NOTES UPON THE ARTESIAN WELLS OF DENVER.

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The present number of artesian wells in the Denver Basin is about two hundred. Of these nearly one hundred and fifty are within the city limits, while the remainder are scattered about through the country, most of them being near the Platte river. During the coming year the number will be materially increased, particularly in the country, for it is here that the greatest activity now prevails. From the interest manifested in this subject by farmers and ranchmen we may safely conclude that it will not be long before a large proportion of the farms and ranches in the Denver Basin will be supplied by artesian water.

An extended and careful study of the existing wells, and so far as possible of the history of each one, has furnished material for some general statements and conclusions of interest and value. A few of the chief points will be presented.

It is a difficult matter to form an estimate of the total quantity of water being supplied by the artesian wells today. When it is stated that a well flows a certain quantity of water per day, it means in many cases merely that it flows at that rate for a short time, i.e., while the test is being made, or while the faucets are open. In a minority of cases are the wells actually flowing continually. This is much more common in the country than in the city. It is therefore not at all probable that the total discharge from all the wells is anything like the sum of the stated capacities of the individual wells; firstly, as remarked, because many of the wells do not flow continually; and,

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secondly, because if they did the hydrostatic pressure would presumably be so reduced that some wells would entirely cease to flow. The value of any estimate based upon the stated capacities of the wells is then questionable. It has, however, been roughly calculated as follows. The sum of the stated capacities, as nearly as it can be obtained is 5,800,000 gallons in twenty-four hours. Taking into consideration the wells flowing continuously, those flowing intermittently, and those being pumped, it seems not a very high estimate to suppose that one half of this quantity, or 2,900,000 gallons, is actually delivered every twenty-four hours.

The causes of the decrease in flow, or of the total failure of some wells, are mainly three; first, poor casing and packing; second, a filling and clogging up with sand; and third, the tapping of the same water-bearing stratum by too many wells, or by a single well more advantageously situated. The best example of the first cause can be seen at the Villa Park well in Barnum's sub-division. This well was cased with stove-pipe, which is leaking so, that although the water does not rise to the top of the casing, it comes to the surface outside and causes innumerable springs on the hill-side below.

In many cases, no doubt, a defective packing has caused a very large decrease in flow of water. At one well the casing was turned through an angle of about 180° after the seed-bag packing had been put down, with the result that the flow decreased immediately, due it is supposed to a rupture or displacement of the seed-bag. In such a case the water, rising outside of the casing, is absorbed and carried off by other porous strata.

As an example of the clogging of a well with sand may be mentioned one of those at the Denver and Rio Grande R. R. shops. After a steady decrease in flow for six months it was cleaned out and found to be filled with sand to a height of 50 feet from the bottom. After a thorough cleaning the flow of this well nearly resumed its

former amount. In most cases when wells have been cleaned out a deposit of more or less sand has been found. One well owner gave as an excuse for allowing his well to run continuously that thereby the accumulation of sand was prevented, and the channel kept open.

The third of the causes named above is, however, the one which has brought about the decrease or failure in flow of the greatest number of wells. The relation of cause and effect is here easily seen. A well may be flowing at a good rate when a new well in the neighborhood strikes the water-bearing stratum, and then the flow of the old well may suddenly fall off or cease entirely. If the new well is cased and the waste shut off the older one may again resume its normal flow. The decrease is naturally most marked where the new well is situated upon lower ground. Mrs. Eckhart's well on the hill in North Denver was flowing with a presure of about 35 pounds when the Gurley Bros.' well, lower down, struck the water-bearing sandstone. The flow of the Eckhart well ceased at once and has never been restored. Similarly, other wells on high ground in North Denver have ceased or materially decreased in flow since the sinking of wells at lower levels.

Wells situated at about the same level are also found, in some cases, to mutually affect each other. If one be allowed to run continuously for a time the pressure of certain adjoining wells is seen to be materially lessened.

On reviewing these instances we see that a large number of the wells have affected, or been affected by, other wells. This is true to a degree showing conclusively that the supply of artesian water is not at all inexhaustible. But that the limit has as yet been reached in any given neighborhood we have no evidence to show.

The depths from the surface and the thicknesses of the water-bearing sandstones vary considerably. In sinking the Anderson well, on Colfax avenue, five such strata were encountered in going to a depth of 375 feet. These were met at 154, 244, 290, 350 and 375 feet from the surface and

were respectively, 14, 16, 10, 12 and 25 feet thick. The 600 foot stratum had in the Ester well, a few blocks away, a thickness of 59 feet. The sand-stone layers usually designated as the 375 and the 600 foot strata are the thickest and most porous, and are the ones which have so far furnished the largest and most permanent supplies of water. In sinking deeper, flows are cut at about 670, 720, 850 and 930 feet, the latter being the one which furnishes the mineral water at the Court House. The pressures and flows from the different horizons vary in almost all wells, a fact probably to be accounted for by local differences in the porosity and thickness of the water-bearing strata. The 600 foot sandstone when cut by the Timerman well, corner of 17th and Champa sts., was more dense and also thinner than elsewhere, hence the flow from it was small.

The average thickness of the water-bearing strata in North Denver are given by a contractor who has sunk a large number of wells there, as follows:

							Thickness.
1st flow	at	100	feet	below	Platte	River,	4 inches.
2d "	"	208	"	"	"	"	10–12 feet.
3d "	"	240	"	"	"	"	40 "
4th "	"	300	"	"	"	"	20–60 "
5th "	"	500	"	"	"	"	10–80 "

These water-bearing zones are not homogeneous sandstones, but are alternate layers of sandstone, shale, etc., and as the flows increase as the drill sinks into them, they are grouped as above.

A very good flow has been cut at 280 feet by three wells lying within a stone's throw of each other on Golden avenue, near the Larimer st. bridge. All of these wells are allowed to flow continually, and, contrary to the usual experience no diminution of pressure is noticed, neither has any one of them been affected by the others.

Five wells sunk near Argo Park form another interesting group. They all find a good flow of water at a depth

of about 300 feet, are discharging on an average over thirty gallons per minute, and though none is cased beyond bedrock only one has shown any decrease in flow. They all flow continuously. The wells in the country which originally secured a good flow seem to have suffered no decrease, and in some instances an increase has been noticed.

The methods of boring the wells and of casing and packing require no special mention. The chief data in these directions have already been given in the Report on the Artesian Wells of Denver, submitted to this Society nearly two years ago. The cost of boring has decreased somewhat in the meantime. Including the casing the cost of sinking a well now ranges from eighty cents to three dollars per foot, according to depth of well, method of sinking, the kind of casing used, and the difficulties encountered.

On reviewing all the evidence afforded by the wells, it can be said that the water supply as a whole does not yet show signs of decrease. All individual cases of decrease or stoppage of flow seem to be due to defects in the well, or to the influence of some more favorably situated boring.

The question as to the advisability of allowing wells to flow continually, and to waste, is in a measure a local one. In the city, where wells are numerous and near together, the waste should certainly not be allowed, but in the country, where the wells are too far apart to be in any way affected by one another, it is possible that restrictions may not be necessary. A continued flow tends to keep the sand from accumulating in the bottom of a well, and in some cases it is supposed to scour out and form channels in the water-bearing stratum, and by this means to actually increase the flow. The importance of these underground sources of pure water to a city like Denver is apparent to all, and it scarcely needs an argument to show that the Denver Artesian well system should be protected and cared for by special legislation.