the lowering of temperature. Can it be that in the case of a warm-water copepod species breeding in unusually cool surroundings the incubation period may be so prolonged that the animal emerges from the egg in the second nauplius stage ?

SYDNEY G. GIBBONS.

Fishery Board for Scotland,
Marine Laboratory,
Torry, Aberdeen.
Nov. 16.

[1] *Trans. Amer. Mic. Soc.*, **56**, Jan. 1937.
[2] *Ann. Mag. Nat. Hist.*, Sept. 1936.

Effect of Spraying Solutions of Growth Substances on the Inflorescences of the Florists' Chrysanthemum

THE florists' chrysanthemum exists in many forms, two of the commonest being normal 'double' and 'incurved'. In both, the inflorescence consists entirely, or almost entirely, of ligulate flowers, but *the 'incurved' type is distinguished from the normal* 'double' type by the fact that in the former the corollas of the flowers constituting the mature inflorescence remain incurved. Experiments carried out here in which inflorescences of the double chrysanthemum (var. 'Gold Standard') were sprayed with solutions of two growth substances indicate that the difference between these two types of chrysanthemum may be a simple physiological one. The two growth substances used were β-indole-acetic acid (heteroauxin) and α-naphthalene acetic acid. Aqueous solutions of these growth substances of a concentration of 0·05 per cent were sprayed on to partially opened inflorescences by means of an atomiser.

In the unopened bud of the inflorescence the corolla of each flower is rolled longitudinally and folded laterally, and during opening there is a longitudinal unrolling and a lateral unfolding of the corolla of each flower. When partially opened inflorescences are sprayed in the manner described above, corollas which at the time of spraying are mature are unaffected by the treatment. Corollas which at the time of spraying are unrolling exhibit some reversal of movement and become incurved. Corollas which at the time of spraying are still rolled have their normal unrolling inhibited whilst the lateral unfolding proceeds normally and the flower becomes a typical 'incurved' one. The results are the same whether the treatment is applied to inflorescences attached to, or detached from, the parent plant.

Although these experiments have been carried out with synthetic growth substances, the resemblance between the effect of natural auxin and synthetic growth substances in other directions is so striking, that it appears possible that one of the fundamental differences between normal 'double' and 'incurved' chrysanthemums may be a difference of growth substance metabolism.

With single chrysanthemums (vars. 'Single Bronze' and 'Cleopatra') a similar inhibition of corolla unrolling has been obtained, whilst in the latter variety some 'outcurving' of apparently mature corollas was noticed.

L. G. G. WARNE.

Botanical Department,
University of Manchester.
Nov. 7.

Force Constants and Molecular Structure

IN previous papers[1] we have described measurements on the ultra-violet absorption spectrum of carbon suboxide, and have attempted to calculate the force constants of the linkages in this molecule from the measured normal vibration frequencies. A potential function was employed involving four constants, two of these representing 'cross-term interactions'. Unfortunately, at the time only the two symmetrical frequencies ($\nu_1 = 843$, $\nu_2 = 2{,}200$) were known accurately from the Raman data, and it was necessary to assume plausible values for the cross-term constants in order to obtain values for the main constants. Lord and Wright[2] have now published infra-red data from which the two unsymmetrical frequencies may be deduced ($\nu_3 = 2{,}290$, $\nu_4 = 1{,}570$). We thus have four frequencies and four undetermined constants. Insertion of the values gives $k_{CC} = 12{\cdot}69 \times 10^5$, $k_{CO} = 15{\cdot}0 \times 10^5$, $k_{24} = 5{\cdot}10 \times 10^5$, $k_{13} = 2{\cdot}43 \times 10^5$. k_{24} and k_{13} represent C—C—C and O—C—C interactions of the type previously suggested.

The new values of the main constants differ slightly from those previously found, but strengthen the hypothesis then suggested, that the bonds are intermediate between double and triple and that the molecule appears as a resonance hybrid. Moreover, the relatively high value of the interaction term k_{24} in such a molecule is in accordance with other related results, for which a reason was previously suggested. When applied to the relations of Badger and Clark connecting force constant and bond length[3], the new values of the force constants give good agreement and much better than the old. We find for the C—C bond, with Badger's formula $r = 1{\cdot}18$ A., with that of Clark $r = 1{\cdot}165$ A., the electron diffraction value being $1{\cdot}20 \pm 0{\cdot}02$ A.; for the C—O bond $r = 1{\cdot}21$ A. (Badger), $1{\cdot}265$ A. (Clark) and $1{\cdot}29 \pm 0{\cdot}03$ A. (observed).

We should like here also to refer to a recent note in NATURE by Bailey and Hale[4] which seems to misinterpret calculations we have recently made of the force constants of linkages in ethylene and tetrachloroethylene[5], and to raise objections which are invalid. Bailey and Hale point out the necessity of removing uncertainty as to what any particular force constant implies, and also the necessity of considering as far as possible molecules of the same symmetry type. They also refer to the difficulties involved in using a too artificial force field and point out that the calculations only refer to infinitesimally small amplitude. These matters, with others, are fully discussed by us in our detailed papers, and some of the arguments of Bailey and Hale are precisely those which are used by us. So far as the subsequent calculation for the case of ethylene and tetrachloroethylene is concerned, its merits and demerits are fully discussed by us in the paper referred to.

H. W. THOMPSON.

St. John's College,
Oxford.

J. W. LINNETT.

Harvard University.
Nov. 1.

[1] *Proc. Roy. Soc.*, A, **157**, 331 (1936); *J. Chem. Soc.*, 1291, 1384 (1937).
[2] *J. Chem. Phys.*, **5**, 642 (1937).
[3] *J. Chem. Soc.*, 1396 (1937).
[4] NATURE, **139**, 112 (1937).
[5] *J. Chem. Soc.*, 1376, 1384, 1393 (1937).