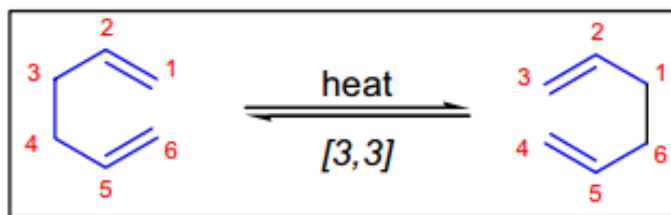



# COPE REARRANGEMENT




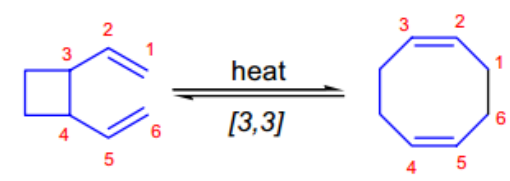
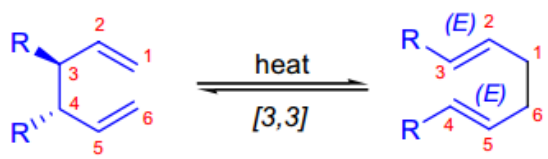
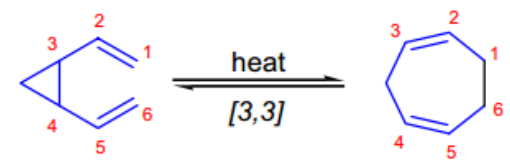
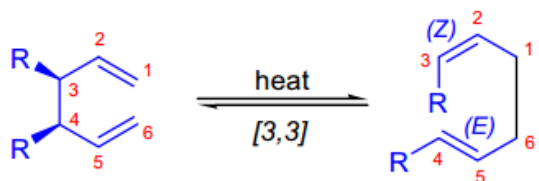
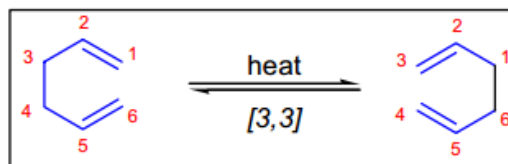


亚瑟·科普（**Arthur Clay Cope**1909年—1966年）著名有机化学家，1947年成为美国国家科学院院士。他的主要成就是发展了两个以他的名字命名的重要有机化学反应科普消除反应和科普重排反应。

1934年成布林莫尔学院的教员，在那里他研究包括首次合成了一系列的巴比妥类药物包括被用于临床的Delvinyl Sodium。并且开发了一个涉及烯丙基热力学重排的反应，这就是后来以他名字命名的科普重排反应，这个反应经过后来的深入研究被应用到许多天然化合物全合成过程中。

