PART II.—THE EFFECT OF VARIOUS SUBSTANCES ON THE RATE OF NITRIFICATION.

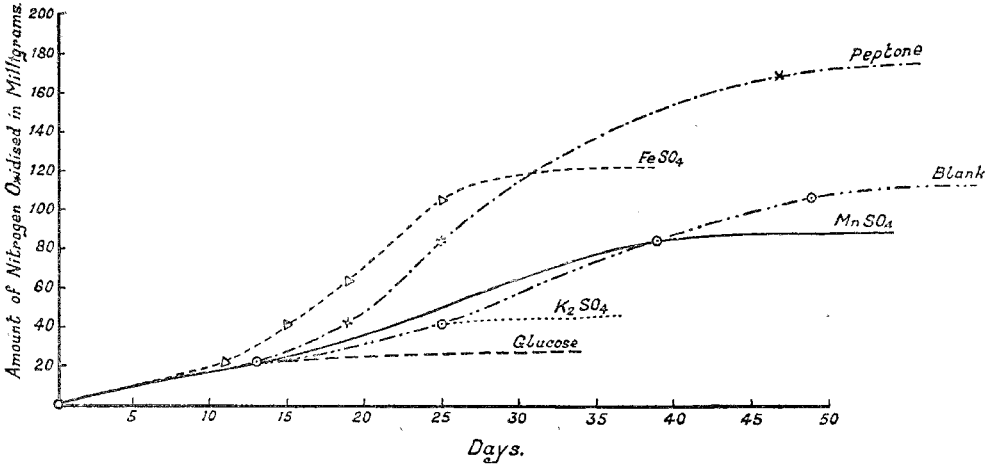
By M. B. Roy.

When nitrification takes place under natural conditions in the soil or during the various processes of sewage purification, numerous mineral salts and other substances may be present which are liable to affect the activity of the nitrifying organisms. The experiments described in this section were undertaken in order to obtain some quantitative knowledge of the effect of such substances on the nitrification process.

For this purpose 0·25 per cent. solutions were made of the following substances :—Manganous, ferrous, calcium, magnesium and potassium sulphates ; chlorides of calcium and sodium : calcium superphosphate, basic slag, sodium phosphate, glucose, peptone and caramel.

Five c.c. of each of these solutions was added to 100 c.c. of a suspension of activated sludge in water (20 per cent. by volume of sludge). The mixtures were contained in a series of test-tubes of about 100 c.c. capacity. To each of these mixtures was added one or two c.c. at a time of a 10 per cent. solution of ammonium sulphate, giving a concentration of ammoniacal nitrogen available for nitrification of from 20 to 40 parts per 100,000. Precipitated calcium carbonate was added as a base and the liquid tested for acidity from time to time. The test-tubes were connected in series and a current of air, freed from any traces of ammonia by passage through sulphuric acid, was passed through the series so that any variation in the air-supply affected each test-tube equally.

One c.c. from each test-tube was taken out at intervals and tested qualitatively for ammonia and nitrites, and in some cases for nitrates, a fresh dose of sulphate of ammonia solution being added as soon as the previous dose had been oxidised. The more important results are summarised in the attached graph. It is clear from the form of the curves that some time is required, viz., about 12 days, before nitrification becomes really active and there is a point beyond which, under the conditions of these experiments, no further oxidation takes place. Both peptone and iron salts considerably increase the activity of the nitrification process as compared with the blank. Manganese accelerates the process up to a point and afterwards exercises a


Amount of Nitrogen Oxidised in Milligrams.
200
180
160
140
120
100
80
60
40
20
5
10
15
20
25
30
35
40
45
50
Days.
Peptone
FeSO4
Blank
MnSO4
K2SO4
Glucose

depressing effect. Potassium salts exercise a depressing effect, while glucose may be almost said to inhibit nitrification, owing, doubtless, to its affording favourable conditions for the activity of denitrifying organisms.

It is reasonable to conclude that the stimulating effect of peptone is due to its furnishing necessary food for the organisms and also the possibility of its decomposition products being capable of conversion into nitrates.

The action of iron salts is doubtless catalytic, and has been confirmed in subsequent experiments by Norris and Ranganathan.

In the case of the other substances it may be stated generally that they show little influence on the rate of nitrification as compared with the blank, and consequently experiments with them were not continued.

The experiments with calcium sulphate were extended to a concentration of 14 per cent. in the actual experimental tube without any appreciable effect on the rate of nitrification. This is of interest in connection with the use of ammonium sulphate as a fertiliser on limed soils.

Another interesting isolated result discovered is the possibility of oxidising dilute solutions of ammonium hydrate in presence of calcium carbonate. This indicates that the ammoniacal liquor of gas works, if sufficiently diluted, could be oxidised directly to nitrate in presence of calcium carbonate without the necessity for the intermediate formation of ammonium sulphate.

In view of the statement by Muntz and Lainé that the nitrifying organism will tolerate concentration of nitrate up to 20 per cent. this amount of calcium nitrate was added to the nitrifying solution, with the result, however, of immediately inhibiting the process. It is clear from the work of Boullanger, referred to in the introduction that such concentration of nitrate is higher than the organisms will tolerate, unless very carefully acclimatised.