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THE STRUCTURE AND STEREOCHEMISTRY OF ISO-EREMOLACTONE

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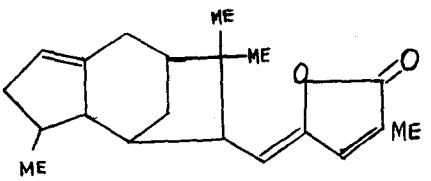
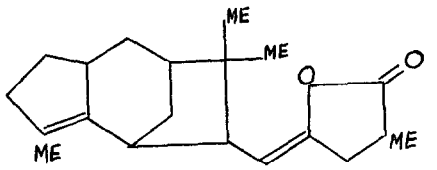
Eremolactone, $C_{20}H_{26}O_2$, which has been isolated by P.R. Jefferies et al[1] from the leaves of Eremophila freelingii by prolonged steam-distillation, belongs to a new series of diterpenes. Birch and his co-workers[2] proposed the possible structure (I) from the spectro-chemical evidence.

I.



Eremolactone when refluxed in ethanol and 2N-hydrochloric acid yields iso-eremolactone. Birch et. al. suggested that iso-eremolactone had the structure (II).

II. 

As there was some uncertainty regarding the proposed structures an X-ray analysis was undertaken with crystals provided by Professor P.R. Jefferies and Mr. J. Middleton of the Chemistry Department of the University of Western Australia.

Initially, the X-ray investigation was commenced with a study of eremolactone itself. It was later discovered that partial isomerisation had taken place during recrystallisation from a warm solution in methanol, and because of the difficulties of obtaining a pure sample it was decided to work on the completely isomerised compound.

Iso-eremolactone crystallises from methanol in beautiful colourless prisms, elongated along the shortest crystallographic axis. The crystal data are as follows:

Chemical formula: $C_{20}H_{26}O_2$

Molecular Weight: 298

a = 12.7 ± 0.1 Å

b = 20.2 ± 0.1 Å

c = 6.66 ± 0.05 Å

U = 1726

Dx = 1.146 gm/c.c.

Dm = 1.143 ± .003 gm/c.c.

μ = 5.45 cm^{-1} for CuKα (λ = 1.5418)

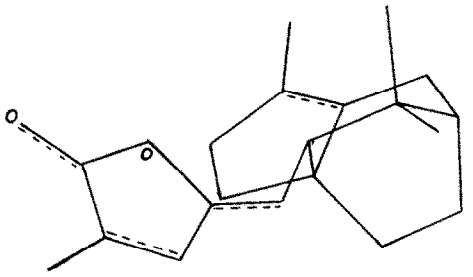
Space Group: $P2_12_12_1$

Z = 4

Three dimensional equi-inclination Weisenberg data about the a and c axes (h = 0→4; ℓ = 0→5) were collected by visual estimation of intensities. There were altogether 2047 independent reflexions of which 169 were below the observable threshold.

The Karle and Haputman method[3] of direct phasing was used to determine the structure. 200 phases for E ≥ 1.5 obtained from the application of the sigma-2 formula were refined by the tangent formula and these were used to compute a three dimensional E-MAP. The sites of 20 atoms were located from this and the positions of the remaining two were revealed in a subsequent difference synthesis. The structure and stereochemistry of iso-eremolactone was thus established to be III.

III.



Four rounds of block diagonal least squares refinements of positional coordinates and thermal parameters reduced the R-index from 0.30 to 0.11. Further refinement is continuing and full details of the X-ray analysis will be published at a later date.

The molecule of iso-eremolactone consists of three six-membered rings bridged together in the boat configuration, with a five-membered ring attached to one of them. The side-chain is confirmed to be a γ-lactone.

Acknowledgements:

The authors wish to thank Professor P.R. Jefferies for enlightening discussions, Mr. J. Middleton for providing the crystal sample and determining the density and Dr. J. Karle of U.S. Naval Research Laboratory for helpful suggestions. One of us (Y.L.O.) acknowledges receipt of a research studentship awarded by the Research Grants Committee of the University of Western Australia.

References:

1. P.R. Jefferies, J.R. Knox & E.J. Middleton, Aust. J. Chem. 1962, 15, 532.
2. A.J. Birch, J. Grimshaw & J.P. Turnbull, J. Chem. Soc. 1963 (445), 2412 - 2417.
3. J. Karle & H. Hauptman, Acta Cryst (1956), 9, 635.