floor were kept in a room which was not insect-proof; each of the 24 seer heaps were 3 in. deep, while the 40 seer heaps were 5 in. deep. Out of each group of 8 heaps one was kept as control and the remaining seven were covered with a one-inch thick layer of dry chopped lantana, saw dust, "bhusa", dry local grass, dry soapnut leaves, sand and pine needles respectively, selection for each treatment being made by randomization. There were thus three replications on each rack and one on the floor. The heaps in the racks were covered on top while those on the floor were covered on the sides also. After covering the healthy potatoes with these articles, 8 maunds of tubers, heavily infested with the pest, were uniformly distributed in the room.

During storage, in addition to the potato tuber moth, potatoes are destroyed by a fungus disease which causes rotting. Therefore, for judging the efficacy of the various covering articles, loss due to the pest and to the fungus disease was taken into consideration and the results obtained are tabulated below:—

Table showing effect of covering potatoes in storage with different articles

Treatment	Average % of loss in Rack A due to		Average % of loss in Rack B due to		Average % of loss on pacca floor due to	
	Potato tuber moth†	Rotting	Potato tuber moth†	Rotting	Potato tuber moth†	Rotting
Control	50·6	6·1	56·1	4·2	73·1	4·4
Lantana	2·6	3·1	1·7	2·1	8·0	3·1
Saw dust	2·1	3·6	0·3	2·5	3·1	4·6
Bhusa	1·8	9·9	3·1	2·5	6·2	1·5
Grass	2·7	2·6	3·2	3·4	10·4	2·9
Soap nut leaves	4·7	2·9	2·5	2·1	10·6	5·4
Sand	5·3	5·7	2·4	3·1	—	4·8
Pine needles	4·1	3·5	7·3	3·5	29·1	6·2

It will be seen from the above table that the percentage of loss due to insect attack as well as rotting was higher when potatoes were stored on the floor than when they were stored on racks. Saw dust, lantana, local grass, and "bhusa" gave good results. These experiments are being continued.

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* *Phthorimæa operculella* Zell. *Gelechidæ lepidoptera.*
† Includes all potatoes showing moth damage.

DO THE ARMY WORM MOTHS IN INDIA HAVE PHASES?

VERY recently, Faure (1943*b*) has published an important paper, which deserves to be widely known in India, on phase variation in the S. African army worm moth, *Laphygma exempta* (Walker). It exhibits *solitaria* (non-swarming) and *gregaria* (swarming) phases. Faure has conclusively demonstrated from laboratory experiments that larvæ reared crowded develop a velvety black or *gregaria* coloration, while those reared in isolation acquire a green or *solitaria* colour. The *gregaria* larvæ are far more active than the *solitaria*. In addition, Faure has brought forward evidence to show that the moth occurs as a pest in certain years, but is not to be seen in others. Normally it breeds permanently only in certain, as yet unknown, outbreak centres from which it migrates to considerable distances in swarming years. Thus, unless the permanent homes of the *solitarias* are discovered through continued search, the biology of the moth cannot be correctly understood and the control cannot be very effective. The parallel with locusts is striking, with this difference that so far the adult moth of the army worm have not been shown to have any apparent morphological phase differences.

This is the first clear instance of well-developed phase variation in an insect other than locusts and grasshoppers where it is now well known since the discovery of Uvarov (1921). Zoologists must now look for it in other animals, wherever a tendency to natural gregariousness occurs.

But to Indian economic entomologists the chief importance of Faure's discovery lies in the fact that the army worm is one of the serious pests of rice, and it is important to know whether, as in S. Africa, it has phases. For, if the phases are present, the permanent homes have to be discovered. The position is further complicated by the fact that Faure has thrown some doubt on the identity of the Indian army worm moth. He writes (1943*b*, p. 1): "..... *Spodoptera mauritia* (Boisd.) appears to be the important army worm in Ceylon and in India, as well as in certain other parts of the continent of Asia, but outbreak of this species have also been reported from Australia, Java, and the Philippines. Both *L. exempta* and *S. mauritia* are recorded as occurring in Africa and in India (Janse, 1937-39); in Africa only *L. exempta* is known as an army worm and in India only *S. mauritia* appears to attain outbreak numbers. Since Swezey (1938) has stated that the nutgrass army worm was for many years known as *Spodoptera mauritia* Boisd., but it has now been identified as *Laphygma exempta* Walk., in Hawaii, one wonders whether the army worms of Africa and India are not perhaps one and the same species.

"The question of the correct identification of the army worms of Africa and India is not merely a matter of academic importance. If it is correct that both species referred to in the preceding paragraph are common in both regions, and that only one of them produces outbreaks in each region, it might be worthwhile to make a thorough study of the two species, both in India and in Africa. It is conceivable that parasites may play a role of importance in preventing outbreaks of *S. mauritia* in Africa, or of *L. exempta* in India, and in this event the importation of parasites into

one or both of these regions might be worth attempting."

