first marked uneasiness on the part of the insect under treatment. In some cases this effect is immediate.

It is to be also noted in this particular that in the case of many specimens the first noticeable effect was an attempt on the part of the insect to clean its antennæ. The striking individual variations, in other words, the revival of many subjects after apparent death, show the necessity of extreme thoroughness in field and greenhouse, that is, a long enough exposure to insure carrying the insect beyond all possibility of recovery.

One hour's exposure to one part liquid CS_2 to 12,000 parts of atmosphere is apparently sufficient to kill aphids, but in making suggestions for practical application, I should certainly urge an hour and a half's exposure to that strength as being more sure, especially with crude CS_2. Ants appear generally to succumb to one hour's exposure to one part liquid CS_2 to 12,000 parts of atmosphere, the same as aphids, and yet in actual practise, to insure the best results, they should be subjected to a longer treatment. Aphids show immediately the effect of exposure, and some were on their backs from two to four minutes after treatment, and yet recovered after an exposure of three fourths of an hour to one part liquid CS_2 to 12,000 parts of atmosphere. *Tribolium confusum* was observed particularly to clean the antennæ immediately upon exposure.

The remarkable vitality of the Aphidæ (insects that we commonly regard as extremely delicate) is to be noted in connection with this work. Further, in a few cases we found that some of the insects which recovered such treatment died later, say within twenty-four hours, although the bottles in which they were confined were left open, only slightly plugged with absorbent cotton. This 'apparent death' is very deceiving. To all appearances these insects were absolutely dead, perfectly motionless, and in many cases we entered them on the record as dead, although we had to change that record several minutes later, when a wing, a leg or an antenna would be seen to move. Frequently only a slight movement of the mouth parts, all other appendages being quiescent, would indicate that the insect treated was still alive.

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A NOTE ON THE CALCULATION OF CERTAIN PROBABLE ERRORS.

The purpose of this note is to call the attention of workers in biometry to a point which serves to lessen somewhat the labor of computation in the frequently arising cases when one wishes to test whether a given frequency distribution obeys the normal law. Though sufficiently obvious, the point seems not to have been noticed.

In determining whether a given distribution of frequency follows the normal or Gaussian law it has been shown by Pearson[1] that the important constants are

$$\sqrt{\beta_1} = \sqrt{\frac{\mu_3^2}{\mu_2^3}},$$

$$3 - \beta_2 = 3 - \frac{\mu_4}{\mu_2^2},$$

$$\text{the skewness} = \tfrac{1}{2}\,\frac{\sqrt{\beta_1}(\beta_2 + 3)}{5\beta_2 - 6\beta_1 - 9},$$

and the 'modal divergence,'

$$d = \text{skewness} \times \sigma.$$

All these constants should equal zero within the limits of the error due to random sampling if the distribution be truly normal.

The probable errors concerned are (for the normal distribution), when $N =$ the total number of individuals,

$$\text{Probable error of skewness} = .67449\sqrt{\frac{3}{2N}}, \quad \text{(i)}$$

$$\text{Probable error of } \sqrt{\beta_1} = .67449\sqrt{\frac{6}{N}}, \quad \text{(ii)}$$

$$\text{Probable error of } \beta_2 = .67449\sqrt{\frac{24}{N}}, \quad \text{(iii)}$$

$$\text{Probable error of } d = .67449\sqrt{\frac{3}{2N}}\cdot\sigma. \quad \text{(iv)}$$

It is at once clear that the values of expressions (i), (ii) and (iii) stand in the relation to each other of

$$1 : 2 : 4.$$

[1] *Biometrika*, Vol. 4, pp. 169–212.

So then in practise it will be necessary to calculate from the formula only one of these probable errors for a given distribution, viz., the probable error of the skewness. Having determined this we need only to multiply it by 2, by 4 and by σ to obtain the values for the other three. RAYMOND PEARL.

BOTANICAL NOTES.

HALLIER'S NATURAL SYSTEM.

