Out of the thirty-five new arrivals, the following nine have taken the county by storm—that is, they are now very common:

Arenaria serpyllifolia.  Lactuca scariola.
Croton monanthogynus.  Melilotus alba.
Dysodia chrysanthemoides.  Plantago Virginica.
Chrysanthemum leucanthemum.  Plantago lanceolata.
Lithospermum arvense.

SOME EVOLUTION AMONG CACTI.   By JOHN M. COULTER.

[ABSTRACT.]

The nascent tubercles of *Eumamillaria*, *Coryphantha*, *Echinocactus*, *Anahalonium* and *Lophophora*, show in their generic characters perfectly intergrading characters, which serve to clear up certain homologies and relationships.

## PHYSICS AND CHEMISTRY.

PERMANGANIC ACID.   By THOS. C. VAN NUYS AND SHERMAN DAVIS.

It is the purpose of this investigation to work out, if possible, I. The exact conditions under which permanganic acid or its salt undergoes spontaneous decomposition. II. Whether it is effective as an oxidizing agent in the decomposition of organic matter.

I. For determining the exact properties of the acid or its salt, the following plan was adopted. Glass tubes, about 30 mm. and 30 cm. long were sealed at one end and carefully annealed. They were then filled with a strong $H_2SO_4$ sol. of potass. permanganate and heated to 100°C. for 12 hrs. This treatment completely removed any organic matter adhering to them. The distilled water was purified by boiling a strong $H_2SO_4$ sol. of potass. permanganate, with a condensing apparatus, for some time and then distilling the second time with $KMnO_4$. The NaOH used in making the standard alkali sol. was prepared from the pure metal and absolutely pure water. The tubes were then carefully rinsed with the C. P

water and made ready for use. After introducing a definite quantity of the standard sol. of potass. permanganate from a burette, graduated to $\frac{1}{100}$ cc, and a definite amount of the acid or alkali, the tubes were sealed, then cooled gradually to anneal them. When cold, the tubes were well shaken to mix the fluid and then introduced into a copper bath 4 in. wide and 15 in. long. When working at 100°C. pure water was used to fill the bath; for higher temperatures aniline was used. We found aniline preferable to paraffin because the heat diffused through it more readily and uniformly. Many conditions were tried to determine if possible all the factors which enter into the problem. From the data obtained there seem to be four primary factors which influence the spontaneous decomposition of permanganic acid. 1. The quantity and kind of acid or alkali used. 2. Time of heating. 3. Temperature. 4. Dilution. This is shown by the following data: I. Quantity and kind of acid used:

| | No. | $SO_3\dfrac{n}{n}$ | KOH | $KMnO_4\ \dfrac{n}{10}$ | Oxalic A. | $KMnO_4$ | Time | Water. | Per cent. Dec. |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | x | 10cc | 12.00 | 2 25 | 2 hr | 8cc | |
| | 2 | 2 | x | 10cc | 12.00 | 2.35 | 2 hr | 8cc | |
| 100°C | 3 | 2 | x | 10cc | 12.00 | 2.22 | 2 hr | 8cc | 3.2 |
| | 4 | 2 | x | 10cc | 12.00 | 2.20 | 2 hr | 8cc | |
| | 5 | 2 | x | 10cc | 12.00 | 2.25 | 2 hr | 8cc | |
| | 1 | 1cc | x | 10cc | 12.00 | 2.20 | 2 hr | 9cc | 1.8 |
| | 2 | 1cc | x | 10cc | 12.00 | 2.20 | 2 hr | 9cc | |
| | 3 | 1cc | x | 10cc | 12.00 | 2.15 | 2 hr | 9cc | |

Orthophosphoric acid shows less decomposition.

II. A. Time of heating.

| | No. | $SO_3\dfrac{n}{n}$ | KoH | $KMnO_4\ \dfrac{n}{10}$ | Oxal. A | $KMnO_4$ | Time. | Water. | Per cent. Dec. |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2cc | x | 10cc | 12 00 | 2.20 | 1 hr | 8cc | |
| | 2 | 2cc | x | 10cc | 12.00 | 2.15 | 1 hr | 8cc | 1.6 |
| | 3 | 2cc | x | 10cc | 12.00 | 2.20 | 1 hr | 8cc | |
| | 4 | 2cc | x | 10cc | 12 00 | 2.15 | 1 hr | 8cc | |

By using 4-6-8cc of acid with constant time, temp. and dilution, we find the per cent. decomposition is almost exactly proportional to the quantity of acid used. It may be represented by the curve A.

By using constant acid and dilution and temp. the per cent. decomposition is approximately proportional to the *time* of heating. Its curve is therefore the same as that for the acid decomposition B. with NaOH.

The NaOH sol. of permanganic acid is much more stable under like conditions than the $H_2SO_4$ sol. This is shown by the following data:

|  | No. | NaOH | $KMnO_4$ | Oxal. A. | $KMnO_4$ | Time. | Water. | Per cent. Dec. |
|---|---|---|---|---|---|---|---|---|
| 100°C | 1 | 2cc | 10.00 | 12.00 | 2.07 | 1 hr | 8 | 0.2 |
|  | 2 | 2cc | 10 00 | 12.00 | 2.02 | 1 hr | 8 |  |
|  | 3 | 2cc | 10 00 | 12.00 | 2.00 | 1 hr | 8 |  |
|  | 1 | 4cc | 10.00 | 12.00 | 2.05 | 1 hr | 8 | 0.7 |
|  | 2 | 4cc | 10.00 | 12 00 | 2.12 | 1 hr | 8 |  |
|  | 3 | 4cc | 10.00 | 12.00 | 2.05 | 1 hr | 8 |  |
| . | 6 | 10.00 | 12.00 | 2.05 | 1 hr | 8 | 0.2 |
|  | 6 | 10.00 | 12.00 | 1.95 | 1 hr | 8 |  |
|  | 6 | 10.00 | 12.00 | 2 01 | 1 hr | 8 |  |
|  | 6 | 10.00 | 12.00 | 2.05 | 1 hr | 8 |  |

From these data we see that the amount of decomposition is within the limit of error in manipulation, for the time and temp. used.

By increasing the time to 2 hr. and dilution to 50cc there is no appreciable increase in the amount of decomposition.

If the temp. be raised to 175°C, the other conditions remaining constant, the dec. rises to 2 per cent.

|  | NaOH | $KMnO_4$ | Oxal. A | $KMnO_4$ | Time. | Dil. | Temp. 175 |
|---|---|---|---|---|---|---|---|
| 1 | 6 | 100 | 12.00 | 2.20 | 1 hr | 34 |  |
| 2 | 6 | 100 | 12.00 | 2.20 | 1 hr | 34 | Per cent. $2 \frac{7}{100}$ |
| 3 | 6 | 100 | 12.00 | 2.20 | 1 hr | 34 |  |

In all these cases we have used a $\frac{1}{10}$ Nor. sol. $KMnO_4$; if $\frac{1}{100}$ be used the decomposition especially with $H_2SO_4$ is much greater.

II. In studying the oxidation properties of the NaOH sol. we followed the outline given by Lentz. We find that by using a Nor. sol. NaOH, a $\frac{1}{10}$ Nor. $KMnO_4$ Sol. and diluting to a definite volume—100cc—the oxidizing properties of this acid is much greater than shown by him. We succeeded in oxidizing 97 per cent. of a standard sol. of grape sugar, even under secondary conditions and obtained constant results in each case. The work on oxidation has not been developed, but it appears from what has been done, that this method with the standard NaOH sol. and the sealed tube can be made to completely oxidize such substances as sugar and glycerine.