Table 2. Comparative concentrations of Po^{210} in tissue of United Kingdom residents.

Tissue	Po^{210} concn. (pc/100 g)	Concn. ratio tissue/plancenta
Placenta	0.33	
Liver	1.69	5.1
Kidney	1.72	5.2
Lung	0.54	1.6
Testis	0.39	1.2
Bone	2.9	8.8

In order to investigate the possibility of a correlation between natural Po^{210} and artificial Cs^{137} levels in human tissues, γ-spectrometric measurements have been made of the Cs^{137} contents of some of the placentas in the Canadian series. The results (Fig. 1) yield a correlation coefficient of 0.93, significant at the 0.1-percent level, for placental concentrations of the two nuclides and thus provide new evidence for an origin and route of uptake of the polonium isotope that are similar to those of Cs^{137}. The explanation of this finding seems to lie in the natural atmospheric content of Rn^{222}, whose decay results ultimately in production of Po^{210} (Cs^{137} is also produced in the atmosphere by radioactivity decay of a rare gas, the fission product Xe^{137}), and in the predominant importance of a food chain involving animals dependent for grazing on large areas of slow-growing vegetation that is known to accumulate both nuclides effectively, following their deposition from the atmosphere.

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Polymorphism in Some Nearctic Halictine Bees

Abstract. *Average difference in size between queens and workers of four social Halictinae common to southern Ontario ranges from 6 percent in* Augochlorella striata *(Prov.) to 15 percent in* Evylaeus cinctipes *(Prov.). Spring larvae receive provisions averaging 33.9 milligrams and become small workers; summer larvae consume on average 61.7 milligrams and develop into large queens and males.*

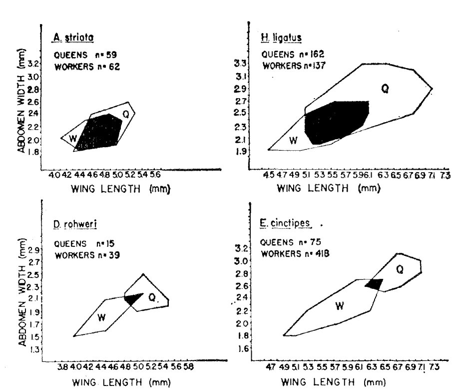

Fig. 1. Size polymorphism of female castes in *Augochlorella striata* (Prov.), *Halictus ligatus* Say, *Dialictus rohweri* (Ellis), and *Evylaeus cinctipes* (Prov.). Wing length and abdominal width are the two parameters used. Caste discontinuity is indicated by decrease in the overlap of measurements (black areas).

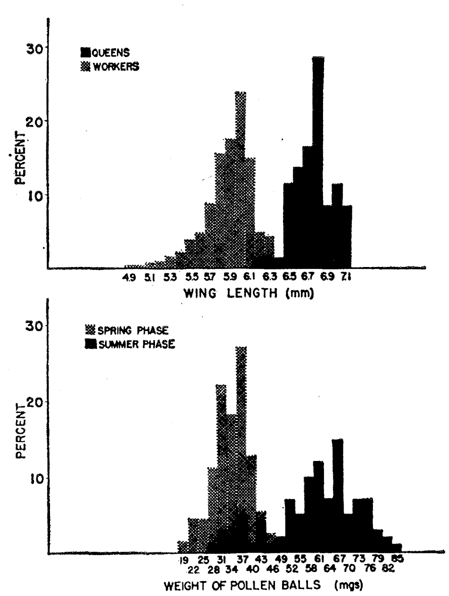

Fig. 2. Caste determination in *Evylaeus cinctipes* (Prov.). Bimodality in both histograms is similar, indicating direct relation between the weight of provisions and the size of bees that developed from them. (Top) N, 418 and 75, respectively. (Bottom) N, 65 and 98; $\bar{x}$, 33.9 and 61.9 mg, respectively.

Living organisms, unlike manufactures from modern assembly lines, show extensive visible variation. Such variation is often caused by environmental factors acting on a genotype, differences between sexes, or recurrent mutations in a population (*1*). Frequency curves for single characteristics (such as height or weight) are usually unimodal, and the variation is then said to be continuous; when a curve has two or more modes, the variation is said to be discontinuous. Such a situation is subject to normal evolutionary pressures and may lead to either polymorphism or speciation (*1*). For many years only visible morphological polymorphism was known, but "cryptic" polymorphisms of a physiological or biochemical nature have recently been discovered (*2*). Polymorphism in Hymenoptera, in contrast to termites, is confined to the female sex, in which there is often a very discontinuous variation, as in the caste system of honeybees and ants.

Halictine bees, which show remarkable variety in structure and behavior, exhibit also a wide spectrum of polymorphism in species having the best-developed social behavior (*3*). The two female castes, queen and worker, often differ greatly in size but always lack the anatomical modifications characteristic of the castes of complex insect societies. Other halictine species, although they may have an incipient level of social behavior, show less difference in size between queen and worker (*3*). *Evylaeus marginatus* (Brullé) is unique in forming perennial instead of the usual annual societies, yet having castes that differ little in size despite their different behavior (*4*).

