TABLE II

Growth of the leaf callus tissues grown in N-6/0, N-6/1 and N-6/2 medium

Medium	Growth pattern of different age of callus tissues					
	1 month old	2 months old	3 months old	4 months old	5 months old	6 months old
N-1 (Control)	++++	++++	++++	++++	++++	++++
N-6 0	++++	++++	++++	++++	+++	+++
N-6 1	++	++	+	Died	–	–
N-6 2	++++	++++	+++	+	+	Died

++++ = best callus growth; +++ = satisfactory growth; ++ = slow callus growth; + = very slow callus growth.

Thus, an auxin-autotrophic callus tissue of *N. sativa* was obtained from N-6/0 medium containing only basic salts and vitamins of the medium. These tissues are still maintaining their profuse growth after keeping for 11 months in hormone free medium (Fig. 2). *Further trials are needed to establish these autotrophic lines as mutants which will lead to additional areas of investigation both in basic as well as applied science.*

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CHEMICALLY-INDUCED VARIANTS IN BLACK GRAM—*PHASEOLUS MUNGO* L.

ALTHOUGH black gram (*Phaseolus mungo* L.) is an important pulse crop it has not received the attention it deserves in the matter of mutation breeding. T–9, a short duration, day-neutral variety of black gram obtained from the Pulse and Oil Seed Research Station, Berhampore, West Bengal, was used in the present study. Dry seeds were treated with 0·1% and 0·2% aqueous solutions of ethyleneimine (EI) and hydroxylamine (HA) for 4 hours at room temperature in each case and a control was maintained in distilled water (DW). After washing, the seeds were sown in the experimental plots of the Department of Botany, University of Calcutta.

Cytological studies revealed that the percentage of chromosomal aberrations induced was the highest in 0·2% HA. The aberrations consisted of breakage in metaphase and lagging and unequal separation in anaphase. Meiotic studies showed fragments and univalents at metaphase I and laggards, bridge with or without fragments at anaphase I. Control plants did not show any meiotic irregularity. Percentages of pollen sterility were 12·92 in 0·1% EI, 14·01 in 0·2% EI, 12·39 in 0·1% EI, 13·77 in 0·2% HA and 2·24 in control (DW).

Reduction in germination could be due to the fact that the treated seeds were sown directly in the field. In the M_1-generation, variations in plant height, leaf shape, pod shape and pod size were observed. Most of them did not persist in the subsequent generation, presumably because of mutation shock or other physiological causes. Seeds of normal looking M_1 plants were used to raise the M_2-generation in which plant mutants were detected.

In the M_2-generation, percentage of germination which was the lowest in 0·2% EI was 60% as compared to 90% in DW (control). Chlorophyll mutants were mostly albinos which did not survive for more than 3–4 days. Some other seedling mutants were also observed in which growth was severely affected. Most of them survived for less than a month and were grouped as lethals. Percentage of seedling mutants was maximum in 0·2% EI.

Plant mutants were those which could be detected in the adult stage as well as those seedling mutants which grew into adult plants retaining their morphological abnormalities. Percentage of these variant

plants was highest in 0·1% EI. Such variants were grouped as follows :—

(*a*) *Tall plants* (Height ranged from 30·50 cm to 31·70 cm) were much taller than the normal and were healthy and vigorous, with a large number of branches. The branches were widespread. Leaves were longer and narrower than the control and variation in leaf shape was conspicuous. They were characterised by early flowering and good yield of seed.

(*b*) *Bushy plants* (Height ranged from 18·70 cm to 21·70 cm) were comparatively short, stout and healthy. Very short internodes and very high number of branches gave a bushy appearance. Variation in leaf shape and pod shape were conspicuous. Flowering was almost normal but yield was comparatively high.

(*c*) *Dwarf plants* (Height ranged from 13·50 cm to 15·50 cm) were much shorter and did not look healthy. Considerable variation in leaf shape was noticed with characteristic late flowering and yield. Pollen sterility was high.

(*d*) *Stunted plants* (Height ranged from 8·50 cm to 10·0 cm) were very short without any branch or very rarely with a single branch and were completely sterile.

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A BIFURCATED SEEDLING OF *CARTHAMUS TINCTORIUS* LINN.

AMONG seedlings of *Carthamus tinctorius* grown in an experimental plot, some had a bifurcated shoot and some a bifurcated root while a few had a bifurcated shoot as well as root. The anatomy of a seven week old seedling of the latter category was investigated (Fig. 1).

