

suitable than sorghum, as it neither shades nor affects the growth of cotton plants.

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¹ Vasudeva, R. S., *et al.*, *Ind. J. Agric. Sci.*, 1939, 9, 595.

A Note on the Occurrence of Tri-Cotyledonary Seedlings in *Crotolaria juncia* Linn.

DURING the course of an investigation now in progress, seedlings of *Crotolaria juncia* were raised in the garden attached to the Bose Research Institute. Seeds were supplied by the Fibre Expert to the Government of Bengal, Dacca. Number of cotyledonary leaves in the

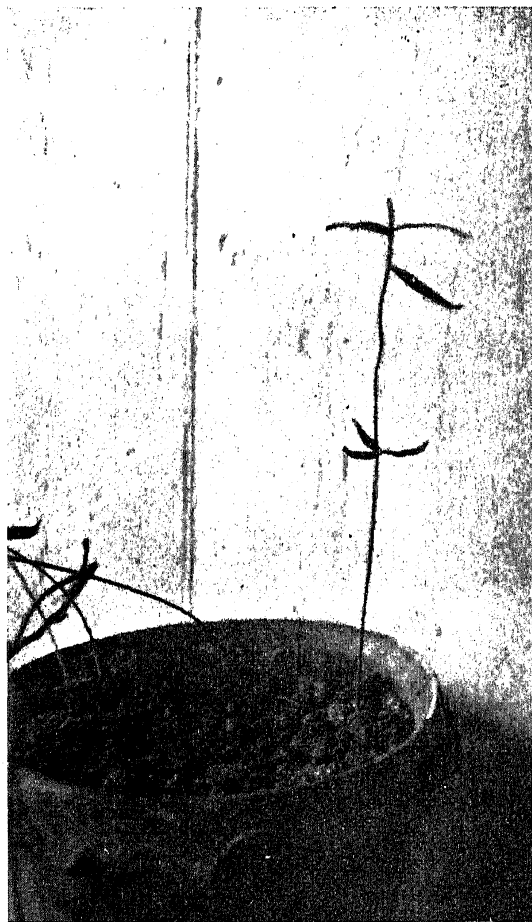


FIG. 1

Photograph of a seedling of *Crotolaria juncia* showing three cotyledons. $\times 1/3$.

seedlings were ordinarily two but few showed abnormal number of three cotyledons. It was found that multiplication of cotyledons in *C. juncia* were of frequent occurrence in the sample of seeds used during investigation. Seedlings which were subsequently raised at the Falta sub-station of the Institute also showed abnormality in the number of cotyledons. Out of 760 seedlings eight seedlings had three cotyledonary leaves. None of the cotyledonary leaves showed any sign of external distortion or splitting and were arranged symmetrically in a whorl.

Multiplication of cotyledonary leaves have been noted in few angiosperms: *Acer pseudo-platanus*, *Cheiranthus cheiri*.¹ Abnormal number of cotyledons (3-5) have been noted in *Correa*, *Crataegus*.² Tri-cotyledonary seedlings have been noted in *Apium pteroselium* and few species of *solanum*.² In *Crotolaria juncia* faciation of inflorescence axis and of stem have only been noted.³ Progenies of the tri-cotyledonary seedlings will be studied in the next generation and a detailed account will be published later.

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¹ Worsdell, *Principles of Plant Teratology*, 1915, 2, 215.

² Masters, *Vegetable Plant Teratology* (*Lond. Roy. Soc.*): 1868, 370.

³ T. C. N. Singh, *Journ. Ind. Bot. Soc.*, 1930, 9, 250.

