

## THE NITROGEN CONTENT OF CEYLON RAIN

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THERE has been rather wide variation in the amounts of nitrogenous matter—both ammonia and nitrate-nitrite—brought down by rain water annually in different parts of the world as indicated by the records of various observers. The results of N. H. J. Miller (1) at Rothamsted, which date back to nearly four decades, obtained during a period of 13 years' rainfall indicate that the annual quantity of ammoniacal and "nitric" nitrogen varied between 4.43 lb. and 3.31 lb. with an average of 3.84 lb. per acre per annum. A very low value of 0.5 lb. of nitrogen as ammonia was recorded by Gray of New Zealand, while about the same time a value of over 14 lb. was registered in Venezuela.

In the tropics, atmospheric electrical disturbances are popularly believed to promote the formation of oxides of nitrogen with consequent increase in the total amount of nitrogen brought down by rain. Unfortunately the average amount ascertained by different observers in the tropics has been even less than what has been recorded in European countries, except that the tropical rain was at times better supplied with nitric nitrogen. Leather (2) recorded figures of 3.405 and 3.250 lb. of total nitrogen as having been brought down annually at the two Indian stations Dehra Dun and Cawnpore respectively. Corbet (3) on the other hand estimated that in Malaya 40–50 lb. of nitric acid (equivalent to 9–11 lb. nitrogen) and lesser amounts of ammonia were returned annually per acre in the rain water. The only work carried out in Ceylon was that by M. K. Bamber (4) in 1898–9. He obtained values of 3.65 and 1.28 for ammoniacal and nitrate-nitrite nitrogen respectively. In view of the development of microchemical technique and the improved modern analytical methods available, it was considered desirable to find out whether or not larger amounts of nitrogen are in reality brought down in any part of Ceylon.

In this paper, the results of an investigation on this subject which was carried out at Peradeniya are set out.

*Sampling.*—The rain waters (whenever any fell) actually collected in a rain guage were transferred to Winchester quarts

and stored under toluene. Half-monthly samples were kept separately and analysed with the least possible delay. In a few cases daily specimens of rain water were also examined.

*Technique.*—For the estimation of ammoniacal nitrogen, 500 mls. were treated with 10 mls. of 10 per cent. w/v  $H_2SO_4$  and carefully concentrated to about 30 mls. The ammonia in this solution was distilled using a Micro-Pregl still into standardized hydrochloric acid of approximately N/100. Back titration was carried out employing a micro burette reading to .01 mls which is equivalent to .0014 m.gm. of nitrogen. Hence for the volume taken, the results do not have an error exceeding  $\pm$  .003 p.p.m. especially as readings were taken in duplicate. Total inorganic nitrogen was similarly obtained, but after the reduction of  $NO_3-NO_2$  nitrogen by the usual micro-chemical technique using a fixed quantity of reduced iron in two stages. The differences between the two sets of figures are correct records of the nitrate-nitrite nitrogen in rain water.

The analytical data for the period May 1, 1940, to April 30, 1941, are given in Table I.

It is to be noted that a figure as high as 12.85 lb./acre per annum of inorganic nitrogen has been recorded. Of this amount, nitrogen in the form of ammonia is nearly  $7\frac{1}{2}$  lb.—actually 7.49 lb.—and therefore is in slight excess. Hence the ratio of “ $NH_3, N$ ”/“ $NO_3-NO_2, N$ ” is 1/0.72, which is very near the value obtained by Leather at Dehra Dun (India).

The following conclusions may also be drawn :—

(a) The highest amount of total nitrogen brought down was in the second half of March, 1941, when there was fairly heavy rainfall following a period of drought.

(b) For nearly six months of the year, viz., August to January, there was a preponderance of ammonia in the rain waters and hence the ratio of ammoniacal nitrogen to nitrate-nitrite nitrogen was much above 1.5. The periods October 1–15 and November 16–30 were, however, exceptions; but it has to be stated that these rainfalls were frequently accompanied by heavy thunderstorms.

(c) During the months of July, 1940, and April, 1941, the nitrogenous matter brought down was least.

(d) In general, when the rainfall is small the rain water contains a higher concentration of both ammonia and nitrates.

#### DISCUSSION

The total amount of nitrogenous matter brought down by rain is not only dependent on the extent to which matter in the atmosphere had been previously washed out by rain but also on the total quantity of the fall. In the wet zones of

Ceylon, therefore, it may reasonably be concluded that the higher the rainfall the greater would be this value. On the other hand, in the dry zones, the amount of nitrogen returned to the soil cannot be expected to be so great. Whilst the nitrogen figures obtained for Peradeniya weather conditions must be considered as being fairly satisfactory—and this is partly due to the rainfall being above normal (average rainfall figures for 16 years at the Peradeniya Experiment Station and for 56 years at the Royal Botanic Gardens, Peradeniya, are 93·52 and 91·81 inches respectively)—it has to be realized that, owing to a great part of this precipitation being lost by surface run-off, &c., the actual amounts available to plants will be appreciably smaller.

#### REFERENCES

- (1) Miller, N. H. J.—The amounts of nitrogen as ammonia and as nitric acid in the rain water collected at Rothamsted. *Jour. Agric. Science* Vol. I., p. 280.
- (2) Leather, J. W.—The composition of Indian rain and dew. *Memoirs Department of Agriculture, India (Chemical series)*, Vol. I., p. 1.
- (3) Corbet, A. S.—*Biological processes in tropical soils*, p. 86.
- (4) Bamber, M. K.—Report on Ceylon tea soils, Colombo, 1900.

TABLE I  
(Nitrogen)

	Rainfall Inches	Parts per Million		Ratio a/b	Pounds per Acre.		
		As Ammonia (a)	As Nitrate and Nitrite (b)		As Ammonia	As Nitrate and Nitrite	Total
May ..	9.52	.060	.093	.645	.129	.200	.329
1940	19.80	.048	.087	.552	.215	.390	.605
June ..	8.50	.081	.210	.386	.156	.404	.560
16th-30th	6.22	.090	.178	.506	.127	.250	.377
July ..	1.99	.116	.102	1.14	.052	.046	.098
1st-15th	1.22	.145	.128	1.13	.040	.035	.075
16th-31st	4.48	.102	.120	.850	.103	.122	.225
August	.96	.910	.191	4.76	.193	.041	.239
1st-15th	.96	1.32	.280	4.72	.287	.061	.348
16th-30th	8.14	.449	.192	2.34	.827	.354	1.181
September	5.69	.072	.100	.720	.093	.129	.222
October	7.10	.270	.167	1.62	.434	.268	.702
1st-15th	11.98	.612	.075	8.16	1.659	.203	1.862
16th-30th	4.05	.192	.462	4.16	.176	.423	.599
November	4.26	.900	.132	6.82	.867	.127	.994
December	3.02	.190	.030	6.33	.130	.020	.150
January	2.41	.300	.069	4.35	.164	.038	.202
1941	1.39	2.00	.520	3.85	.629	.164	.793
February	1.92	.210	.850	.247	.091	.369	.460
March ..	.67	.300	.900	.333	.049	.148	.197
1st-15th	.00	—	—	—	—	—	—
16th-31st	5.92	.670	.990	.677	.897	1.326	2.223
April ..	5.20	.096	.072	1.33	.113	.085	.198
1st-15th	2.64	.090	.262	.344	.054	.156	.210
16th-30th							
Total ..	*118.04	.281	.201	1/0.72	7.490	5.359	12.849

1"/acre rainfall = 226,240 lb. or 101 tons.

\* The rainfall for this period at the Experiment Station, Peradeniya, was 115.37".