The common axis about 1·71 cm long, from either end of which the bifurcations start, has normal anatomical features, though stunted in growth as compared to a normal seedling. The cotyledonary node is pentalacunar with a median flanked by two small laterals and two larger ones, the latter being the products of split laterals common to both cotyledons. The first foliar node bearing a pair of opposite leaves at right angles to the cotyledonary plane, shows similarity to the cotyledonary node excepting for the absence of the split lateral (Fig. 2). The larger laterals near the leaf margins leave independent gaps at the foliar node. The median gaps of the first leaf pair are not closed resulting in two horse-shoe shaped vascular groups in the axis (Fig. 2). At the points of insertion of the leaves, the cortex shows gradually deepening invaginations. Simultaneously, procambium formation followed by vascular differentiation at the gaps change the two horse-shoes into two separate vascular rings (Fig. 3). With the completion of the cortical invaginations, the bifurcation is complete and two independent axes result. These show alternate phyllotaxy (mirror image of each other) with typically trilacunar nodes. The bearing of this nodal variation on the question of the derivation of a trilacunar condition from a multi or penta-lacunar one can only be speculative without wider sampling.

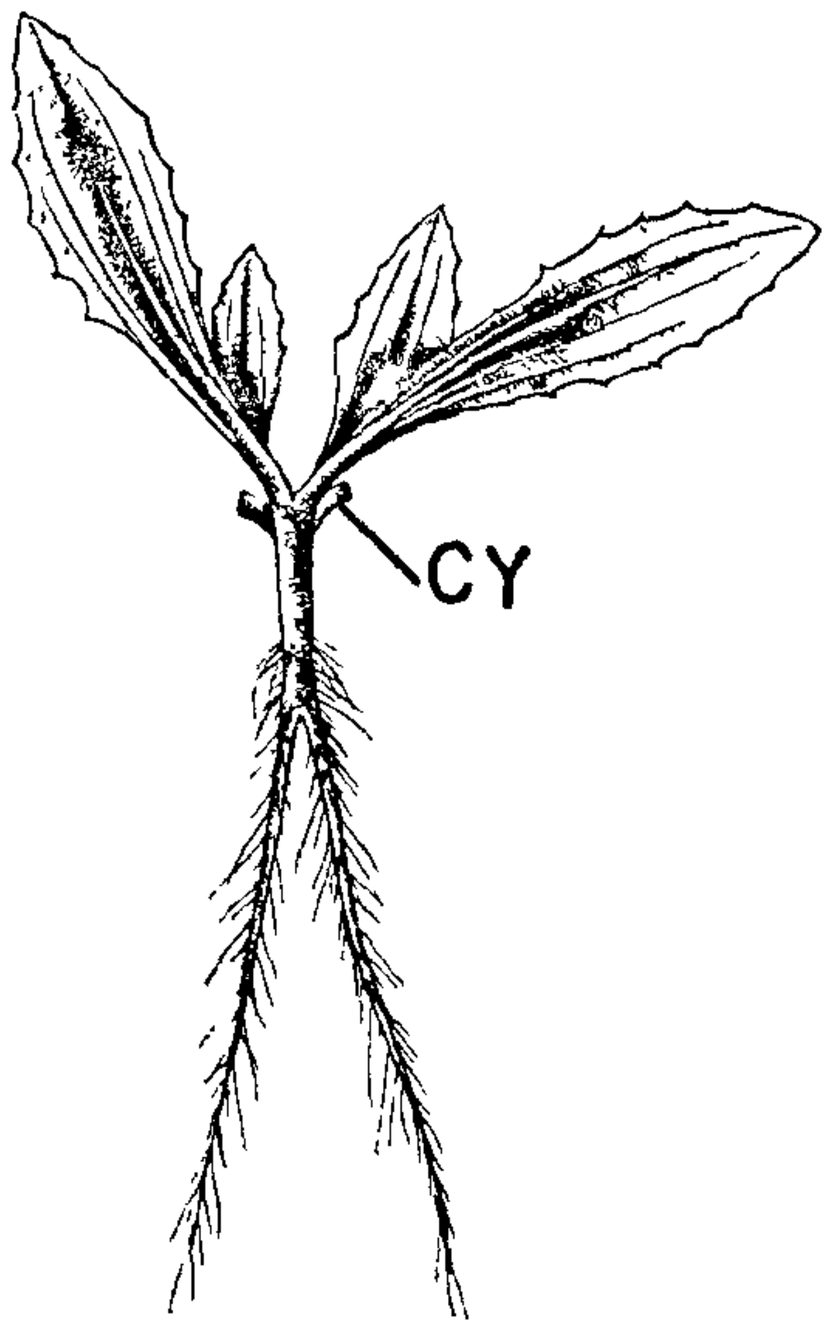

FIG. 1. Bifurcated seedling of *Carthamus tinctorius*.

The normal diarch root with a solid metaxylem core develops a lenticular pith resulting in the splitting of the metaxylem (Fig. 4). Two arcs of cambium, formed at the periphery of the pith cut off phloem towards the inside (against the pith) and xylem to the outside (against the metaxylem) (Fig. 5). Just proximal to the bifurcation (1·19 cm) the pith splits into two due to necrosis of some cells across the centre, the two vascular arcs still being joined at the common protoxylem poles (Fig. 4). Further distally, bifurca-