

ping of limestone rocks from the hillsides the hardier helioid forms are located.

Station No. 20.—The soil in this region is made up of Houston Clay and the shallow phase of Houston Clay. The surrounding country is similar to Station No. 11, with the exception that there is a much greater amount of lowland along Ten Mile Creek than along the stream mentioned in the discussion of Station No. 11. Many forms were collected in drift along the creek and in addition a series of succinids were found clinging to vegetation close to the water's edge. This locality was visited after heavy rains and the rushing water had washed many land snails into a large drift, which gave a wonderful representation of the snail fauna of the entire area.

Station No. 21.—The soil in this region is composed of Trinity Clay, Lewisville Clay, the shallow phase of Houston Clay, the low phase of Bell Clay and Chalk. This particular area is not far from the source of White Rock Creek. Although the vegetation is not as abundant as along the stream nearer to White Rock Lake, a good representation of snails was obtained from the woods, as well as from drift along the stream. The forms collected were very similar to those found in Station 14.

(Concluded in our next issue)



A COMPARISON OF HARDNESS IN DALLAS WATER BEFORE AND AFTER TREATMENT IN THE CITY WATER PLANT

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A measurement of the change in hardness produced in raw water by the usual treatment in the city purification plant of Dallas, Texas, was a project undertaken by the class in elementary quantitative analysis. The treatment which would affect the hardness was the addition of ferrous sulphate and lime at the time the water was pumped into the settling basins, and filtration through gravel. In making this comparison, the total alkalinity, temporary hardness, and permanent hardness of raw water and water

after treatment, were determined. Raw water samples were taken as the water entered the purification plant; samples of treated water from city main at the plant.

The total alkalinity of water is represented by its carbonate, bicarbonate, borate, silicate, and phosphate content. The procedure for this determination follows: three 100 cc samples of each water, measured by a volumetric flask, were rinsed into porcelain casseroles, two drops of methyl orange added to each, and the mixtures titrated with fiftieth normal hydrochloric acid.

Temporary hardness is due to the presence of bicarbonates of calcium and magnesium. To measure this a 500 cc sample of the water was boiled gently for ten minutes, covered and cooled to room temperature, then rinsed into a 500 cc volumetric flask and diluted to the mark with recently boiled and cooled distilled water. After the carbonates precipitated, three 100 cc samples were titrated against the fiftieth normal acid. The temporary hardness, considered as calcium bicarbonate, was determined by the difference in the amount of hydrochloric acid in this titration and the titration for total alkalinity.

The normal carbonates of calcium and magnesium, and soluble salts of these metals, are the common causes of permanent hardness. To measure this factor 50 cc of a standard sodium carbonate solution were added to each of three 100 cc samples of each water. These were evaporated to dryness, and the residue, calcium and magnesium carbonate, filtered and washed with recently distilled water until free from alkali. The filtrate was titrated against an acid of known normality, with methyl orange as an indicator, in order to find the amount of sodium carbonate used in excess of that needed for precipitation of the calcium and magnesium compounds. From the difference in the amount of sodium carbonate originally used, and that determined by titration, the amount needed to precipitate the calcium and magnesium was calculated, causing the permanent hardness reported as calcium sulphate.

The results recorded below represent, for each determination, the average values obtained from three samples:

1. Determination of Total Alkalinity:

	Raw Water	Treated Water
No cc HCl acid required to neutralize 100 cc samples	11.20 (.0217 N)	3.10 (.0196 N)
Weight of CaCO_3 equivalent to the acid used .....	.0122 g.	.00297 g.
Total alkalinity, in mgm per liter	122.00	30.00

2. Determination of Temporary Hardness:

No cc acid required to neutralize 100 cc samples	9.36 (.2017 N)	3.00 (.0196 N)
Difference in acid used in (1) and (2) due to removal of $\text{Ca}(\text{HCO}_3)_2$ by precipitation as CaCO_3	1.84	.10
Weight of $\text{Ca}(\text{HCO}_3)_2$ removed by precipitation .....	.003175 g.	.0001589 g.
Temporary hardness in mgm per liter	31.75	1.00

3. Determination of Permanent Hardness:

Weight of Na_2CO_3 in 50 cc of solution added to each sample .....	.5238 (.1975 N)	.02935 (.01106 N)
No cc HCl acid required to neutralize excess Na_2CO_3 after precipitation	41.76 (.2168 N)	47.84 (.0196 N)
Weight of Na_2CO_3 used in reaction with CaSO_4 in 100 cc sample .....	.0442	.00011
Weight of CaSO_4 per 100 cc sample .....	.0567	.01726
Permanent hardness as CaSO_4 , mgm per liter....	566.7	172.6