On the Origin and Distribution of Cloud Charges

OF the two important theories advanced to explain the production of electrical charges in thunder clouds, *viz.*, the "breaking drop" theory of Simpson and the "ion capture" theory of Wilson it has not yet been decided which is the process really in operation. It is generally considered that perhaps both are in operation. Simpson's theory¹ predicts negatively polarised clouds and Wilson's theory² predicts positively polarised clouds. In practice both are

observed. The observations of Banerji³ in India are in accordance with Simpson's theory. Observations by other investigators^{4,5} in England and Africa show a preponderance of positively polarised clouds. Recent balloon observations of Simpson⁶ and field measurements of Wormell⁷ in England confirm the preponderance of positively polarised clouds in that place. Hence the idea is gaining ground that the Wilson process is the more effective one in the formation of cloud electricity.

In the interpretation and discussion of the results one important factor seems to have been ignored. This is the influence of impurities in the water of clouds.

The purpose of this note is to point out the possibility of the formation of positively polarised clouds even by the Simpson mechanism. For this it is necessary to point out certain experimental results of J. J. Thomson⁸ on the breaking of water drops in air. While distilled water develops a positive charge it was found that very small amounts of certain impurities dissolved in it entirely reverse the effect, the drops acquiring a negative charge. Thus Thomson gives the following results: 0.2 c.c. of H₂SO₄ in 1,000 c.c. of distilled water reverses the effect. A drop of hydrogen peroxide or methyl violet and other organic compounds not only reverses the effect but the amount of negative charge per c.c. is two or three times greater than the positive charge produced in distilled water.

Simpson developed his theory on the assumption that the water of the drops was pure. But if the drops of a cloud contain traces of impurities then there is an explanation of clouds with negative bottoms produced by Simpson's mechanism. In this connection it is interesting to point out the investigations of Schwend (quoted by Simpson¹) on individual rain drops, which showed a marked mixing of drops having positive and negative charges. This seems to show that the kind of charge developed depends on the nature of each drop, perhaps the nature of the nucleus on which it condensed.

The important observation that the negative fields under positively polarised clouds are more intense than the positive fields under negatively polarised clouds can be explained by Thomson's observation that traces of some organic compounds as well as hydrogen peroxide greatly enhance the electrification in addition to reversing it. The large amount of charge in negative rain may be due to this also.

Now the chances of impurities likely to produce such effects are greater near cities and over oceans. This has some connection with the observation of Nukiyama and Noto⁹ in Japan that in general coastal storm clouds have the Wilson distribution while the Simpson type is predominant in inland clouds. Hence the situation of a station seems to determine the polarity of clouds over it.

It is probable that the formation of traces of hydrogen peroxide may be the chief cause for the predominance of positively polarised clouds. The formation of hydrogen peroxide has been detected in rain. Besson¹⁰ has shown its existence together with ozone in the heavy drops of rain as also in spray and evaporating water. Chlopin¹¹ found hydrogen peroxide in moist air exposed to ultra-violet radiation. Thus it seems that Simpson's mechanism will largely produce positively polarised clouds unless there are impurities which will destroy hydrogen peroxide. Hence it will be profitable to analyse rain water at various stations to see whether or not sufficient quantities of the above impurities exist to explain the reversal.

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September 17, 1940.

¹ Simpson, G. C., *Proc. R. Soc.*, (A), 1926, **114**, 376.

² Wilson, C. T. R., *J. Frank. Inst.*, 1929, **208**, 1.

³ Banerji, S. K., *Phil. Trans. R. Soc.* (A), 1928, **231**, 1.

⁴ Wormell, T. W., *Proc. R. Soc.* (A), 1927, **115**, 445.

⁵ Schonland, B. F. J., *ibid.*, 1928, **118**, 233.

⁶ Simpson and Serace, *ibid.*, 1937, **161**, 309.

⁷ Wormell, T. W., *Phil. Trans.*, 1939, **238**, 249.

⁸ Thomson, J. J., *Phil. Mag. Sc.* 1894, **37**, 341.

⁹ Nukiyama, D., and Noto, H., *Jap. J. Astr. Geophys.*, 1928, **6**, 71.

¹⁰ Besson, A., *C. R.*, 1911, **153**, 877.

¹¹ Chlopin, W., *Zeit. Anorg. Chem.*, 1911, **71**, 2198.