Faure (1943*a*) had shown earlier the occurrence of comparatively weakly developed phases in the lesser army worm *Laphygma exigna* (Hubn.). He has also shown (1943*b*) that the lawn caterpillar, *Spodoptera abyssinia* Guen. exhibits what is probably an incipient development of phases.

This note has been written with the purpose of bringing Faure's discovery to the notice of Indian entomologists. Phase studies in India should be conducted simultaneously on *L. exempta* and *S. mauritia*. Ayyar (1940, p. 152) states that in the latter the larvæ, when full grown, are dark to pale green, though there is a good deal of variation in colour. This may possibly be due, in part, to phase differences. The life-history of *L. exempta* in S. Africa has been given by Hattingh (1941).

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1. Ayyar, T. V. R., *Handbook of Economic Entomology for South India*, 1940, p. 528, Madras. 2. Faure, J. C., *Emg. in S. Afr.*, 1943*a*, **18**, 69–78. 3. —, *Sci. Bull. Dep. Agric. and For. Un., S. Afr.*, No. 234 (Nov. 1943), 1943*b*, p. 17, pl. 1. 4. Hattingh, C. C., *Ibid.*, No. 217, 1941, p. 8, pls. 2. 5. Janse, A. J. T., *The Moths of South Africa* (1940), Pretoria, 1937–39, p. 435, pls. 46. 6. Swezey, O. H., *Proc. Hawaii Ent. Soc.*, 1938, **10** (1), 75–6. 7. Uvarov, B. P., *Bull. Ent. Res.*, 1921, **12** (2), 135–63.

MICROBRACON BREVICORNIS, W. IN THE BIOLOGICAL CONTROL OF THE LAB-LAB POD-BORER

Microbracon brevicornis W. (Braconidæ), the ectophagous larval parasite of *Corcyra cephalonica* St., the common moth-pest of stored rice, jowar and flour, has recently been successfully tested in the laboratory and out in the field, against *Adisura atkinsoni*, the common pod-borer caterpillar of Lab-lab. In most of the several cultures set up in the laboratory with particular instars of laboratory-bred pod-borers and treated with freshly emerged individuals of *Microbracon brevicornis* W., the host was readily stung and eggs were deposited by the females; the grubs hatching out from the eggs fed on the caterpillar-hosts and pupated in due course and adult parasites subsequently emerged out. Not only naked and free host caterpillars but also others inside Lab-lab pods in the different cultures were freely parasitised, the female parasites even penetrating easily, through punctures, inside the pods.

Similar observations were made, also, in the case of cloth cages enclosing infested pod-bearing branches of Lab-lab, and others fixed in the soil enclosing whole bushes into which suitable numbers of parasites were introduced.

Bulk releases of *Microbracon brevicornis* W., in selected plots (with proper controls) of borer-infested Lab-lab, in the field were also made at the Hebbal Farm. Definite numbers of pods picked out at random, at definite intervals in the treated and control plots, were examined in the laboratory and clear and abundant signs of parasitisation were found; other lots of pods picked in the field were kept by, from which adult parasites were, in due course, recovered in fair numbers.

The natural field parasites, namely, *Microbracon hebetor*, of the Lab-lab pod-borer larvæ was, of course, also recovered from the pods picked out from the plots. It is clearly evident that both the natural parasite of the pod-borer larvæ and the introduced or released parasite, *Microbracon brevicornis* W., select out the same hosts separately in the same plot for parasitisation.

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CLASSIFICATION OF MANGOES

IT is estimated that there are now over 500 known and named varieties of mangoes in India. This number, however, is not based on a scientific system of classification, because it has been usual to classify them on the shape and other characters of the fruit. An attempt is now made to determine whether morphological characters such as tree habit, branching and foliage would be helpful in evolving a satisfactory classification.

The mango wealth of India may be considered under two groups: (*a*) Seedling trees, and (*b*) grafted trees. In spite of their number and utility, the latter are merely horticultural varieties, having their origin in chance seedling trees, the genetic purity of which is not established. It must be recognised that as a result of grafting, features like low branching and tree vigor are likely to be influenced by the root-stock and hence a full and natural description of any variety may only be obtained from the original seedling tree. In view of this, only the naturally growing seedling trees ought to be considered as a basis of classification.

In a study of 25 grafted mango varieties and 107 seedling trees grown in the Baroda State, it is observed that:—

(1) The branching is close and erect, semi-open or open, depending upon the angle at which the main branches are held in relation to the main trunk.

(2) The foliage is sparse, medium dense or dense; and light green, green or dark green in colour.

(3) The sizes and shapes of leaves vary widely. Leaves borne at the ends of shoots have a broader base than those at the lower nodes. Waviness of the margin, folding of the sides of the lamina, texture and aroma are some other factors which vary considerably. The anthocyanin displayed by young immature leaves is an interesting character. Scaly leaves of opening buds and those towards the stem apices are generally light green in colour, irrespective of the shade they exhibit as they mature. The light green gradually changes into the characteristic green of fully grown leaves through various intermediate shades.