that sex-segregation does not take place at meiosis. Dr. Cadman herself is of the opinion that in the two species of Mycetozoa she has investigated, *D. nigripes* var. *xanthopus* and *Reticularia Lycoperdon* (Bull.), "there is no difference, morphological or physiological, between the gametes in either species".

In conclusion, it may be said that anyone who has worked at the cytology of this group will appreciate the technical difficulties that are involved in its investigation.

G. LISTER.

871 High Road, Leytonstone, E.11,
Dec. 13.

[1] *Trans. Roy. Soc. Edinburgh*, **56**, 93-142; 1931.
[2] "Untersuchungen über die Sexualität der Myxomyceten", *Planta*, **9**, 645-672; 1930.
[3] "Comp. Morph. and Biol. Fungi, etc.", Oxford Ed., p. 441; 1887.
[4] "Myxomycetenstudien 8", *Ber. Deutsch. Bot. Gericht*, **29**, 239; 1911.
[5] "Observations on Mycetozoa in the Genus *Didymium*", *Trans. Brit. Myc. Soc.*, **14**, 227-248; 1929.

Carbon/Nitrogen Ratios in Cacao Soils.

BY tabulating and comparing the results of a detailed laboratory examination of profile samples of cacao soils collected in January 1930, in the island of Tobago, British West Indies, one of us (G. G.) was able to demonstrate [1] a close correlation between the yielding capacity and the carbon/nitrogen ratio for the organic matter contained in the surface six-inch layer of soil. The mean ratio for 'good' soils yielding more than 8 bags (or 1320 lb.) of fermented and dried cacao beans per 1000 trees (pickets) is 8·3 (21 samples), and for 'bad' soils yielding less than 8 bags per 1000, 6·8 (10 samples). Statistically, this correlation is highly significant ($t = 4·5$), and the C/N ratio is not necessarily dependent on the total amount of organic matter present ($t = 1·1$). Although a complete explanation of this relationship is not yet forthcoming, the result implies that the nature of the organic matter present, rather than its total amount, is the primary factor concerned in the productivity of cacao soils under the climatic, cultural, and soil conditions that obtain in Tobago.

Afterwards, similar comparisons of yields and C/N ratios for cacao soil—profile samples collected in Trinidad and in Grenada, B.W.I.—have been established. The following additional results have been demonstrated:

	Mean C/N Ratios (Top 6 in. Soil).	
	'Good' Cacao Soils. (Yield, more than 8 Bags/1000.)	'Bad' Cacao Soils. (Yield, less than 8 Bags/1000.)
Trinidad . .	7·0 (54 samples)	5·7 (46 samples)
Grenada . .	8·0 (23 samples)	6·5 (12 samples)
(Tobago; for comparison) . .	8·3 (21 samples)	6·8 (10 samples)

Whilst these results substantiate the earlier Tobago result, the numerical values of the C/N ratios for the Trinidad and the Grenada soils are not identical with those for the Tobago soils, but they are of the same order of magnitude, and their differences are approximately the same.

A comparison of the climatic, cultural, and soil conditions within the three areas is instructive. The climatic differences are not very marked. Within each area, the annual rainfall (45 to 120 inches) is distributed between seven wet months (June to December) and five dry months. The cultural treatment is somewhat similar, except that leguminous shade trees (Immortel) are generally grown in the cacao fields of Trinidad and Tobago, but not in those of Grenada, whilst artificial manures are regularly employed in Grenada but not in the other islands. The soil types are markedly different. The cacao soils of Trinidad are mainly derived from Tertiary sedimentary rocks and from their recent alluvial representatives, but some alluvial soils of the Northern Range of mountains are derived from Palæozoic dynamo-metamorphosed sediments. The cacao soils of Tobago are about equally distributed between—(*a*) metamorphic sedimentary rock types, similar to those of northern Trinidad; (*b*) partly metamorphosed, intrusive basic igneous rock (epidiorite) types; and (*c*) alluvial equivalents of both. The cacao soils of Grenada are derived from Pleistocene basic volcanic rocks (hornblende and augite andesites and olivine basalts; lavas, intrusions, and fragmental rocks) or their alluvial derivatives. Detailed studies of all these soil types are now being prosecuted at the College, and include a special investigation of the transformations of their organic matter contents. It is hoped thereby to discover the true significance of the C/N ratio of soil organic matter in its relation to nutrition of the cacao tree.

