MORNING THUNDERSTORMS AT COCHIN IN THE PRE-MONSOON SEASON

As pointed out by Sreenivasiah,[1] there is a remarkable concentration of rain and thunderstorm in the morning and forenoon hours at Madras in the early part of the withdrawing S.W. monsoon season. It is also the author's experience that such morning thunderstorms are very frequent on the west coast of the Peninsula, for example at Cochin, in the pre-monsoon months. In both cases, cumulonimbus clouds, as a rule, form over the sea off the coast and advance towards the coast later with the winds prevailing aloft. The nature of the "trigger", which releases the energy from the conditionally unstable atmosphere in such cases is still obscure. The notes kept by the author while at Cochin during the pre-monsoon months in the year 1944, when a number of radar observations were available, appear to throw some light on the problem.

All the data available at Cochin relating to the pre-monsoon morning thunderstorms are shown in Table I below. The place from where the radar observations were made was Eddappilli, about 10 miles to the N.E. of Cochin. The times given under column 2 are those of location of the active thunderstorms by the radar. The ranges of the storm centres from the coast and their bearings with respect to the place of observation are given in the next two columns. The data in the last two columns are the observations made at 09.00 hrs. I.S.T. at the Cochin Observatory.[2] Though the wind on the 20th at the Observatory was calm at 09.00 hrs., it was N.E. at the pibal station at Willingdon Island, which is a little to the east of Cochin. Also, at 09.00 hrs., moderate continuous rain was in progress at the Observatory. The current weather observations made at the pibal station also showed that the land breeze persisted from about 02.00 hrs. to 12.00 hrs. on all the days; and there was no shift in the wind direction until the thunderclouds came overhead.

TABLE I

Date	Time in I.S.T.	Range in miles	Bearing in deg.	Surface wind	Minimum temp. in °F.
9-5-1944 ..	1115	43-46	255	ENE	77
11-5-1944 ..	0601	25-35	230	ENE	74
20-5-1944 ..	0858	8-11	227	Calm	75
29-5-1944 ..	1125	42-52	305	SE	77
29-5-1944 ..	1235	35-45	307	SE	77

It is seen from the above table that the bearing of the centre of the thunderstorm on the various days is just opposite to the direction of the surface wind at the time. This is significant because the surface wind on all those occasions was the relatively cool land breeze, which generally extends vertically up to 2,000-3,000 feet and horizontally beyond the coast up to 30-40 miles, depending on its strength. Owing to its thermal contrast from the seasonal winds, the land breeze would act like a cold front. The prevailing moist westerlies ensure a higher wet-bulb temperature in the lower levels and create a thick environment of latent instability. This is particularly so at coastal stations where dew points are usually high in the surface layers. This environment commences from about 2,000 feet, as borne out by the observed height of cloud base. Hence, as soon as the advancing wedge of cold air lifts up the surface layers of the atmosphere into this environment, vigorous convection is set up, and thunderclouds develop. The trigger for the release of energy in the atmosphere resulting in the morning thunderstorms, therefore, seems to be the land breeze at the coast itself.

It will also be noticed from Table I, that the time of commencement of the thunderstorm as well as the distance from the coast where it forms depend on the magnitude of the minimum temperature. The lower the minimum temperature the closer to the coast do these clouds form and the earlier in the morning. This inference would be helpful in anticipating the time of occurrence of these thunderstorms. As the nocturnal cooling of the ground layers of the atmosphere determines the value of the minimum temperature, the clearer the skies at night, the earlier can the thunder-clouds be expected to develop. The probable isobaric situation towards the morning hours must, of course, be taken into account in deciding upon the nature of the land breeze. Katabatic winds, if present, and the cooling of the ground layers of the atmosphere due to past precipitation would augment the effect of the land breeze.

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OBSERVATIONS ON NITRITE-PRODUCING BACTERIA FROM DIFFERENT SOURCES AND THE ROLE OF PROTOZOA IN NITRIFICATION

DURING recent years, there has been increasing evidence to show that, apart from the special forms of nitrifying bacteria (species of *Nitrosomonas* and *Nitrosococcus*), there are other types of bacteria commonly occurring in soil and other systems which are capable of producing nitrite fro mammonium salts.[1-3] We have carried out some studies on the occurrence and distribution of nitrite-forming bacteria in natural systems, such as water, sewage, soil and compost, and also on the extent of their activity in these media. The nitrifying activity of these bacteria, individually and collectively, as also in presence of certain forms of protozoa (*Vorticella* sp. and *Epistylis* sp.) which have been found to influence nitrification in Activated Sludge,[4,5] has also been studied.

