SUMMATION OF DISSIMILAR STIMULI APPLIED TO LEAFLETS OF SENSITIVE BRIER (SCHRANKIA).

BY LEWIS B. BIBB.

First Lieutenant, Medical Corps, U. S. Army.

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The writer has made experiments upon the leaflets of *Schrankia uncinata* Willd, or sensitive brier (Fig. 1), to determine whether sub-minimal stimuli of different character, such as chemical and mechanical, when applied simultaneously would combine their effects so as to reinforce each other and produce a visible response. *Schrankia* appeared suitable for this purpose because the closure of one leaflet mechanically stimulates the next distal leaflet and causes it to close also (this will be referred to as secondary stimulus), and thus a wave of closure is started which does not stop until all distal leaflets on the same side of the mid-rib are closed. Moreover, the intensity of the secondary stimuli is uniform as regards the leaflets of any given pinna, but varies according to the time of day. The intensity of the secondary stimulus is insufficient in the early morning to produce a visible response, but in the late afternoon it is sufficient to provoke prompt closure of the distal leaflets in turn. It was believed therefore that by choosing different times of the day for the experiment the intensity of the mechanical stimulus due to the effect of one leaflet on another could be varied at will, and that, at some optimum hour, the stimulating effect referred to would barely fall short of provoking a response. When this hour was found by actual trial in each individual case, it was planned to apply subminimal stimulation and then to observe whether the closure of one leaflet was followed by the closure of the next distal leaflet; that is, in the early morning, a single leaflet of *Schrankia* can be caused to close against the next distal leaflet without causing the latter to close (Fig. 2). In the late afternoon, on favorable days, the closure of any proximal leaflet inevitably provokes closure of the next distal leaflet (Fig. 3). The problem was
Fig. 1. Silhouette of leaf fastened (by a quick movement) between panes of glass and then fixed by heat to prevent closure of leaflets. Five pairs of pinnae are shown, each consisting of about a dozen pairs of leaflets.

Fig. 2. Silhouette made artificially to show appearance of pinna after a single leaflet has been caused to close by stimulation. This result usually is seen in the forenoon.

Fig. 3. Silhouette made under artificial conditions to show appearance of pinna after wave of closure has involved all leaflets distal to the leaflet originally stimulated. This result is usually seen in the late afternoon.
to ascertain whether subminimal chemical stimulation could be so applied as to lower the threshold of susceptibility to stimulation and cause the leaflets to behave in the forenoon as they normally behave in the afternoon.

Several attempts were made to transplant Schrankia, but such treatment interfered with its reactivity. A spray of the plant was isolated within an Erlenmeyer flask, with the object of securing a definite concentration of chemical substance (chlorine gas or ammonia fumes) in the atmosphere surrounding the leaflets; but this experiment proved a failure because of condensation of water on the inner surface of the flask. Attempts were made to summate subminimal mechanical stimuli with subminimal stimulation due to the concentration by a lens of the rays of the sun, and to summate mechanical stimuli with stimulation of different acids, but these experiments failed.

Finally, on June 22, 1919, at 11.15 a.m., the following experiment was performed. Several pinnæ of a plant growing in the open were tested by touching a more or less proximal leaflet, and in each instance, the touched leaflet closed without inducing closure of its next distal neighbor. A petri dish containing ammonia water (27 per cent) was then placed carefully underneath the adjacent compound leaf (consisting of five pairs of pinnæ) and after a few seconds, a single leaflet of each of four pinnæ was touched. In every instance, all leaflets, on the same side of the mid-rib, lying distal to the touched leaflet closed in a regular succession or wave. These results were confirmed by repeating the experiment on June 24, at 4 p.m.

On July 3, in the forenoon, several pinnæ of an individual plant were tested by touching one leaflet of each pinna. In every instance, the touched leaflet closed without causing closure of the next leaflet. A stream of chlorine gas mixed with air (10 per cent chlorine) was then allowed to flow gently over each of several pinnæ taken in turn. 6 seconds after the beginning of the application of the chlorine mixture, a proximal leaflet was touched; it closed and caused the closure of the next distal leaflet. The wave of closure proceeded until all distal leaflets on the same side of the mid-rib were closed. The fact that the leaflets on the opposite side of the mid-rib did not close was accepted as proof that the chlorine mixture did not alone cause the closure of the distal leaflets. All of several leaflets tested gave similar results.
SUMMARY AND CONCLUSIONS.

1. The pinnae of sensitive brier or *Schrankia* are favorable for demonstrating summation of dissimilar stimuli.

2. The demonstration was made as follows: A time of day was chosen when the closure of a single proximal leaflet did not provoke closure of the next distal leaflet. An irritating gas was applied to the pinna. A few seconds later, a single leaflet was touched; it closed, induced closure of the next distal leaflet, and inaugurated a wave of closure which proceeded until all leaflets on the same side of the mid-rib were closed.