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R. W. DITCHEBURN.
E. J. POWER STEELE.

Trinity College,
Dublin.
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¹ NATURE, 147, 474 (1941).

² Science, 93, 21 (1941).

Infestation of Manufactured Food by Insects

In summarizing the "Report on a Survey of the Infestation of Grain by Insects"¹, Dr. A. D. Imms² has stated that the important result of the survey is the demonstration that the infestation occurs throughout all the industries. In Dr. Imms's opinion the major problems appear to be the regulation of humidity and temperature.

Another side of the problem which is no less important and which has not been dealt with by the Committee is the presence of infestation in manufactured cereal products which are exported from Great Britain to the tropics. It was brought to our notice that a large number of bottles in different consignments of a proprietary invalid food manufactured in England had become infested with beetles.

The food was prepared from malted cereals and wheat flour and the process of preparation was a complicated one in which the article was subjected to heat not exceeding 170° F. and was also subjected to drying *in vacuo*. On examination, the seals of the bottles were apparently intact, although beetles, a large number of them being dead, were noticed inside the bottles. They were two distinct species, *Tribolium castaneum* Linn. and *Sylvanus surinamensis* Linn. The solidification of the food was an inevitable consequence of infestation and in a few samples solidification occurred without the presence of beetles.

With special regard for the manufacturers, we made some experiments with the view of determining if possible how these beetles invade the food. The two main propositions were: (1) if they enter the food in the egg or larval stages before this is put into the bottles; (2) or if they get in afterwards. The former presumption is groundless as a temperature of 125° F. over a period of one hour has been found fatal to eggs, larvæ, pupæ and adults. That it is more probable that the infestation takes place after bottling is supported by the statement made by the local representative that an absolutely fresh consignment is very rarely infested.

It is therefore quite apparent that the beetles get in through the sealing and this is supported by the fact that sometimes the food has been found to solidify without the apparent presence of beetles, which suggests that in these cases there has been connexion with the outside air. In one bottle in which we carefully examined the attachment of the circular disk and waxed paper with a hand-lens, we found the cover loose in two places. This, however, may not have represented careless packing, but the work of the beetles or their larvæ. We therefore suggested the possibility of the beetles, whether larvæ or adults, making a way for themselves through

the sealing. With this possibility in view we set up an experiment to see whether larvæ and adults which were previously starved could invade a bottle of the food through a well-sealed cover and we found that they could not or did not. When placed inside a sealed bag made of thin paper without any food, which was then buried in flour dust, the larvæ and adults were not able to eat their way out and died of starvation inside the bag.

The weight of evidence therefore inclines us to the belief that the insect gains ingress to the food through crannies left in the sealing of the covers and not by gnawing a way through for itself.

Regarding the country of origin of infestation, both the species being cosmopolitan, there is no reason why invasion of the food should not take place anywhere either in England, on the sea, or in India. However, as larval and pupal skins were detected in the solidified material and especially on the inside of the waxed paper used for sealing, it is highly probable that the invasion takes place in the larval stage. The smallness of its size and its flattish form allows it to penetrate apparently tightly wrapped packages.

It is indeed surprising that the beetles showed no signs of any attempt to multiply, although both sexes were present. In temperate climates there are normally 4-5 generations a year, but in the tropics the breeding of both the species is continuous.

The matter of using the proper kind of seal is therefore extremely important and sealing wax should be preferred to ordinary wax, the attachment of which is likely to be loose due to shaking on the journey.

D. N. ROY.

Department of Medical Entomology,
School of Tropical Medicine,
Calcutta.
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¹ "Report on a Survey of the Infestation of Grain by Insects." (London: H.M. Stationery Office, 1940.)

² "Grain Destruction by Insects", by Dr. A. D. Imms, NATURE, 146, 238 (1940).

"The Physical Condition of the Planets"

READING Sir James Jeans's most interesting and informative lecture at the Royal Institution (see NATURE, May 3, p. 526), one is, I think, brought up short by the following statement "The greater part of both atmospheres [of Jupiter and Saturn] will be at a pressure of more than a million terrestrial atmospheres. Under such pressures, no known substance remains gaseous." This latter statement is so far contrary to what I, in common no doubt with most chemists, have been taught "from my youth up", that I cannot believe it represents Sir James's considered opinion.

If Sir James Jeans really thinks that the general acceptance for the past fifty years of the 'critical temperature' as a definite property of all gases is erroneous, and that the observations of Andrews and of Amagat have been incorrectly interpreted, surely he would have taken some other opportunity than a semi-popular lecture to announce his conclusion to the scientific world.

Another point in Sir James's lecture which appears difficult of acceptance is the postulation of low temperatures in the interiors of these large planets. It is, I think, generally accepted that in a planetary