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G. GRIFFITH
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Trinidad, Nov. 28.

[1] Unpublished Thesis in part fulfilment of the requirements of the Associateship of the Imperial College of Tropical Agriculture, Trinidad, B.W.I., session 1929-30.

Raman Lines and Infra-Red Bands in Nitrous Oxide.

THE question whether or not the N_2O molecule is linear, and if so, whether the oxygen atom occupies a position between the two nitrogen atoms or at one end, was discussed by Snow [1] some time ago. The incomplete evidence then available seemed to favour the symmetrical configuration. We have, however, been able to show conclusively that the molecule is unsymmetrical, though linear.[2] The form of the bands and the spacing of the rotation lines is inconsistent with any but the linear model. The selection rules for vibrational transitions and for the appearance of zero branches, and the fact that all three fundamental frequencies are optically active, indicate the asymmetry.

The lowest frequency fundamental vibration, designated as ν_2, involves simultaneous displacements of the three atoms perpendicular to the linear axis, the central atom moving toward one side and the extreme atoms toward the other. Dennison [3] has shown that in the first excited state each atom executes a circle about its normal position as centre. The molecule thus becomes a very slender rotating triangle the lengths of the sides of which *do not vary*. Consequently there is no change in polarisability with phase, and, according to Placzek,[4] no Raman scattering. A second fundamental frequency, designated as ν_1, involves simultaneous displacements of the two extreme atoms towards and away from the centre, with rapid changes in polarisability, and should give an intense Raman line. We find this band in the infra-red at 1285 cm.$^{-1}$.

The third fundamental frequency, ν_3, which we find at 2224 cm.$^{-1}$, involves displacements of both extreme atoms in one direction along the axis and of the central atom in the opposite direction. If the molecule were symmetrical (both extreme atoms identical) the configurations at phases one-fourth and three-fourths would be mirror images of one another. At zero phase the polarisability would be either a maximum or a minimum, the sequence of values assumed during half of the period being repeated precisely during the next half period. Thus no Raman displacements of the fundamental frequency would occur. For the

unsymmetrical molecule, however, this would not be the case, and Raman lines would be expected, though perhaps with low intensity.

The observations of Bhagavantam [5] corroborate in a satisfactory manner our conclusions regarding asymmetry. He finds an intense Raman line with the displacement 1283 cm.$^{-1}$, and a rather weak line with the displacement 2226 cm.$^{-1}$, in very good agreement with our values for ν_1 and ν_3. The former corresponds to the intense scattering in CO_2 associated with the symmetrical and optically inactive vibration at about 1338 cm.$^{-1}$, but for the latter CO_2 has no counterpart, in spite of the fact that its strongest infra-red absorption band occurs at 2349 cm.$^{-1}$.

Because of the small energy and double weight of the first vibration state ν_2, a large fraction of the N_2O molecules (about one-eighth) are excited to this level at room temperature. The Raman displacements for light scattered by these excited molecules would be slightly different from those for normal atoms, giving rise to satellite lines. From combination relations we are able to predicate the positions of these weaker lines, not yet observed; their displacements should be 1278 cm.$^{-1}$ and 2210 cm.$^{-1}$. Lines corresponding to the stronger of these have already been observed in the Raman spectra of CO_2 and HCN precisely at the positions indicated by the infra-red observations.

E. F. BARKER.

University of Michigan,
Nov. 30.

[1] *Proc. Roy. Soc.*, A, **128**, 294; 1930.
[2] *Physical Review*, **38**, 1827; 1931
[3] *Rev. Mod. Phys.*, **3**, 280; 1931.
[4] *Z. Physik*, **70**, 84; 1931.
[5] NATURE, **127**, 817; 1931.

Selective Action of Living Tissue to Homogeneous Radiation.

A SELECTIVE action has been observed [1] when the allantoic membrane of the embryo chick is exposed to homogeneous X-radiation obtained by crystal diffraction.

