from the Niagara waters, Buffalo alone taking 6,000 horse power for its city railroads and other power purposes. The present indications are that industries will move to Niagara instead of the electricity generated at the falls being transmitted to any great distance for industrial purposes.

### A NOVEL PORTABLE FOLDING BOAT.

An improved portable folding boat has been invented by John Osmond, 921 W. 12th Street, Chicago, Ill., which is adapted for the use of travelers, hunters, fishermen, and prospectors.

Our illustrations show the boat with its folding and removable parts in various positions. The boat comprises essentially two middle sections and two end sections. The two middle sections are hinged together so they may be folded together, one section being used as a cover for the other. The two end sections are detachably connected by bolts with the middle sections, so that they may be placed within the middle sections when not in use. In order to lock the two middle sections together when they are extended, bolts are used which are provided with washers to prevent leakage. When the four sections are in position and bolted together, a complete boat is formed having pointed ends constituting buoyant air-chambers. The end sections, when not in use, are placed within the middle sections, and serve as storage compartments for provisions. The seats of the boat are so hung that when the parts are folded, they may be swung out of the way. The oars, in order to be readily stored in transportation, are made in detachable sections.



OSMOND'S PORTABLE BOAT.

### AN AUTOMATIC SIPHON.

A patent was recently issued to Charles F. L. McQuistion, of Butler, Pa., for an automatic siphon especially adapted to the flushing of sewers and drains where the flow of water is small or intermittent. Fig. 1 is a partial section of the device; and Fig. 2 is a detail showing a portion of the siphon and of a vent-pipe employed.

The siphon, *A*, discharges into a trap or water-seal. A vent-pipe, *B*, similarly bent to the siphon, *A*, has its lower end within the trap and above the siphon-discharge, and its upper end above the bend of the siphon. The upper end of the vent-pipe is located above the siphon-intake and below the siphon-bend, a distance exceeding the depth of the seal at the lower upturned end of the vent-pipe. As shown in detail in Fig. 2, the vent-pipe, *B*, and the siphon, *A*, are connected by a passage running through a fitting, *C*.

The upper portions of the vent-pipe and siphon are arranged in the water-collecting tank. As the water rises in the tank, it enters the intake of the siphon, *A*, until it reaches the level of the upper end of the vent-pipe, *B*. As the water rises, the air in the pipes is compressed, but is prevented from escaping by the water-seals at the discharge ends of the pipes. A continued compression of the air by the rising water will finally blow out the water-seal at the lower leg of the vent-pipe, thus causing the water rapidly to rush into the upper ends of the pipes and to empty the tank.

Should it be so desired, the upper part of the vent-pipe can be omitted; but in this case the compression of air begins immediately upon the rise of the water in the tank.

### The Removal of Tattoo Marks.

In the Archives de Médecine Navale for October there is an instructive article by Dr. Félix Brunet, a junior surgeon of the French navy, on Détatouage, or the art of removing pictorial designs and inscriptions from beneath the outer skin. Soldiers and sailors—the latter especially—are notoriously fond of this species of adornment, but men at best are but fickle creatures, and with advancing years many among them become anxious to be relieved of the too persistent records which they then no longer look upon as ornamental. As Dr. Brunet says, there are few naval medical officers who have not been asked by patients to remove tattoo marks: but, unfortunately, when their services are thus required they are obliged to depend upon their own resources, as little or no information is afforded by the text-books.

It is true that an immense number of methods have been recommended, both in ancient and in modern times, but all are more or less inefficient, while many of them are barbarous. Tattooing varies so considerably as to site, extent, and depth that no single method, however elastic, can possibly answer in all cases. Dr. Brunet enters into an elaborate historical survey of his subject, exhibiting a vast amount of erudition. Among other stories he tells once more how Bernadotte died rather than lay bare his arm for phlebotomy. In his salad days Napoleon's famous general had been an ardent republican, and had he consented to the uncovering of the limb, an elaborate design attesting to his unalterable devotion toward the Republic One and Indivisible would have come to light.

In conclusion Dr. Brunet formulates his procedure as follows: "The empirical means proposed for the removal of tattoo marks being either inefficacious or dangerous, while the scientific expedient of repricking with various caustics is insufficient, we propose a method, more complicated but surer, and separable into the following stages: (a) delimitation of site to be operated on by diachylon plaster, anæsthesia by cocaine; (b) vesication by ammonia; (c) removal of epidermis, free rubbing of exposed design by nitrate of silver pencil; (d) after five minutes' salt or boricated water dressing, to be renewed the next day, when also the diachylon may be removed; (e) cicatrization under powder formed of equal parts of iodoform, red bark, charcoal, and salicylate of bismuth. This method is not applicable to all cases. Sometimes, notably in tattooing of the face, dissection is the best treatment. When a very large design is in question, it can be dealt with piecemeal." The method would probably be drastic, but whether its author is quite consistent in reflecting upon the barbarity of other processes while recommending his own is open to question. Any such method certainly should not be attempted except under the direction of a surgeon.

BEER tabloids are to be put on the market in Germany. It is said one of the small tablets dropped in a glass of water will, in a few moments, turn it into a glass of beer.

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**NIAGARA AS AN INDUSTRIAL CENTER.**—[See page 343.]