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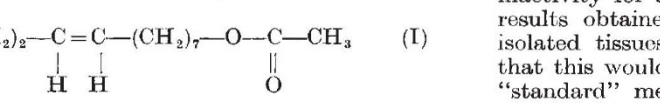
## Sex Pheromone of the Oriental Fruit Moth

THE chemistry and specificity of sex pheromones in two subfamilies of the lepidopterous family Tortricidae[1,2] have been studied because of the large number of economically important insects included. We identified the pheromone structure of the red-banded leaf roller moth, *Argyrotaenia velutinana* (subfamily Tortricinae), as *cis*-11-tetradecenyl acetate[3], and now report the pheromone structure of the oriental fruit moth, *Grapholitha molesta* (subfamily Olethreutinae), to be *cis*-8-dodecenyl acetate (I).



$$CH_3—(CH_2)_2—\underset{H}{C}=\underset{H}{C}—(CH_2)_7—O—\overset{O}{C}—CH_3 \qquad (I)$$

Crude extracts from the female abdominal tip[4] were saponified and acetylated to give a hundred-fold increase in pheromone concentration. We investigated the structures by the usual techniques[3] of column, gas and thin-layer chromatography, ozonolysis and mass spectrometry. Compound I was synthesized by two independent routes[3] and elicits a very intense male oriental fruit moth response in laboratory bioassays[5]. More importantly, more than 1,200 *G. molesta* males have been attracted to the synthetic pheromone in field tests. The most effective attraction is obtained with 10 to 200 μg of the compound absorbed on polyethylene.

Related geometrical and positional isomers of the acetate, mixed with the synthetic pheromone, exhibit male inhibition[6] by greatly reducing the attractiveness of the acetate in field tests. An interesting observation was that two closely related pest insects, *G. prunivora* and *G. packardi*, were attracted to *cis*-8-dodecenyl acetate and *trans*-8-dodecenyl acetate respectively, but were not attracted to any other test isomers. Male *G. prunivora* were not attracted to *G. molesta* females, however, suggesting the possible role of secondary chemicals.

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## Temperature Dependence of Metabolic Rate in Animals

RECENT work by Newell and Northcroft[1] has suggested that the basal or standard metabolic rates of poikilotherms are not sensitive to changes in temperature within wide limits: in the four species studied, the temperature coefficient, $Q_{10}$, was 1·0 or less between approximately 7° C and 23° C. This was substantiated by experiments showing that in both poikilotherms and homeotherms there is a plateau of temperature independence ($Q_{10}$ less than 1·3) extending from approximately 5° C to the mean environmental temperature in poikilotherms[2,3] and to normal body temperatures in homeotherms[4]. The validity of this observation on mitochondria has been challenged by Tribe and Bowler[5], who demonstrated normal temperature dependence in whole blowflies and in isolated flight muscle tissues. Because of the ecological and physiological importance of the concept of temperature independence, we have investigated the level of cellular organization at which it may operate in both poikilotherms and homeotherms.

In our first series of experiments, the rates of oxygen consumption by two common marine invertebrate poikilotherms was measured during periods of observed inactivity for a range of temperatures. To confirm the results obtained, the experiments were repeated using isolated tissues from these animals, for we considered that this would approximate more closely to the *in vivo* "standard" metabolic rate than any disrupted cellular system. Crabs of the genus *Carcinus* and limpets of the genus *Patella* were used. The first experiment utilized British species (*C. maenas* and *P. vulgata*), but subsequently the experiments were repeated at the Stazione Zoologica, Naples, using Mediterranean species (*C. mediterraneus* and *P. coerulea*) living in seawater approximately 10° C warmer than the former animals. Oxygen consumption by whole animals in air was measured using constant pressure respirometers[6]. Gill tissue from *Carcinus* and mantle tissue from *Patella* was suspended in seawater that had been filtered through a membrane, and the endogenous oxygen uptake was determined by either Warburg or Gilson manometric methods. Tissue results were calculated in μl. of $O_2$/mg dry weight/h and the whole animal results are based on the uptake of a 10 g animal after the statistical analysis described previously[7,8]. From these values the $Q_{10}$ for 5° C temperature intervals was derived.

It is well known[9,10] that $Q_{10}$ is dependent on temperature with values falling below 2·0 at the higher temperatures. Table 1 shows that the $Q_{10}$ values obtained here follow the normal pattern, being highest at low temperatures and decreasing with increase in temperature. For certain small temperature intervals (for example, *Patella vulgata* 15°–20° C), the $Q_{10}$ values are lower than anticipated, but it is not yet clear whether this is significant or whether it is an experimental artefact. In neither the