ing its polarity reversed. In one case, the bud did not move from the green, but in the other two cases the buds moved downward as usual onto the white part of the budding region.

Another possible explanation for the observed reversal in the direction of bud movement in inverted budding regions is that it was caused by an alteration in the orientation of the bud with respect to the long axis of the parent. The upper surface of the bud (facing the distal end of the parent) had, of course, become the lower surface (facing the basal end of the parent) at the same time that the polarity of the budding region was reversed. In order to determine whether reversing the upper and lower surfaces of the bud influenced the direction of the bud's movement, buds were cut off four parents, rotated 180° around their long axes, and grafted back at the points from which they had been removed. This was done with buds that had begun to form over the border of the green and white portions of the parent animals (Fig. 3). In the resulting grafts (Fig. 4), the white portion of a bud was more or less in contact with the green part of the parental budding region, and the green portion of a bud was in contact with part of the white region of the parental budding region.

In each case the area of contact of rotated buds and the distal green part of the budding region was reduced during the next 2 days, often to the point where the buds came in contact exclusively with the proximal white part of the budding region (Fig. 5). The color of the parent at points confluent with rotated buds was passed onto the buds giving rise to a checker-board appearance (Fig. 5); the distal portion of the bud was white and green, and the proximal portion was green and white.

Although these results excluded the possibility that the orientation of the upper and lower surfaces of the grafted portion of the buds influenced downward movement, it was still conceivable that the orientation of the bud influenced the upward movement of buds in animals in which the budding region had been inverted. To test this possibility, I reversed the orientation of a bud on each of two animals as above, but, when the bud had healed in place (about 1 hour later), the budding region of each parent was cut out, inverted, and reinserted into the parent. In these animals the polarity of the budding region was opposite that of the remainder of the parent, but the bud was oriented as it had been originally. These buds moved toward the distal white section of the parental budding region (Fig. 6), as had the other buds on inverted budding regions (Figs. 1 and 2). Evidently the direction of bud movement is not influenced by the orientation of the grafted portion of buds irrespective of whether the buds are moving up or down.

The view that the movement of buds depends on growth and attrition at opposite ends of the parent is not supported by the present results. This view can also be challenged on the basis of Campbell's evidence that mitotic figures are present throughout the length of the hydra's body (*3*). This suggests that the distal end of the parent does not grow away from the buds. Furthermore, reports (*3*, *6*) now indicate that the cell layers of the parental body wall can move downward at different rates. Since these layers in the parent are continuous with the corresponding layers of the developing bud, it is hard to imagine a mechanism through which the cell layers of the parent, moving at different rates, could move the bud as a unit at a single rate. Finally, buds generally move downward faster than the inner cell layer in the parent's budding region (*4*). Had the bud's movement depended on the movement of the parental body wall, the rate of the bud movement would scarcely have exceeded that of the inner cell layer of the parental body wall.

Another possibility not supported by my results is that the orientation of the upper and lower surfaces of the distal part of the bud influences the direction of its movement. The proximal part of the bud, which grows out of the parent after the distal part (*4*, *5*), moves either upward or downward depending on whether the polarity of the budding region has or has not been reversed.

The only alternative explanation remaining is that something inherent in the polarity of the budding region governs the direction in which buds move. This influence is stable enough to withstand the grafting procedure and survives for several days with the polarity of the budding region reversed.

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Hampea Schlecht.: Possible Primary Host of the Cotton Boll Weevil

Abstract. *The boll weevil severely infests buds in natural stands of* Hampea *sp. in Veracruz, Mexico. The geography and ecology of these trees suggest that they may be the long-sought primary host of the boll weevil.*

The boll weevil (*Anthonomus grandis* Boh.) was described in 1843 from an insect collected in 1841 on an unidentified host plant in the state of Veracruz, Mexico. Many years later (1880) the weevil was reported to occur on cotton (*Gossypium hirsutum* L.), but it was not recognized as a serious pest of cultivated cotton until around the turn of the century. The subsequent history of its migration from Mexico to other cotton-growing areas is well known (*1*).

Its earlier history, however, has remained a mystery, the elements of which are as follows. The boll weevil has a narrow range of hosts, as it thrives only on plants of the genus *Gossypium* L. (the cottons) and, to a limited extent, on certain species of the related genera *Thespesia* Corr. and *Cienfuegosia* Cav. (*2*). The weevil is now well established on *C. affinis* (HBK.) Hochr. in Venezuela; it was first observed on plants of that species in 1949 (*3*). It occasionally infests plants of a few other malvaceous genera, but it is apparently unable to maintain populations on them.

Cotton has been cultivated in Mexico for several thousand years (*4*), but only in recent decades has the boll weevil expanded from a little-known oddity on this host into a major agricultural pest. Three hypotheses may account for this situation: (i) the insect was introduced into Middle America from elsewhere; (ii) the insect was indigenous to Middle America and occurred on cotton, but it only recently

evolved into a more aggressive form; or (iii) the insect was indigenous to Middle America but only recently transferred to *Gossypium* from a related host plant. There has been no positive evidence in support of any of these hypotheses. We now report observations that support the third hypothesis.

