where $$y = \frac{I_1}{I_{-1}}$$

$$\gamma = 1 - \frac{\xi^2}{4} - \frac{\xi^2\rho^2}{48}$$

and $$\delta = \frac{\xi^2\rho^2}{12}.$$

The graph of the equation y and a very closely follows the experimental curves obtained by me at various frequencies between 3 and 20 m.c. [The properties of the relation y and a have been discussed fully in Hardy's *Pure Mathematics*, p. 224 (1928), esp. compare figures 41 (*b*) and 41 (*c*), with the experimental curves above.] The experimental results are in good agreement with the Raman-Nath theory.

The form of this equation accounts for all the peculiarities of the curves observed under (*a*), (*b*), (*c*) and (*d*).

Further, for smaller values of $\frac{\gamma}{\delta}$, which is the case for lower ultrasonic frequencies, one would expect a flat maximum, since the maxima will be separated by asymptotes, the distance between which (say x) will determine the extent of the maximum. The values of x as determined experimentally are as given below :—

	x =
at 20 m.c.	0
15 m.c.	$0 \cdot 41\ a$
10 m.c.	$0 \cdot 67\ a$

This explains well why the maximum gets flatter at lower frequencies.

In conclusion, it may be remarked that the experimental results obtained at oblique incidences on the diffraction of light by high-frequency sound-waves are in good agreement with the generalised Raman-Nath theory, as tested here between 3 m.c. and 20 m.c., provided the supersonic intensity is not great at high frequencies.

A detailed paper will be published elsewhere.

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[1] S. Parthasarathy, *Proc. Ind. Acad. Sci.*, 1936, **3**, 442, 594.

[2] C. V. Raman and N. S. Nagendra Nath, *ibid.*, 1936, **3**, 459; Nath, *ibid.*, 1936, **4**, 221.
See also "Der Ultraschall," by L. Bergmann (1937).

Cashew Nut Shell Oil as a Mosquito Larvicide.

THE opinion of well-known malariologists is not totally in favour of the heavy and light oil mixtures which are slow to act and tend to be blown away from the surface of the treated area before many larvæ and pupæ are killed. Our investigation was undertaken to discover a suitable toxic substance which, added to the oil film, produced rapid death in a large number of larvæ and pupæ within as short a time as possible. The details of our experiments would be published elsewhere but we have found that the addition of cashew nut shell oil to kerosene or "High Speed" Diesel oil enhances *their* killing power three times, when tested under laboratory conditions. This activation of the oil at the same time proportionately decreases the cost of the anti-mosquito measures.

Working with larvæ and pupæ of *Armigeres obturans*, a culicine mosquito commonly obtainable in Bombay, we found that while 3 ml. per square foot of kerosene oil alone was necessary to obtain a cent. per cent. kill, one ml. of a mixture of 5 parts of cashew nut shell oil and 95 parts of kerosene or H.S. Diesel oil was adequate for the purpose.

India at present holds a monopoly of cashew nut shell oil, which is obtained as a by-product during the production of cashew kernels. The tree *Anacardium occidentale*, originally introduced from South America, has well established itself in the coastal forests of India. The oil referred to above is used for painting wood, as a protection against insects and is exported to America and Europe for paint mixtures.

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Assimilation of Atmospheric Nitrogen by Germinating Peas.

ASSIMILATION of gaseous nitrogen by germinating legumes, non-symbiotically, has been the subject of numerous enquiries during recent years, but no conclusive results have so far been obtained[1-4].

In the course of our studies on the germination of certain legumes in colloid

volumes of air, we have obtained definite evidence to the effect that there is direct assimilation of nitrogen from the air. Significant results were obtained by using pea seeds. Weighed quantities of the seeds were soaked in distilled water and allowed to germinate for varying periods in presence of known volumes of air. At the end of the experiment, the air was analysed gasometrically for its nitrogen content and the quantities of nitrogen absorbed by the seeds during the period of germination determined. A few of the results thus obtained are as hereunder :—

TABLE I.

Variety	Weight of seeds (g.)	Period of germination (days)	Nitrogen absorbed (c.c. at N.T.P.)
Local	3·67	3	8·0
,,	3·97	2	6·0
Acclimatized	7·17	5	44·7
,,	11·21	3	34·2
Local	11·27	6	104·8
Acclimatized	11·18*	5	88·6
,,	8·55*	5	56·8
,,	5·93*	3	36·6
,,	4·32*	2	24·1
,,	6·32†	4	0·8

* Treated with 0·2 per cent. mercuric chloride solution to sterilize the seed coat.

† Treated with 0·5 per cent. copper sulphate solution to arrest germination.

Studies on the absorption of nitrogen during successive periods of germination have shown that there is progressive increase in assimilation with the period of germination. Thus, in one experiment, 11·2 g. of pea seeds absorbed 36·5 c.c. of nitrogen during the first three days, while a further three days' germination resulted in the fixation of another 69·0 c.c. of the gas.

When seeds treated with mercuric chloride solution were crushed under sterile conditions and plated out into sterilized nitrogen-free media, there was no development of any colonies even after several days incubation. Further, it was noticed that such seeds could germinate and grow without any nodulation of the root systems in sterile tubes with nitrogen-free nutrients. These observations together with the fact that the *Rhizobia* do not, by themselves, fix any nitrogen[5] would suggest that it is the germinating seed, independent of any organism, that fixes the nitrogen.

The foregoing results were confirmed by an independent study of the changes in the total nitrogen content of peas on germination by a modified Kjeldahl procedure.[6] There is a definite increase in the nitrogen content as a result of germination even at the end of three days (Table II). Such

TABLE II.

	Nitrogen in mg. per 100 g. of dry material		
	Variety I	Variety II	Variety III
Ungerminated	3476 ± 30	3514 ± 40	4042 ± 42
Germinated*	3775 ± 30	3780 ± 18	4343 ± 38

* Results calculated to original weight of the ungerminated seeds.

increase has been found to be not due to any error in the Kjeldahl procedure or to the variability in the nitrogen content of the material itself.

Further investigations are now in progress.

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[1] N. Vita, *Biochem. Zeit.*, 1932, **245**, 210; N. Vita and R. Sandrinelli, *ibid.*, 1932, **252**, 278; *ibid.*, 1932, **255**, 82; see also N. Vita, "Ergebnisse der Enzymforschung," 1937, **Band 6**, 209.

[2] K. Girtschanoff, *Zeit. hl. Bakt.*, 1935, **92**, 349.

[3] E. Smyth and P. W. Wilson, *Biochem. Zeit.*, 1935, **282**, 1.

[4] C. Olsen, *ibid.*, 1937, **291**, 178.

[5] D. Burk, *Jour. Phys. Chem.*, 1930, **34**, 1174.

[6] A. Sreenivasan, *Ind. Jour. Agric. Sci.*, 1932, **2**, 525; *ibid.*, 1934, **4**, 320, 546; *Jour. Ind. Inst. Sci.*, 1935, **18A**, 25; A. Sreenivasan and V. Subrahmanyan, *Ind. Jour. Agric. Sci.*, 1933, **3**, 646.