Tetrahedron Letters No. 29, pp 2625 - 2628.
© Pergamon Press Ltd. 1978. Printed in Great Britain.

0040-4039/78/0715-2625$02.00/0

A SYNTHESIS OF DISUBSTITUTED ACETYLENES

Basil Lythgoe* and Ian Waterhouse

Department of Organic Chemistry, The University, Leeds LS2 9JT

(Received in UK 28 April 1978; accepted for publication 19 May 1978)

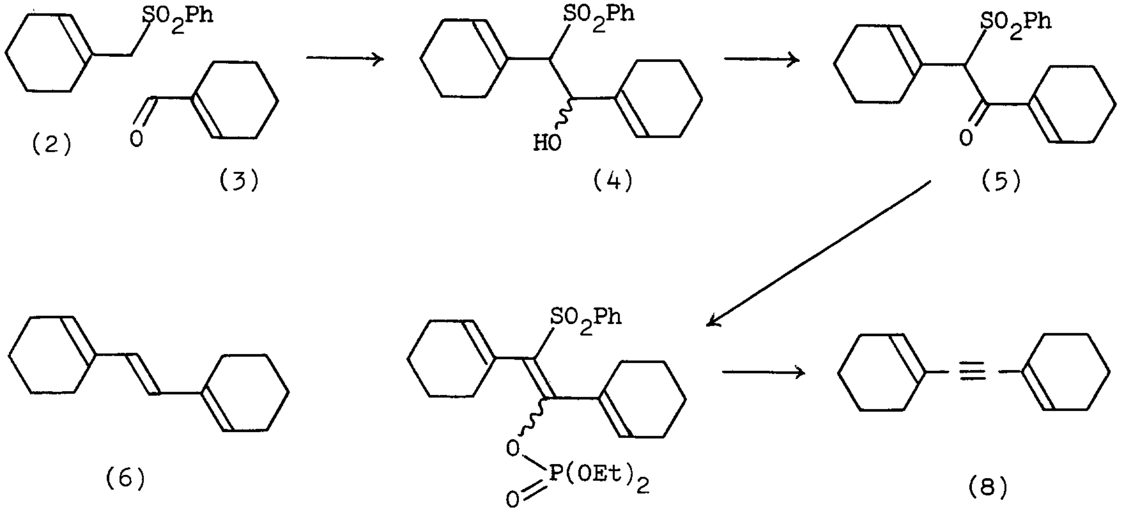
Disubstituted olefins $R^1CH:CHR^2$ can be conveniently prepared from the fragments RCH_2OH by addition-elimination sequences of which the prototype is the Wittig reaction. By contrast, disubstituted acetylenes $R^1C\vdots CR^2$ (1) are usually prepared[1] from terminal acetylenes $R^1C\vdots CH$ by alkylation processes. Of the interesting attempts[2] which have been made to develop addition-elimination routes to disubstituted acetylenes, one[3], an extension of the Wittig method, is effective for the preparation of the compounds (1, R^1 = Alkyl, R^2 = Aryl), (1, R^1 = Alkyl, R^2 = CO_2Et), and (1, R^1 = Alk-1-enyl, R^2 = CO_2Et), but not for some other important classes, such as the dialkyl compounds (1, R^1 and R^2 = Alkyl) and the conjugated enynenes (1, R^1 and R^2 = Alk-1-enyl). We now report a new sequence, using mild reaction conditions, which is effective for the preparation of acetylenes of the last two types.

The diastereoisomeric β-hydroxy-sulphones[4] (4), obtained[5] from cyclohex-1-enylmethyl phenyl sulphone (2) and cyclohexene-1-carbaldehyde (3), were oxidised by the Pfitzner-Moffatt method[6] to give the β-oxo-sulphone (5) [85% from (2)]. It was treated with lithium di-isopropylamide and then with diethyl phosphorochloridate to give the enol phosphate (7). Reduction in tetrahydrofuran-dimethylsulphoxide at 0° with sodium amalgam[7] regenerated a little (5) but gave as the major product [77% based on unrecovered (5)] di(cyclohex-1-enyl)acetylene[8] (8).

The β-oxo-sulphone (12)[9] was obtained[10] from the sulphone (9) and the methyl ester (10), and was converted as before into the enol phosphate (13). On reduction this gave (69%) 2,7-dimethylocta-2,6-dien-4-yne (14, R = H), τ 4·57 (2H, s, =CH), 8·09 (6H, s, MeC=), and 8·18 (6H, s, MeC=). Similarly, the β-oxo-sulphone (17), obtained from the sulphone (15) and the ester (16), was converted (53%) into eicos-2-yne (18), m.p. 24-25°, τ 8·23 (3H, t, *J* 2 Hz, MeC≡).