Biometric analyses of halictine castes in southern Ontario show a progressive discontinuity in the degree of variation in the four species studied, from *Augochlorella striata* to *Evylaeus cinctipes* (Fig. 1). The nature of the life cycle influences the degree of polymorphism (*3*). The two species with the greatest caste discontinuity (average difference in size between the castes is 10 percent in *Dialictus rohweri* and 15 percent in *E. cinctipes*) produce only one summer brood, whereas continuous production of progressively larger workers throughout the summer reduces the initial difference in size in the castes of *A. striata* and, especially, *H. ligatus*, and also explains the remarkable range in size of females of the latter two species (*5*).

Although all newly emerged females of the summer brood remain in their natal nests and function as nonreproductive workers, differences in the level of social behavior exist between the four species (*3*). This is not surprising, since the morphs are only expressions of the physiological and behavioral differences between castes. The more discontinuous the visible variation between queen and workers, the more complete is the division of labor and the ovarian inhibition of the workers. Suppression of males in the early broods is associated with the higher levels of social behavior; the summer brood of *A. striata* has as many males as females, while that of *E. cinctipes* has no males at all (*5*).

Determination of caste was once thought to be genetic, but female eggs have proved to be all alike in bees, wasps, and termites that have been studied so far. Plasticity within individuals rather than differences between them are transmitted genetically in social insects, and only the quality or quantity of food seems to influence the immature insect (*6*). The mechanism of caste determination is best known in honeybees, where the food of larvae (the protein and fat that comes from glands of adult workers) determines the fate of a diploid egg. A critical point is reached about the 3rd day in the larva's life, after which time determination can be only partially reversed (*7*). Similar processes are probably at work in highly evolved ant and wasp societies in which progressive feeding by trophallaxis is common. The more-primitive societies of halictine and some bumblebees feed their brood by mass provisioning, that is, food for the complete development of a new bee is supplied before the larva begins to feed. The physiological plasticity of Hymenoptera (*8*) allows completion of development on very small rations, and this trait must have favored the evolution of a subnutritional variant (worker). Production of such a caste is "cheaper" and also adaptive, since foraging queens spend less time away from the nest and thereby reduce the opportunities of predators and parasitoids.

Exchange of food (trophallaxis) has never been observed in halictine bees, and the lack of morphological specialization in the female castes makes it unlikely that there is a glandular mechanism of caste determination. There is a direct relation between the quantity of food provided and the size of the developing bee, at least in *E. cinctipes* (Fig. 2). Agreement between the two curves (wing length and weight of provisions) is really much closer than Fig. 2 suggests, because pollen measurements of the early summer phase have been included. Pollen balls at that stage are small (the workers apparently need some time to reach optimum proficiency in foraging), and the prevailing protandry in social species destines them for consumption by males.

With species like *H. ligatus*, which show gradual increase in the average size of workers produced during the summer, the amount of provisions tends to increase in the cells as more workers become available for field duties. No abrupt increase in the size of pollen balls was noted in these species before fall; this fact explains the presence of overwintered females of intermediate sizes in pleometrotic (of more than one female) associations in the following spring (*3*). An even smaller difference is found between the pollen balls of the spring and summer phases of *A. striata*, a species having small queens scarcely larger than the smallest workers, and large workers approaching the size of the biggest queens (Fig. 1).

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Insect Aerodynamics: Vertical Sustaining Force in Near-Hovering Flight

Abstract. *The source of vertical sustaining force for large insects capable of near-hovering flight is unclear. Induced velocities of a simulation of the insect* Melolontha vulgaris *in forward flight were measured with a hot-wire anemometer. The results were negative with respect to the drag concept of vertical force, but provided certain support for the circulation concept. Unsteady effects (the effects of variant air velocity) proved significant.*

Flight of birds (*1*) and large insects (*2*) is generally described by means of strip-integration, quasi-steady circulation techniques. However, as flying insects approach the "hovering condition" —that is, as the ratio of forward speed to flapping speed becomes small—requisite lift coefficients become surprisingly large (*3*). Because insect-flight Reynolds numbers (Re) range from approximately 3 to 5000, a range unfavorable (*4*) for the development of large lift coefficients, other possible explanations of a vertical sustaining force have maintained currency.

One such possibility is the drag concept (*5*), in which the difference between downstroke and upstroke drag is deemed the prime source of support. This view has been advocated particularly for the smallest of insects (*6*), moving at Re so low (≤ 10) that air is experienced as a largely viscous medium; but at higher Re the validity of this concept is uncertain.

Another possibility is that of virtual-mass effects (*3*): As the wing accelerates the apparent inertia is increased by the mass of air (induced mass) that is influenced by the motion of the wing; for example, in the case of a small acceleration normal to a nominal flight path, the induced mass encompasses the cylinder of air whose diameter equals the wing chord (*7*). As the apparent inertia of but a portion of this mass, the boundary layer, has been deemed significant to the wing loading of insects (*8*), it is conceivable that induced-mass acceleration may produce usefully large, transient, lift forces.

A large insect exhibiting near-hovering characteristics was chosen for examination of these possibilities. *Melolontha vulgaris*, a beetle, has size and velocity such that the airflow Re falls well outside the Stokes drag regime. If the vertical sustaining force arises largely from circulation effects, it has been calculated (*3*) that a mean lift coefficient of about 2.0 is required on the downstroke. By the standard of experience with propellers and helicopters, which operate at an Re more favorable