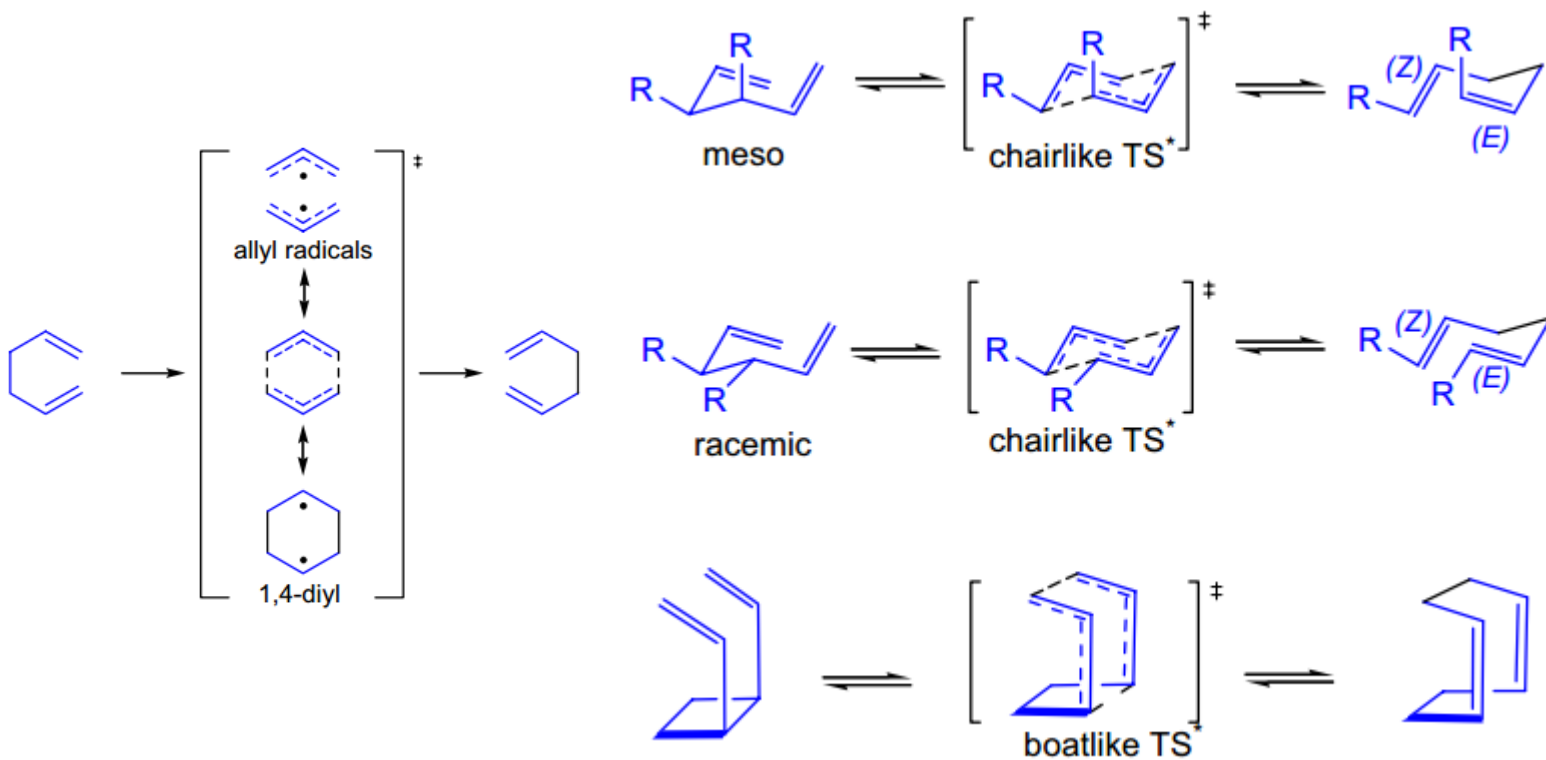
1973年美国化学会为了纪念亚瑟·科普由亚瑟·科普基金提供资助设立亚瑟·科普奖(Arthur C. Cope Award),每年颁发给那些在有机化学研究领域做出杰出研究贡献的有机化学家。





- The rearrangement is reversible because there are no changes in the number or types of bonds, and the position of the equilibrium is determined by the relative stability of the starting material and the product.
- The reaction is both stereospecific and stereoselective as a result of a cyclic chairlike transition state.
- The required temperature is significantly lower (room temp. or below) when: 1) the dienes are substituted in positions C3 or C4; 2) the dienes are cyclic and ring strain is relieved; or 3) the Cope rearrangement is catalyzed by transition metal complexes.

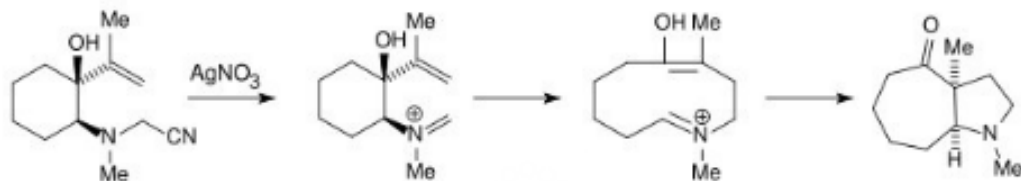
# Mechanism:



