

weaker in the light of the night sky. A discovery of this significance for the physics of the upper atmosphere must be carefully considered, and a programme of exhaustive investigation of the 3470 line is now under way. Until further study, therefore, the identification must be given as a tentative one, attractive as the above arguments may sound.

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<sup>1</sup> Kaplan, *Phys. Rev.*, 43, 800 (1935).

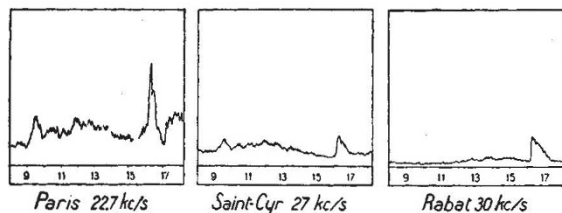
<sup>2</sup> Dufay, *J. Phys.*, vii, 5, 523 (1934).

<sup>3</sup> Gauzit, *J. Phys.*, vii, 5, 527 (1934).

### Effect of Catastrophic Ionospheric Disturbances on Low-Frequency Radio Waves

K. G. Budden and J. A. Ratcliffe<sup>1</sup> have described an effect of catastrophic ionospheric disturbances on low-frequency radio waves (16 kc./s.), but this action did not show an increase in atmospherics.

This last statement agrees with our observations. It is certain that an increase in atmospherics seldom appears on a frequency of 12 kc./s. This has been known for several years. A recent observation shows that, on a frequency of 17 kc./s., increase had already disappeared.



Increases noticed at Paris (22 kc./s.), St. Cyr (27 kc./s.) and Rabat (30 kc./s.) on November 6, 1936 (date of the anomalously published by K. G. Budden and J. A. Ratcliffe), are shown on the accompanying figure.

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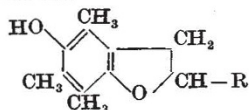
Office National Météorologique,  
196 rue de l'Université,  
Paris, VII<sup>e</sup>.  
Feb. 19.

<sup>1</sup> NATURE, 140, 1060-1061 (1937).

### Vitamin E: Structure of $\beta$ -Tocopherol

In a recent publication<sup>1</sup> we indicated that  $\beta$ -tocopherol,  $C_{28}H_{46}O_2$ , might be a coumaran or chroman derivative bearing a long side chain in the heterocyclic nucleus.

With the view of testing this hypothesis, we have synthesized 5-hydroxy-2:4:6:7-tetramethylcoumaran (I), m.p. 124-125°, starting from pseudo-cumouquinol and allyl bromide, and also 5-hydroxy-4:6:7-trimethyl-2-*n*-heptadecylcoumaran (II), m.p. 95-95.5°, isomeric with  $\beta$ -tocopherol, from pseudo-cumouquinone and ethylsodiostearoylacetate followed by partial hydrogenation of the intermediate coumarone.



I R = CH<sub>3</sub>

II R = C<sub>17</sub>H<sub>35</sub>

Both the synthetic coumarans are very similar to  $\beta$ -tocopherol in absorption spectrum and reducing properties.

Substance	Wave-length		$\epsilon$ mol.	
	Max.	Min.	Max.	Min.
$\beta$ -tocopherol .. ..	295m $\mu$	260m $\mu$	3577	520
'Heptadecylcoumaran' ..	297m $\mu$	258m $\mu$	3993	624
'Methylcoumaran' .. ..	296m $\mu$	270m $\mu$	3840	1305

When thermal decomposition is attempted, synthetic 5-hydroxy-4:6:7-trimethyl-2-*n*-heptadecylcoumaran distils at 370° without charring, giving a mixture from which a trace of a quinol is obtained, m.p. 185-190° (subl.) (cf. thermal decomposition of tocopherols, *loc. cit.*).

These results together with the surface film measurements of Dr. Danielli, recorded below, give support to the view that  $\beta$ -tocopherol is a coumaran derivative. The detailed configuration of the side chain, and the distribution of CH<sub>3</sub>-groups in the ring system remain to be determined. Side methyl estimations of  $\beta$ -tocopherol indicate the presence of six or seven CH<sub>3</sub>(C). Two or possibly three of these can be attached to the aromatic nucleus; the remaining three to five can be accounted for by formulating the side chain and the heterocyclic nucleus as a 'dihydrophytyl'-like structure; such a structure would explain also the oily nature of the vitamin and the ready production of quinols on thermal decomposition. This hypothesis is supported by results of oxidation: two oily fatty acids, C<sub>17-18</sub> and C<sub>11-12</sub>, are obtained, giving crystalline phenylphenacylestere.

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<sup>1</sup> Bergel, Todd and Work, *J. Chem. Soc.*, 253 (1938).

Both  $\beta$ -tocopherol allophanate and 5-hydroxy-4:6:7-trimethyl-2-*n*-heptadecylcoumarone spread on *N*/100 hydrochloric acid to give stable films. The limiting area of the first compound is 30 sq. A. and that of the coumarone is 26 sq. A. *p*-Hexadecylcyclohexanol has a limiting area of 30 sq. A. and the lactone of  $\gamma$ -hydroxystearic acid an area of 29 sq. A. It may therefore be concluded that the first two compounds mentioned are analogous in structure and that in cross-section  $\beta$ -tocopherol cannot have a ring system more than one ring in thickness measured perpendicular to the side chain. The ring system cannot be analogous to a phenanthrene or sterol skeleton.

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