

set a devastating earthquake. One is therefore led to suppose that when a quake occurs under such conditions it must spread over a large area and produce great destruction of life and property. It is significant that during the undermentioned Earthquakes viz.—

(1) Assam quake (1897) 4-25 p.m., 12th June;

(2) North Bihar quake (1934) 2-25 p.m., 15th January;

(3) Kangra quake (1905) 6 a.m., 4th April; the positions of the Moon were as follows:—

(1) Moon away from the Sun by about  $150^\circ$  east, i.e., anti-Moon  $30^\circ$  west of Sun.

(2) New Moon.

(3) New Moon.

If we examine Figs. 1 to 3 we see that

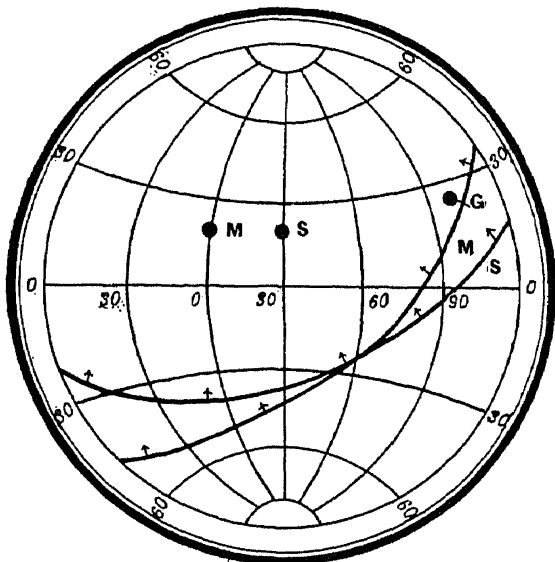


Fig. 1.

Assam Quake.

4-25 p.m., 12th June 1897, Near New Moon.

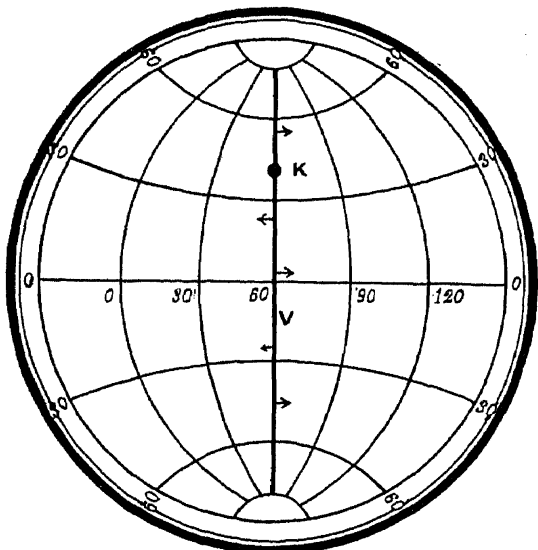


Fig. 2.

Kangra Quake.

6 a.m., 4th April 1905, New Moon.

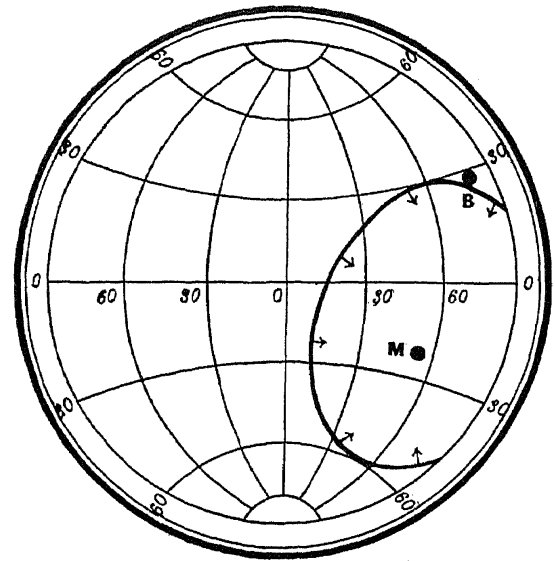


Fig. 3.

North Bihar Quake.

2-15 p.m., 15th January 1934, New Moon.

during Assam quake and Kangra quake the vertical tide producing forces influenced the epicentral tract, while in North Bihar quake, the horizontal forces passed through the earthquake area.