IN the July number of *The New Phytologist* Professor Dr. Hans Hallier discusses further his provisional scheme of the phylogenetic system of flowering plants. The general features of his system are: (1) the Angiospermae constitute a monophyletic group; (2) the Amentaceae are not an old type remaining in a lower state of development, but as 'the highest and most reduced types of one of the lines of Dicotyledons'; (3) they and all other lines of Dicotyledons have been developed by reduction of flower and fruit from the *Polycarpicae,* the latter group being derived immediately from *Bennettitaceae* or other extinct Cycadales; (4) in the same manner, the *Liliiflorae* and all other syncarpous Monocotyledons have been derived by union of the carpels, by reduction in the number of parts, by epigynous insertion of the perianth, and by other changes in the structure of flower and fruit from the polycarpous Monocotyledons (*Helobiae*), which latter group originated from the polycarpous Dicotyledons (*Polycarpicae* and *Ranales*); (5) the *Apetalae* and *Sympetalae* are unnatural groups.

In applying these general principles, Dr. Hallier has worked out the following arrangement of the Dicotyledons, which he distinctly says is provisional for all after the Piperales.

1. POLYCARPICAE (*Magnoliaceae, Canellaceae, Anonaceae, Myristaceae, Calycanthaceae, Monimiaceae, Lauraceae*).

2. RANALES (*Berberidaceae, Menispermaceae, Ranunculaceae, Nymphaeaceae, Ceratophyllaceae*).

3. RHOEDALES (*Papaveraceae, Capparidaceae, Resedaceae, Cruciferae*).

4. PIPERALES (*Lactoridaceae, Piperaceae, Chloranthaceae, Myrothamnaceae*).

5. MALVALES (*Sterculiaceae, Papayaceae, Euphorbiaceae, Bombacaceae, Malvaceae, Elaeocarpaceae, Tiliaceae, Rhamnaceae, Urticaceae, Dipterocarpaceae*).

6. EBENALES (*Sapotaceae, Convolvulaceae, Ebenaceae, Symplocaceae, Styracaceae*).

7. GERANIALES (*Zygophyllaceae, Cneoraceae, Oxalidaceae, Geraniaceae, Linaceae*).

8. MYRTIFLORAE (*Lecythidaceae, Caryocaraceae, Rhizophoraceae, Lythraceae, Myrtaceae, Melastomaceae, Combretaceae, Geissolomaceae, Penaeaceae, Oliniaceae, Thymelaeaceae, Elaeagnaceae*).

9. ROSALES (*Saxifragaceae, Rosaceae, Anacardiaceae, * * * * Meliaceae, Rutaceae, * Leguminosae, * * * * * * * Sapindaceae, * Celastraceae, * Aquifoliaceae, * * * * * Guttiferae, * * Dilleniaceae*).

10. ERICALES (*Clethraceae, Pirolaceae, * Ericaceae, * * * Diapensiaceae, * * Primulaceae*).

11. SARRACENIALES (*Sarraceniaceae, Droseraceae*).

12. SANTALALES (*Olacaceae, Ampelidaceae, * Santalaceae, Myzodendraceae, Gnetaceae, Loranthaceae*).

13. UMBELLIFLORAE (*Cornaceae, Araliaceae, Adoxaceae*).

14. AMENTIFLORAE (*Hamamelidaceae, Myricaceae, Salicaceae, Juglandaceae, Betulaceae* (incl. *Casuarineae*), *Fagaceae*).

15. PASSIFLORALES (*Flacourtiaceae, Violaceae, Cistaceae, * * Passifloraceae, * * * Onagraceae, * * * Gentianaceae, Aristolochiaceae, Rafflesiaceae, Loasaceae, Begoniaceae, Cucurbitaceae, Campanulaceae, * * * Compositae*).

16. CENTROSPERMAE (*Crassulaceae, Cactaceae, * * * * Portulacaceae, * Phytolacaceae, Tamaricaceae, Caryophyllaceae, Polygonaceae, * * Amarantaceae, Chenopodiaceae, Batidaceae*).

17. CAPRIFOLIALES (*Caprifoliaceae, Valerianaceae, Dipsaceae*).

18. TUBIFLORAE (*Apocynaceae, Loganiaceae, Rubiaceae, Bignoniaceae, Oleaceae, * * Acanthaceae, Verbenaceae, Labiatae, Scrophulariaceae, * Solanaceae, Polemoniaceae, Boraginaceae, Hydrophyllaceae*).