

heavy cargo which was stowed in her forward holds. By this means she was evenly balanced.

When the weather was once more propitious, Capt. Anderson hurried forward the arrangements for his next attempt to float her. He constructed a coffer dam six feet in diameter round the after end of the ship, and requisitioned the assistance of several powerful centrifugal pumps, the aggregate pumping capacity of which was 1,100 tons per hour. By this means the water in the after part of the wreck was soon removed, and with the aid of five powerful tugs he had the satisfaction of hauling her into deep water once more. The "Dennington" was towed into Portland Harbor, where she was temporarily patched up. She was then taken to Southampton by the salvage steamer "Greencastle."

A FEW REMARKABLE ARTESIAN WELLS AND THE USES TO WHICH THEY ARE PUT.

BY ERWIN HINCKLEY BARBOUR.

The traveler in eastern South Dakota and Nebraska is always duly impressed by the powerful flowing wells met with throughout this magnificent area. The conditions here seem to be favorable for artesian water, and wherever the general level is reduced by such rivers as the James and the Missouri, gushing wells seem a certainty, if drilled to a depth varying from 500 to 1,000 feet or more. The shales and limestones of the Carboniferous period form an underlying, impermeable stratum throughout this region. Upon these there rests a bed of 300 to 400 feet of very permeable sand of the Dakota Cretaceous. These are the finest water-bearing beds of the plains, and they are cased in above, even more effectually than below, by 1,000 to 2,000 feet of water-tight Cretaceous shale (chiefly Pierre) and bad-land clays (Oligocene). The beds are so tipped that there is a difference of several thousand feet between the eastern edge, where the great fountains occur, and the western edge, or the fountain head.

In the Rocky Mountain uplift, of which the Black Hills is but the most eastern spur, the western edge is thrust upward to an elevation of 5,000 to 6,000 feet higher than the eastern edge. The upturned edges of all of these beds are exposed along the eastern flank of the Rocky Mountains, ready to catch the falling rains, melting snows, and the mountain streams. On the lower levels, then, where this water-bearing Cretaceous is struck, flowing wells are so certain that to bore for water seems like tapping a water main.

When there is no friction or leakage the head would be equivalent to that of a column of water several thousand feet high. Hence, in spite of mechanical losses due to friction, etc., and to the natural escape of the water through leakage, a high pressure is to be expected, and is fully realized, in the great wells, which discharge large volumes of water, and even suffice to run mills and machinery. As an example of the

artesian well serving as an engine of some economic importance, a better instance could not be cited, perhaps, than that of the well at Niobrara, in Knox County, Nebraska, which, in addition to the work of pumping water and running the dynamos for the

Niobrara. From the stone-catcher the water is conducted to the mill, where it strikes the fans of a 4-foot Pelton wheel through a one and one-half inch nozzle.

It works perfectly, steadily, silently, and with no coal or ash to shovel, no engineer and stoker to pay. And, after first costs are met, it can be depended on for years of steady service without involving any additional outlay. In the event of fire, the full energy of the well is turned at the first alarm into the city mains, and the linemen, with hose have instant command of the situation.

Modern cities, boasting of the most approved systems, offer no better protection from fire.

than does this small Western town. At night the same water runs the dynamo and lights the place, besides filling the public reservoir—all of which seems like getting a great deal for nothing. After the energy of the water is expended on the Pelton wheel, it flows through a wasteway into a lakelet, and thence finds its way for three miles by a creditable little stream to the Niobrara River. A city might be founded on such a natural resource, for it seems assured that every wheel could be turned by this subterranean store of energy, which can be tapped indefinitely, and over many square miles of country.

Hundreds of these artesian wells are daily put to all sorts of commonplace uses, while here and there we find one engaged in work of a novel kind. One of these is the artesian irrigating plant on the Furgusson farm at Beaver Crossing, Seward County, Nebraska, where nine shallow artesian wells, none of them over 100 feet deep, make it possible to water 115 acres on short notice. The worse the drought, the better for the owner of such a farm.

The great Test Well at Lincoln, 2,463 feet deep, helps to supply water to Salt Lake, while the two wells at the Sulpho-Saline Baths of Lincoln supply water for the great natatorium of that institution. In Omaha a series of artesian wells add greatly to the beauty of various parks, by supplying fountains, streams, pools and lakes, the largest of which, seen on the Miller estate, covers some thirty acres. But of all the utilization of artesian water the most highly commendable and original seems to be that at Pierre, South Dakota, where three great wells perform the singular work of supplying water, natural gas, and electricity for the town. The discharge comes to the surface as

water, but, paradoxically enough, goes to the consumer as natural gas and electricity. Taking advantage of the discovery made shortly after the completion of the wells, that with the lowering of the pressure as the water escapes natural gas is liberated, the wells were piped into suitable retaining tanks and a sufficient quantity of natural gas was thus accumulated to supply the town and run the engines of the electric light plants as well as those of a 60 horse power pumping station.