类似反应

## Aza-Cope重排

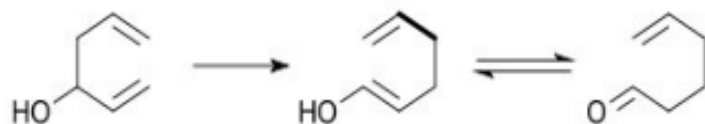
含氮分子也可以发生Cope重排，该类反应叫“**aza-Cope重排**”。如下图所示：



在这个反应中，**Ag<sup>+</sup>**作为一个路易斯酸，脱去氰基。接下来发生一个[3,3]- $\sigma$ -迁移重排，得到一个既含有一个烯醇基团，又含有一个亚胺基团的中间体。烯醇和亚胺相互反应，最后生成一个二元环的氨基酮。

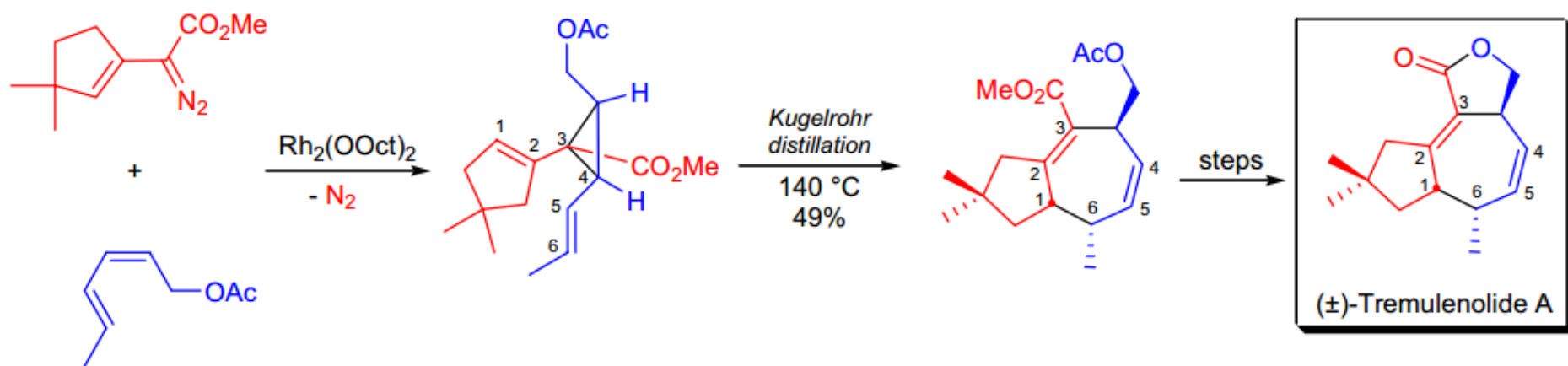
## Oxy-Cope重排

如果在碳3上连了一个羟基，那么用一个强碱，例如氢化钾，可以在低很多的温度下实现Cope重排，这种特殊的反应叫做“Oxy-Cope重排”。如下图所示，经过中间体烯醇的酮-烯醇互变异构，最终得到一个醛或一个酮。



# Synthetic Application

The Cope rearrangement of a divinylcyclopropane intermediate was the key step in the total synthesis of ( $\pm$ )-tremulenolide A by H.M.L. Davies et al.<sup>45</sup> The divinylcyclopropane intermediate was obtained by a Rh-catalyzed stereoselective cyclopropanation of a hexadiene. Usually the Cope rearrangement of divinylcyclopropanes occurs at or below room temperature, In this case, a congested boat transition state was required for the rearrangement so forcing conditions were necessary. The product cycloheptadiene was obtained by Kugelrohr distillation at 140 °C as a single regioisomer in 49% yield.



# Synthetic Application

A tricyclic ring system containing all the stereogenic centers of the nonaromatic portion of (–)-morphine was prepared by T. Hudlicky and co-workers using an *intramolecular Diels-Alder cycloaddition* followed by a *Cope rearrangement*.<sup>46</sup> Interestingly, the initial Diels-Alder cycloadduct did not undergo the *Cope rearrangement* even under forcing conditions. However, when the hydroxyl group was oxidized to the corresponding ketone, the [3,3]-sigmatropic shift took place at 250 °C in a sealed tube. The driving force of the reaction was the formation of an  $\alpha,\beta$ -unsaturated ketone.

