binations, although controls inoculated with a little garden soil or even sea bottom muds have given positive results. There was no perceptible nitrification in media consisting of raw sea water to which ammonium salts were added in different concentrations. Varying the temperature from 4° to 30° C. by six-degree intervals did not give any evidence of the presence of nitrifiers in the sea water.

On the other hand, soil nitrifiers, *nitrosomonas,* failed to elaborate any nitrites when inoculated into sea water with the addition of magnesium carbonate in excess and ammonium sulfate, although they were still viable after eight weeks at 20° C. In a medium consisting of 50 per cent. sea water and 50 per cent. Winogradsky's solution inoculated with *nitrosomonas,* nitrification occurred, but not as readily as in straight Winogradsky's solution. With 75 per cent. sea water the amount of the reaction was negligible and 90 per cent. sea water stopped it. The addition of 5 to 10 per cent. sea water to Winogradsky's solution accelerated the oxidation of ammonium to nitrites by the biological agents mentioned above. Such evidence seems to warrant the conclusion that if bacterial nitrifiers are in the open seas, they are different from the soil forms, but it does not preclude the possibility of there being bacterial nitrifiers in the sea which require special methods of cultivation. Investigations are now in progress which may help to elucidate this point.

In continuing the inquiry into the mode of origin of nitrates, it was found, contrary to expectation, that sunlight favored nitrification in sea water under certain conditions. When pyrex flasks partly filled with raw sea water plus 0.005 per cent. ammonium sulfate were exposed to light on the top of a building for two weeks there was a measurable increase in nitrites as well as nitrates and a corresponding decrease in the ammonium content. The controls in the dark were unchanged. Examinations revealed that there were fewer viable bacteria in the flasks which had been exposed to sunlight than in the dark controls. The removal of bacteria by filtering the water through a Berkefeld N candle into sterile flasks did not influence the oxidation of ammonium to nitrites when thus irradiated. The reaction was accelerated by the addition of manganese dioxide. No perceptible oxidation of ammonium occurred in distilled water nor in artificial sea water under comparable conditions. Autoclave sterilization (120° C. for 30 minutes) of sea water destroyed its photochemical nitrifying properties. This is attributed to the thermal destruction of certain oxidizing substances or even organic catalysts.

Many of the above experiments were repeated, using ultra-violet light having a maximum intensity in the 2950Å region. Such irradiation of sea water mixtures produced results not unlike those observed under the influence of sunlight, except for the speed of the reaction. Exposure to the mercury arc at thirty inches for two hours caused the oxidation of as much ammonium as the daylight did in two weeks. Again it was found that more ammonium was oxidized to nitrites by irradiation of sea water than distilled water. Ultrafiltration of sea water did not alter it in this respect, but autoclaving it retarded the reaction. Increasing the intensity of the irradiation ten times by bringing the source to within about 9½ inches from the test solutions actually caused the destruction of more ammonium than could be accounted for as nitrites or nitrates.

In view of these observations it appears that at least part of the nitrification which occurs in the sea is photochemically activated. Zolcinski[4] has repeatedly found that chemical nitrification in the soil is activated by sunlight in the exclusion of biological agencies. It is well known that under certain conditions ultra-violet light causes the oxidation of ammonium to nitrites. Due to the slight penetrability of water by these rays, they could play an important rôle only at or a few millimeters from the surface. Inasmuch as no light filters were used in these preliminary tests, many rays other than the ultra-violet may have been the effective ones. The mercury arc did supply visible light of great intensity. As previously stated, the solar rays responsible for the reaction will pass through pyrex glass. The point to be emphasized at this time is not which rays are active, but rather that the irradiation of sea water causes the oxidation of ammonium to nitrites and that sunlight supplies the necessary rays. In a later communication a report of the foregoing experiments will be amplified and additional observations given.

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[4] *Int. Rev. Sci. Pract. Agric.,* 2: 838, 1924 (Abstract).