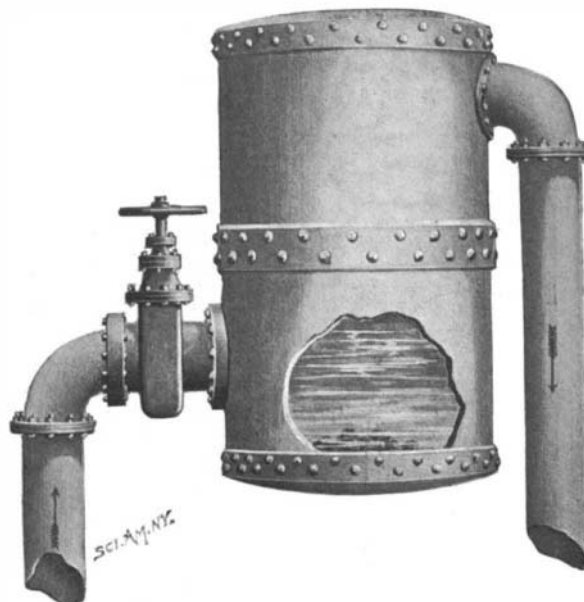
ARTESIAN WELL THAT DISCHARGES 11,158 GALLONS DAILY. DEPTH OF WELL, 1,303 FEET.



ARTESIAN WELL AT BEAVER CROSSING, NEB.—NINE SUCH WELLS MAKE IT POSSIBLE TO IRRIGATE 115 ACRES.

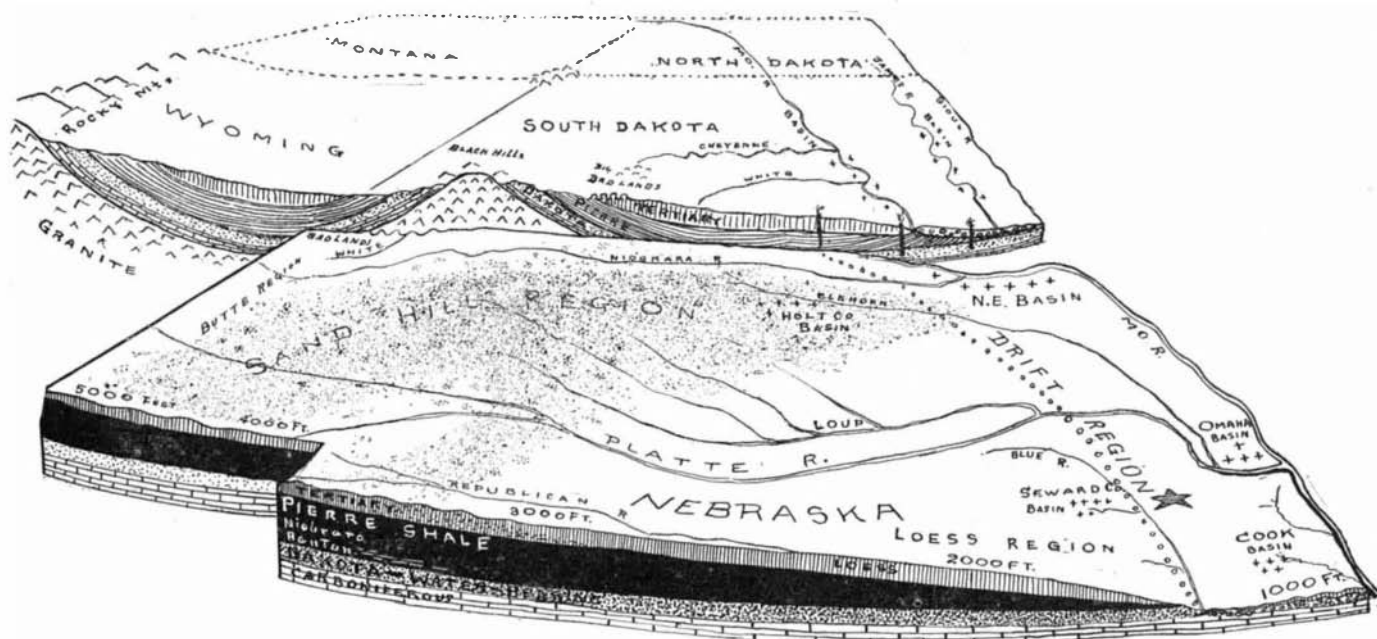
town, also drives the machinery of a 60-barrel flour mill.

The water flows through a 6-inch casing into a unique device called the "stone-catcher," the object



STEEL STONE-CATCHER AT THE HEAD OF ARTESIAN WELL.

of which is to arrest pebbles, small boulders, and stones, which are shot out with sufficient force to damage the steel casing and machinery. One such pebble, weighing 22½ pounds, is still preserved in



MAP DESIGNED TO SHOW THE RELATION OF THE BEDS TO THE ARTESIAN REGIONS IN NEBRASKA AND SOUTH DAKOTA.

The sandstone of the Dakota Cretaceous, some 300 feet in thickness, is encased below by Carboniferous limestones and shales, and above by shales chiefly of the Pierre. All beds dip downward from the mountains to the east, where the artesian regions occur.