Reports

Permeable Spots in the Cuticle of the Thin-Walled Pegs on the Antenna of the Grasshopper

The largest of three types of basiconic sensory pegs which are present on the antennal flagellum of the grasshopper is permeable at its tip to water and to aqueous solutions of dyes when they are applied to the outer surface of the antenna of the living insect (*1*). These large permeable pegs, which are thick-walled except at the tip, are found not only on the antennae but on other parts of the body as well, and experimental evidence indicates that they are probably the receptors which are affected by strong repellent odors (*2, 3*). The two smaller types of basiconic pegs, both of which are thin-walled, occur only on the antennae, and these have resisted many attempts to demonstrate that they, too, are permeable to water and to dyes (*1*).

Recently it has been found that each of these types of thin-walled peg is provided with a minute permeable spot near its base and that this is also the point where the distal processes of the sensory neurones are attached. Because of the small size of these spots, their position at the base of the peg, and their own natural, pale brown color, stain, when it does enter, is not easy to detect. The preparations in which the permeability of these spots was first successfully demonstrated were made with the antennae of the large eastern lubber grasshopper, *Romalea microptera* (Beauvois), which is a particularly useful species for the study of fine histological detail. The antenna was removed from the living insect and placed at once in a petri dish between two small squares of cotton gauze that had been wet with a 0.5-percent solution of methylene blue in Ringer-Locke solution. The cut end of the antenna protruded from between the layers of gauze so that the dye could not reach it. Two hours later, the antenna was cut into several short pieces and fixed in ice-cold 8-percent ammonium molybdate for 12 hours or longer. The pieces were then washed in cold distilled water and divided lengthwise, and the soft tissues were brushed out. After a quick dip in 70-percent alcohol and in absolute alcohol, followed by 10 or 15 minutes in dioxan, the pieces were cleared in toluol and mounted flat and with the outer surface uppermost in Harleco synthetic resin. In such preparations, the large basiconic pegs are stained blue at the tip, while the two smaller types of basiconic pegs each show a single, small, rounded, blue patch near the base. The coeloconic pegs, which are also permeable at their tips, are only rarely colored, for the air that occupies the small cavity in which each lies is usually not displaced by the staining solution, and special means must be used to bring the dye into contact with the tips of these pegs (*3*).

It is now possible to state, for the first time, that each of the four types of sensory pegs—three basiconic and one coeloconic—that are present on the antennal flagellum of the grasshopper is provided with a small specialized region through which water and dyes in aqueous solution pass readily. In the coeloconic peg and in the largest of the basiconic pegs, this specialized area is at the tip, while in the two smaller types of basiconic pegs it is located at the base.

In the past it has been generally assumed and often stated in the literature that the thin-walled sensory pegs of the insect function as chemoreceptors, and there is much experimental evidence to support this view (*4*). It is of particular interest, then, to point out that in the thin-walled basiconic pegs on the antenna of the grasshopper it is not the entire wall that is permeable but only a very small specialized region of it.

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Does Starvation Increase Sperm Count?

With reference to a recent article on starvation and sperm count (*1*), we wish to make a few comments. It is common knowledge that sperm count in an ejaculate is subjected to great variations in the same individual and among different species (*2*).

When a simple analysis of statistical significance was applied to the data of this article (*1*), it was found that comparisons of differences in each individual dog before starvation, during starvation, and after starvation have P values of about 0.5. Not one case displayed significant differences (P value of 0.01) either when analyzed according to sperm concentration or for total number of sperm. Furthermore, according to the recent determinations of McMillan and Harrison (*3*), the transportation of sperm from testis to the tail of the epididymis probably takes at least 14 days. Thus, if starvation did increase sperm count, it did not reflect sperm production but the evacuation of a large number of sperm from the epididymis. As for the high birth rate of the undernourished in India, many complicating factors may be involved, from the high selection pressure for fertility (*4*) to the lack of radio and television (*5*).

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The comments of Chang and Scheaffer are of interest because (i) they point up the controversial nature of the effect of starvation on fertility and (ii) they pose further problems for solution. We are now writing a longer article reviewing the literature, which mostly inclines to the opposite view to ours—that is, that starvation, especially malnutrition, decreases fertility. Observation of mating animals, such as the seal, the penguin, and the salmon shows that even 30-percent loss of weight accompanies sexual activity.

Starvation may have a different effect

in well-nourished animals, such as our dogs, and in the debilitated. Even though the *P* value may indicate *no difference* resulting from starvation, this finding of no difference is of importance and against current opinion. The notation of Chang and Scheaffer of the length of time for the transportation of spermatozoa—beyond the period of starvation—poses another problem, that of the mechanism of the effect of starvation. Chang and Schaeffer emphasize the need for knowledge and the lack of clarity in this unsettled problem.

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Rigidity of the Earth's Core

The rigidity of the earth's core is significantly less than that of the mantle. This is confirmed by the apparent absence on earthquake seismograms of shear waves that have traversed the core. Additional evidence cited by Honda et al. (*1*) is based on the amplitude of earthquake-generated shear waves reflected from the core (*ScS*) relative to the amplitude of direct-arriving shear waves (*S*). Since some assumptions concerning the radiation pattern of shear waves from an earthquake focus must be made, the latter method is useful for order of magnitude determinations only.