Out of the eighty-one different strains of bacteria isolated on nutrient agar and other media from samples of water, soil, sewage, compost and fæces of animals (the bacteria characterised according to Bergey[6]), thirty-seven were found to produce nitrite (sixteen of these produced only traces of nitrite) in aqueous suspensions of soil, sewage and compost materials. The observations on the nitrite-forming bacteria and the amounts of nitrite produced by the different bacteria, singly and in combination, as also the influence of protozoa on nitrification are given in Tables I and II. The effect of addition of small amounts of Activated Sludge and septic tank sludge on nitrification in the medium was also studied.

Nitrification in aerated sewage and other media was found to start only after the flocculation of the suspended and colloidal matter in the media: formation of nitrite was found to proceed after aeration for 24 to 72 hours, largely depending upon the nature and concentration of the organic matter and the inoculum; and production of nitrate was found to take place as the aeration was prolonged after 72 to 96 hours.

The observations given in Tables I & II show that the nitrite-producing bacteria are commonly distributed in nature and that the amounts of nitrite produced by the bacteria alone, singly or all together, are less than those formed in presence of certain forms of protozoa, such as the *Vorticellids* occurring in Activated Sludge.

TABLE I

Extent of nitrite production by the individual strains of bacteria from different sources, with and without Vorticella *sp. (after aeration of the medium for 96 hours)*

Sources examined	No. of different strains of bacteria isolated	Media employed for the nitrification test (800 c.c.)	No. of nitrite-formers observed	Nitrite produced (p.p m)	Nitrite produced by bacteria in presence of *Vorticella* sp. (p.p.m.)
River water ..	2	Sterilised sewage	1	0·06	2·50
Tank water ..	6	,,	5	traces to 0·08	0·2 to 3·0
Borewell water ..	3	,,	2	traces to 0·08	0·25 to 1·50
Garden soil ..	6	Sterilised soil suspension	1	traces	0·35 to 0·60
Compost heaps ..	13	Sterilised compost extract	2	traces to 0·04	0·12 to 2·0
Raw sewage ..	3	Sterilised sewage	1	0·04	0·06 to 0·08
Septic tank sludge ..	2	,,	1	0·04	0·08
Activated sludge ..	3	,,	3	0·04	0·12 to 0·20
Cow dung ..	7	,	3	traces to 0·04	0·08 to 0·12
Horse dung ..	8	,,	2	traces	0·25 to 3·0
Fæces of rat, rabbit, dog and monkey	28	,,	16	traces to 0·06	0·07 to 3·80

1. c.c. of active bacterial culture was used as inoculum in each case; the protozoan inoculum contained about 20,000 active cells of *Vorticella* sp.

TABLE II

Effect of addition of mixed cultures of bacteria, protozoa, and sludges to suspension of soil, sewage and compost on nitrification in the medium (after 96 hours' aeration)

Treatments (in each case 2 litres of sterilised suspension of soil and compost extracts and sewage mixed in the proportion of 1 : 1 : 1)	Nitrite nitrogen (p.p.m.)	Nitrate nitrogen (p.p.m.)
Mixed cultures of all the 81 strains of bacteria	0·04	Nil
Washed cells of *Vorticella* sp. ..	0·40	traces
Washed cells of *Epistylis* sp. ..	1·80	0·80
Activated sludge ..	2·50	traces
Septic sludge ..	0·30	Nil

The percentages of nitrification by the bacteria associated with the protozoa and in the sludges were found comparatively negligible; the number of active protozoa in the protozoan inocula and in the activated sludge introduced was about 22,000 in each case; the septic sludge also contained a corresponding number of protozoa including *Vorticella* sp. but mostly in the form of cysts which on aeration became active.

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INFLUENCE OF HEAT ON THE PHYSICO-CHEMICAL PROPERTIES OF GUM-ARABIC

GUM-ARABIC, an acid polysaccharide, is mainly a calcium salt of arabic acid,[1] the nucleus of which is aldobionic acid (galactose-glucuronic acid) to which sugar molecules of galactose, arabinose and methyl pentose are attached.