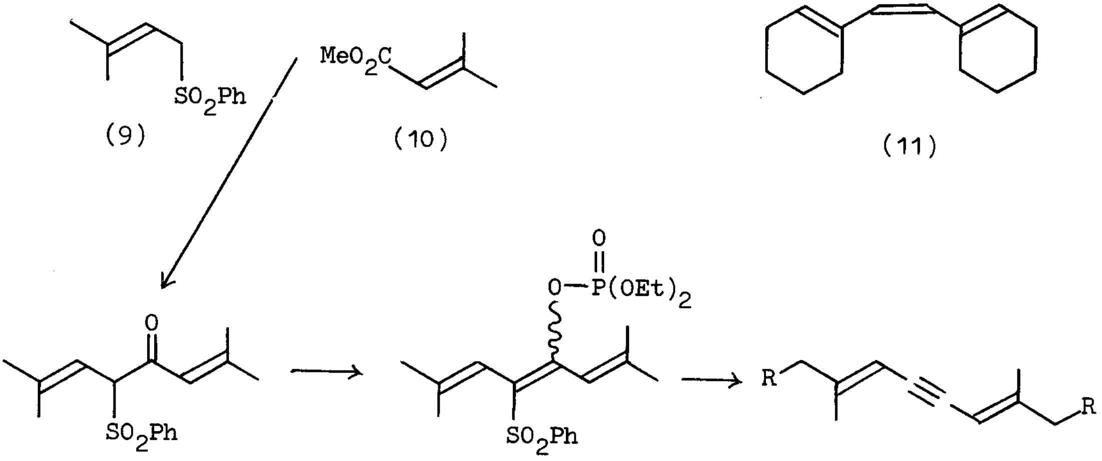
As well as being obtained by the synthetic methods mentioned above, β-oxo-sulphones can be obtained by the phenylsulphenylation of ketones, followed by oxidation of the PhS group. The new method therefore allows a triple bond to be introduced into an aliphatic chain containing a keto group, which would otherwise be difficult to effect.

Disubstituted acetylenes are of interest because they are easily converted into *cis*-disubstituted olefins, e.g. (8) ⟶ (11)[8]. We have shown[4] that β-hydroxy-sulphones such as (4) can be converted efficiently into *trans*-disubstituted olefins such as (6); by virtue of the new acetylene synthesis highly stereoselective routes are now open from common intermediates to central-*cis*- as well as central-*trans*- conjugated trienes. New and improved syntheses of conjugated trienes such as precalciferol$_3$[11] and phytoene[12] should therefore be possible. It should be possible to prepare from geranylgeraniol the C_{40} conjugated enynene (14, R = farnesyl); semihydrogenation would then give natural 15-*cis*-phytoene; the existing synthesis[12] gives this compound only as the minor component (20%) in a mixture with the 15-*trans*-isomer. Experiments to test these possibilities are in hand.



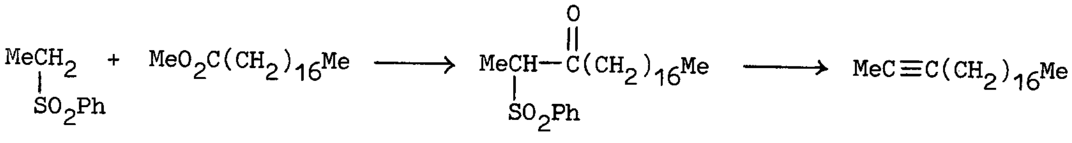
(2) (3) (4) (5)

(6) (7) (8)



(9) (10) (11)

(12) (13) (14)



$$\underset{SO_2Ph}{MeCH_2} + MeO_2C(CH_2)_{16}Me \longrightarrow \underset{SO_2Ph}{MeCH}-\overset{O}{\overset{\|}{C}}(CH_2)_{16}Me \longrightarrow MeC{\equiv}C(CH_2)_{16}Me$$

(15) (16) (17) (18)

References

1. The Synthesis of Acetylenes, T. L. Jacobs, Organic Reactions, 1949, 5, 1; Chemistry of Acetylenes, H. G. Viehe, Ed., Marcel Dekker, New York, 1969.
2. E.g. J. Cymerman Craig, M. D. Bergenthal, I. Fleming, and J. Harley-Mason, Angew. Chem. Internat. Edn., 1969, 8, 429; I. Fleming and C. R. Owen, J. Chem. Soc. (C), 1971, 2013; D. P. Bauer and R. S. Macomber, J. Org. Chem., 1976, 41, 2640; ref. 3.
3. S. T. D. Gough and S. Trippett, J. Chem. Soc., 1962, 2333; G. Märkl, Angew. Chem. Internat. Edn., 1962, 1, 160.
4. P. J. Kocienski, B. Lythgoe, and S. Ruston, J.C.S. Perkin I, 1978, in the press.
5. L. Field, J. Amer. Chem. Soc., 1952, 74, 3919.
6. K. E. Pfitzner and J. G. Moffatt, J. Amer. Chem. Soc., 1965, 87, 5661, 5670.
7. This reagent has been used (in alcoholic media) in the synthesis of olefins from β-hydroxy-sulphones: M. Julia and J.-M. Paris, Tetrahedron Letters, 1973, 4833; ref. 4.
8. H. H. Inhoffen and G. Quinkert, Chem. Ber., 1954, 87, 1418.
9. R. V. M. Campbell, L. Crombie, D. A. R. Findley, R. W. King, G. Pattenden, and D. A. Whiting, J.C.S. Perkin I, 1975, 897.
10. H. O. House and J. K. Larson, J. Org. Chem., 1968, 33, 61; and refs. therein.
11. T. M. Dawson, J. Dixon, P. S. Littlewood, B. Lythgoe, and A. K. Saksena, J. Chem. Soc. (C), 1971, 2960.
12. M. Khan, D. E. Loeber, T. P. Toube, and B. C. L. Weedon, J.C.S. Perkin I, 1975, 1457.