A quantitative estimate of the rigidity of the core may be obtained by a difficult computation involving the known rigidity of the mantle and the data for bodily tides and pole movements. Takeuchi (*2*) found a maximum value of core rigidity of 10^9 to 10^{10} dyne/cm^2 by this method. More recently, Molodenskiy (*3*) gives $\frac{1}{2} \times 10^{12}$ dyne/cm^2.

In this paper (*4*) the rigidity of the core is determined from the amplitude ratio of twice reflected shear waves, ScS_{II} to once reflected waves ScS_{I} under conditions of near vertical incidence. This procedure minimizes the number of assumptions required to interpret the data. Five occurrences of $ScS_{\text{I, II}}$ pairs suitable for amplitude-ratio determinations were found on Huancayo seismograms of near earthquakes with intermediate focal depths (see Table 1). The identification of these phases is made certain by the presence of their surface images $sScS_{\text{I, II}}$ (see Fig. 1).

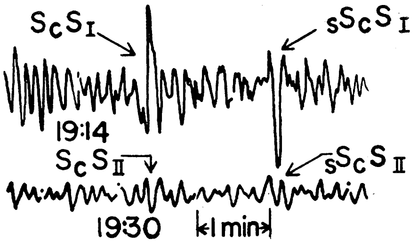

Fig. 1. Core phases from the earthquake of 22 December 1940.

To interpret the amplitude-ratio data, we use the approximate relationship

$$ScS_{\text{II}}/ScS_{\text{I}} = [Rc \exp(-2\sigma d)]/2 \quad (1)$$

where σ is the average absorption coefficient for shear waves in the mantle, d is the depth of the core, and Rc is the reflection coefficient for shear waves vertically incident on the mantle-core interface. The dimensionless dissipation parameter $1/Q$ is related to σ by $1/Q = \beta T \sigma/\pi$, where β and T are the velocity and period of shear waves, respectively. Rc is given by

$$Rc = [(\mu_m \rho_m)^{1/2} - (\mu_c \rho_c)^{1/2}] \\ [(\mu_m \rho_m)^{1/2} + (\mu_c \rho_c)^{1/2}]^{-1} \quad (2)$$

where μ and ρ are rigidity and density respectively, and the subscripts m and c refer to mantle and core in the neighborhood of the boundary. Implicit in the use of Eq. 1 are the assumptions that spherical divergence and the plane-wave, steady-state reflection coefficient are applicable. Since the wavelengths and focal depths are small compared with the radii of curvature of the boundaries, these assumptions are reasonable. They are partially validated by the identical amplitudes of *ScS* and its surface image *sScS* as shown in Fig. 1. The mean ratio of $ScS_{\text{II}}/ScS_{\text{I}}$ for five earthquakes was 0.3. As indicated by Eq. 1, this decrease in amplitude may be ascribed both to absorption of the shear waves in traversing the mantle and to loss on reflection from the core boundary. On the assumption of a perfectly elastic mantle in which $\sigma = 0$, Eqs. 1 and 2 yield a maximum value of core rigidity: $\mu_c < \mu_m \rho_m / 16 \rho_c$. Using $\rho_m/\rho_c \sim 4/7$ and $\mu_m = 3 \times 10^{12}$ dyne/cm^2 (*5*), we find $\mu_c < \mu_m/30 \sim 10^{11}$ dyne/cm^2. Assuming a vanishing rigidity in the core, and taking $T = 11$ sec. and $\beta = 6.2$ km/sec, we find that the maximum value for the average dissipation constant in the mantle is $1/Q \sim 200 \times 10^{-5}$. This is sufficiently close to values of $1/Q$ found by other methods (*6*) to indicate a rigidity in the core between zero and at least an order of magnitude smaller than 10^{11} dyne/cm^2. Since the incompressibility in the core is of the order of 10^{13} dyne/cm^2, the ratio of rigidity to incompressibility is smaller than 10^{-3}, indicating a state unlike that of a normal solid.

Table 1. Huancayo observations of amplitude ratio $ScS_{\text{II}}/ScS_{\text{I}}$. The average amplitude ratio is 0.29.

Earthquake date	Origin time (hr:min:sec)	Distance (deg)	Focal depth (km)	Magnitude	Amplitude ratio
6 May 1936	03:38:55	4	160	6	0.25
16 Feb. 1943	07:28:35	4	190	7	0.42
26 Feb. 1952	11:31:00	5	260	7	0.25
19 Sept. 1935	09:55:47	7	250	6½	0.29
22 Dec. 1940	18:59:46	8	230	7	0.25

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Effect of a Severe Storm on Electric Properties of a Tree and the Earth

For more than a decade, virtually continuous measurements have been made of the relatively steady-state standing potential of a tree. The potential difference is determined between two reversible, nonpolarizable silver-silver chloride electrodes imbedded in the cambium in the long axis of the tree, and separated by about 3 feet. These potentials show diurnal, monthly, and seasonal variations of considerable interest and, over the years, a suggestion of a correlation with sunspot activity.

It seemed worthwhile, therefore, to begin the study of the electric environment of the tree as measured by earth and atmospheric potentials recorded simultaneously with the potentials of the tree in order to determine the possibility of an interrelationship.