Regarding these forces R. D. Oldham wrote long ago:—“With all these objections there remains a sufficiently strong case for the reality of the influence of these forces in determining the time and origin of earthquakes to justify a fuller investigation.” It is considered that a fuller investigation of all the devastating quakes might lead to the establishment of a definite law regarding the magnifying influence of the forces due to Moon.

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Fruit and Seed Development in *Tinospora cordifolia* Miers without Fertilisation and Embryo Formation inside.

As the internal morphology of the ovule in the family Menispermaceæ is not much known, during the years 1932 and 1933, the undersigned fixed for investigation a large amount of material of *Tinospora cordifolia* Miers from plants growing in the local botanical garden. This included a large number of fruits in different stages of development, beginning with the carpels of flowers that had just withered and ending with the mature red drupes, and was meant for the study of embryogeny in the species.

We have, however, been surprised to find the total absence of embryos in all this material. The ovules have been found to develop quite normally upto the formation of the embryosac. The megaspore-mother cell gives rise to a complete row of four megaspores. The chalazal one of these develops into an 8-nucleate embryosac of the usual type. The megaspore-mother cell, the linear tetrad of megaspores and the embryosac are deep-seated, the embryosac being covered by about ten layers of parietal tissue. It shows an egg-apparatus of the normal form at the micropylar end, two polar nuclei about the middle, but slightly towards the micropylar end, and three antipodals at the chalazal end. The last resemble those of certain Ranunculaceæ<sup>1</sup> in shifting their position towards one side as the embryosac increases in size during endosperm development. On the contrary, no pollen on the stigmas of the carpels or any pollen-tubes penetrating the nucellus of the ovule have been seen even in more than two hundred ovules examined for the purpose. No fertilisation takes place and the various parts of the embryosac except the two polar nuclei gradually degenerate. The parts of the egg-apparatus lead in the process and then a little later the antipodals share the same fate. The behaviour of the polar nuclei is just the reverse. They fuse with each other in the micropylar half of the embryosac to give rise to a secondary nucleus and the latter without undergoing the process of triple fusion divides to form a large amount of endosperm. The growth of the endosperm on the ventral side of the carpel is very irregular and it consequently becomes ruminant. Along with the development of the endosperm, the embryosac goes on increasing in size and absorbing the nucellus. The integuments of the ovule change into the testa of the seed and the wall of the ovary differentiates into the epicarp, fleshy mesocarp and the stony endocarp of the drupaceous fruit, without any embryo being formed inside.

This absence of embryos in the seeds of apparently normal fruits of *Tinospora cordifolia*, we have also confirmed by dissecting many of them, though it is not possible to put forward any exact cause for the failure of pollination, which appears to be the primary cause for such a development. In the Benares Hindu University Botanical Garden

while there are a number of female plants, there is only one male plant at a distance of a few hundred feet from the former. The pollen of this male plant is quite normal; and although no germination experiments have been tried, it appears from its structure to be quite viable. The lack of pollination may be, therefore, due only to the distance between the male and the female plants, the effect of which is enhanced by these plants growing on other trees often with dense foliage, like the mango. But whatever the explanation may be for the lack of pollination, it is quite clear that in '*Tinospora cordifolia*' without the stimulus of fertilisation and without the development of embryo inside, apparently normal seeds and fruits are formed. In this respect, a comparison can be made with Kashyap's observation in Lahore on the ovules of *Cycas revoluta*.<sup>2</sup> There are only female individuals of this cycad in Lahore, but even then the ovules develop into seeds, which externally look quite normal. Inside only the female gametophyte is developed and there is no fertilisation and embryo formation. As the cause of such a development in *Cycas revoluta*, Kashyap suggested the possible influence of some foreign pollen. In angiosperms, the morphology of the endosperm being different, it is not unlikely that in *Tinospora cordifolia*, the necessary stimulus for the development of the seed and fruit may be coming from the formation of endosperm itself inside and its formation without fertilisation is not an unusual thing even in the Ranales.

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#### Kinks on Impact Curves of Struck Strings.

THE present note is meant to indicate that Kaufmann's theory is sufficient to explain the phenomena associated with struck strings, specially with reference to Piano-forte where the striking length  $a$  and the elastic strength of the felt hammer are small. In this case particularly Kaufmann's theory when modified for elasticity can be applied with advantage. In order to do this divide the total duration of impact into

<sup>1</sup> Coulter, J. M., *Bot. Gaz.*, 1898, 25, 73.

<sup>2</sup> Kashyap, S. R., *J. Ind. Bot. Soc.*, 1921, 2, 116.