The biological response, depicted in Fig. 1, *A*, may be described in terms of a series of maxima connected by an empirical formula $\lambda = kn^2$, where λ is expressed in cm., k is a constant equal to $3{\cdot}2 \times 10^{-10}$,

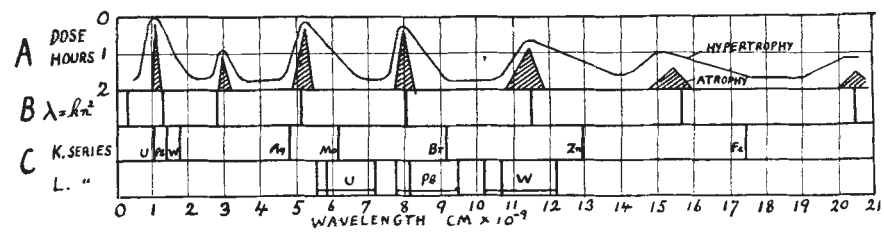

FIG. 1.

and n is given successive integral values from 2 to 8 (Fig. 1, *B*).

A 'maximum' is predicted at a wave-length of $3{\cdot}2 \times 10^{-10}$ cm. by making n equal to 1, but unfortunately the experimental investigation would be very difficult.

The position of a 'biological maximum' is only known within a margin of $\pm 0{\cdot}25 \times 10^{-9}$ cm., owing to the use of comparatively wide spectrometer slits, and the experimental evidence is somewhat scanty for high and low values of n. Nevertheless, there are great difficulties in associating the selective action with the *K* and *L* levels of heavy atoms, some of which are present in minute quantities (Fig. 1, *C*). (Tungsten, silver, and bromine are not present, but of importance in energy measurement.)

The suggestion is made that the above formula might be associated with a series of nuclear energy levels in one of the light atoms which form the main bulk of living tissues.

W. MOPPETT.

The University of Sydney,
Oct. 12.

[1] Moppett, *Proc. Roy. Soc.*, B, **105**, p. 402.

Effect of Light on the Surface Tension of Boys's Soap Solution.

IN his letter in NATURE,[1] Dr. P. Lecomte du Noüy says: "As the concentration of the *soap solution + glycerin* which he [L. D. Mahajan [2]] uses is not stated, but may be as high as 2·5 per cent—which should give a very small drop—it is indeed quite possible that illumination plays a part in this case".

Dr. du Noüy and others who are interested in the subject may be interested to know that I used Boys's soap solution and its various dilutions—even up to one per cent of the Boys's soap solution in the dilution. The minimum strength of the sodium oleate in the dilution which I studied was $2{\cdot}5 \times 10^{-4}$. In all observations the results obtained were found constant throughout for all dilutions. The details of the above work [3] are published in the *Indian Journal of Physics*.

I am now trying still higher dilutions, even up to 10^{-8}. The results are appearing hopeful again, and interesting, and will shortly be published.

L. D. MAHAJAN.

Physics Laboratory, Mohindra College,
Patiala, India, Nov. 20.

[1] P. L. du Noüy, NATURE, Oct. 17, 1931, p. 674.
[2] L. D. Mahajan, NATURE, Sept. 19, 1931, p. 496.
[3] L. D. Mahajan, *Indian J. Phys.*, Calcutta, vol. 6, part ii., pp. 147-153.

An Agricultural Pamphlet.

IN 1905, Wilfarth, Römer, and Wimmer published in the *Landw. Versuchs. Stat.*, vol. 63, a paper, "Über die Nährstoffaufnahme der Pflanzen in verschiedenen Zeiten ihres Wachstums". The importance of this paper in agricultural science was soon recognised, and before long an English translation was published in pamphlet form. Copies of this were obtained by the libraries at Rothamsted and at the Ministry of Agriculture, but not apparently by the British Museum or the Science Library.

The Rothamsted copy was obtained in the days when our library was not properly constituted; we had only very few books and no librarian, and we did not take the full bibliographical details. Our copy has long been missing, and on inquiry at the library of the Ministry of Agriculture we find that by a strange coincidence theirs also cannot be found, so that we know neither the translator nor the publisher, and consequently cannot take steps to obtain a new copy.

I should be grateful for bibliographical information, or, better still, to learn where I can now obtain another copy.

E. J. RUSSELL.

Rothamsted Experimental Station,
Harpenden, Herts,
Dec. 21.