The genus *Hampea*, which has generally been regarded as a member of the family Bombacaceae, probably belongs in the Malvaceae (*5*) and is a close relative of *Gossypium*; with certain other genera, these form a natural tribe, the Gossypieae. Thus, species of *Hampea* become suspect as hosts of the boll weevil, especially in view of the geographical distribution of *Hampea*, which grows from western Colombia through Central America to southern Mexico, at least as far north as the states of Oaxaca and Veracruz. The other genera can be ruled out on the basis of available negative evidence concerning them or because of their geographical remoteness. The critical area seems to be in southern Mexico, where the ranges of *Hampea* and of *Gossypium* come in contact, and where, in fact, the first boll weevil was collected. In a gross geographical sense, the ranges overlap; however, *Hampea* generally grows in damp locations, while *Gossypium* prefers drier areas.

We undertook a field trip to this area in September 1966 to observe *Hampea* in its natural environment. Flowering trees of *Hampea*, tentatively determined to be *H. integerrima* Schlecht. (*6*), were found as a part of the natural vegetation in a number of areas in Veracruz. The species is dioecious, an unusual condition in the Malvaceae (although probably typical of the genus *Hampea*), and both male and female trees produce an abundance of small fragrant flowers in axillary clusters along the branches. The plants are known locally as "Majagua" and "Tecolistle." The former name, at least, is also applied to a number of other plants.

In one locality in Veracruz (between Martínez de la Torre and Misantla) all of the *Hampea* trees observed were heavily infested with boll weevils; most of the flower buds showed oviposition punctures. Apparently no cotton is cultivated at the present time within several hundred miles of the area where we collected the weevils. We found adult weevils on both male and female trees; more adults emerged from flower buds harvested from the male trees. The insects have been identified as *Anthonomus grandis* Boh. (*7*).

These facts suggest that *Hampea* is a natural host for *Anthonomus grandis*. It may, in fact, be the original host from which the insect transferred to *Gossypium* sometime during the 18th century when expanded cotton cultivation provided an opportunity for the insect to spread.

Standley, in the only published revision of the genus *Hampea* (*8*), recognized nine species; seven additional species have been published subsequently, and others probably will be discovered (*6*). Our observations from Veracruz are all that is yet known of the extent to which *Anthonomus grandis* occurs on *Hampea*.

Stands of *Hampea* were observed at the following localities in Veracruz: Papantla (collection number 522), Tecolapan (525), Lago Catemaco (526), between Catemaco and the Gulf coast (527), Martínez de la Torre (534), and between Martínez de la Torre and Misantla (535). Voucher specimens of plants from these localities, bearing the collection numbers given, will be deposited in the Tracy Herbarium (TAES) at Texas A&M University, and duplicates will be distributed elsewhere. These plants grew at elevations ranging from about 150 m for specimens 534 and 535 to about 1000 m for specimen 527. Only in the vicinity of Martínez de la Torre were weevils found infesting the *Hampea* trees. The weevil specimens collected will be placed in the collection of the Entomology Department of Texas A&M University.

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6. The specimens cited differ in some respects from typical *H. integerrima*, primarily in leaf form; they may be taxonomically distinct from it. The typical form has truncate elliptical leaves and occurs at relatively high elevations; the present form has cordate ovate leaves and is found at lower elevations. The plants differ clearly in floral characteristics from *H. rovirosae* Standl. from Tabasco.
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Acetylcholine Receptor: Similarity in Axons and Junctions

Abstract. *Sulfur and selenium isologs of benzoylcholine and its tertiary analog differ greatly in their abilities to block the electrical activity of squid axons. Presumably, differences in the biological activities of these compounds can be correlated with differences in their electron distribution. The relative effects on axons parallel those on junctions of the electroplax, suggesting the presence of similar receptors.*

Evidence has been accumulating supporting the assumption that acetylcholine (ACh) is essential for the control of the permeability cycle during electrical activity of all excitable membranes (*1*). While the essentiality of the components of the ACh system, for example acetylcholinesterase and the ACh-receptor, at junctional regions is generally accepted, their essentiality along axons has been disputed (*2*). The ACh theory of conduction along axons, as proposed by Nachmansohn, has found new support in the demonstration that while electrical activity of excitable membranes is reversibly blocked by potent competitive inhibitors of acetylcholinesterase (such as physostigmine), irreversible inhibitors, such as diisopropyl fluorophosphate (DFP), block activity irreversibly (see *1*).

The specificity of the latter effect was questioned because of the high concentration required, but it has been found recently that DFP is rapidly inactivated in axonal preparations by a phosphoryl phosphatase and that, therefore, the inhibitor enters only in low concentrations (*3*). Moreover, under proper conditions, 2-formyl-1-methyl pyridinium iodide oxime restores electrical activity blocked by organophosphates (*4*); this is of special interest since this compound specifically reactivates acetylcholinesterase inhibited by organophosphates by breaking the P-O bond formed during the phosphorylation (*5*). By a combination of electron microscopy and histochemical staining and by ultra-microgasometric methods, it has been shown that the enzyme is localized in or near the excitable membranes in axonal as well as in junctional membranes (*6*).

The evidence for the association of acetylcholinesterase and electrical activity was supplemented by evidence that electrical activity is also blocked by compounds that compete with