omers, representing in their totality a large number of transient dl-pairs. According to the presently accepted symmetry criteria, the availability of any symmetry conformation(s) is deemed sufficient basis for declaring the molecular aggregate optically inactive and nonresolvable. Thus, for example, the fact that one symmetry conformation may ordinarily be written for 2,2′diphenic acid, or two for meso-tartaric acid, is enough to predict the optical inactivity of either compound. Conversely, the absence of symmetry conformations permits the prediction of optical activity, or resolvability in the case of racemic mixtures.

The usefulness of symmetry criteria is evident, yet it is a remarkable fact that apparently no cases constituting exceptions to this doctrine have heretofore been considered as such. Since the sole necessary criterion for optical inactivity is the presence, in the molecular system, of an equal number of conformational and/or configurational enantiomers, it was tempting to postulate a case of an optically inactive and configurationally pure compound not possessing a symmetry conformation. Consider, for example, the hypothetical structure shown in Fig. 1. It may be assumed that rotation is virtually free about bonds *a*, whereas rotation about bond *b* is effectively restricted to eliminate conformations containing a planar biphenyl system. Compounds possessing the structural features illustrated may exist in three stereoisomeric modifications: d,l, and meso. It must now be emphasized that *no conformation conceivable for the meso modification possesses reflection symmetry*; that is, the symmetry criteria are here no longer applicable. Although any given conformation having the planes of the phenyl rings at right angles to one another cannot possibly be superimposed upon its enantiomer through the application of symmetry operations alone, an interconversion between the enantiomers will still take place by virtue of rotation around bonds *a*. In consequence, the molecular aggregate, consisting exclusively of transient dl-pairs, is optically inactive and not resolvable, in the operational sense that meso-tartaric acid is not resolvable.

It must be noted that this case is dissimilar to superficially analogous cases such as $(a^+)(a^+)C(a^-)(a^-)$, where a^+ and a^- represent dissymetric groupings (for example, sec.-butyl) of opposite configuration: such a compound possesses a symmetry conformation having a fourfold alternating axis of symmetry.

One additional aspect of interest in the situation here outlined is that conformational racemization, in

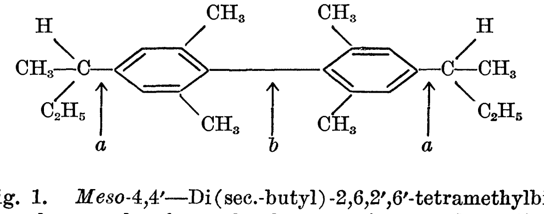

Fig. 1. *Meso*-4,4′—Di(sec.-butyl)-2,6,2′,6′-tetramethylbiphenyl, example of a molecule possessing no alternating axis of symmetry.

the case of this type of compound, cannot proceed via a symmetric intermediate. It follows that in general a symmetric intermediate need not, and sometimes cannot, be invoked to account for racemization.

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27 May 1954.

Some Problems Concerning the Distribution of the Late Paleozoic Gastropod *Omphalotrochus**

The genus *Omphalotrochus* Meek is a wide-ranging stratigraphically significant gastropod. Its importance has received acknowledgment in designation of the *Omphalotrochus* zone in the Moscow basin of Russia. This zone is classified by most Russian geologists as Upper Carboniferous and is correlated with beds underlying the *Pseudoschwagerina* zone (*1*). The base of the *Pseudoschwagerina* zone is considered by some Russian and many American geologists to mark the base of the Permian system.

In other areas of Russia, *Omphalotrochus* occurs in the *Pseudoschwagerina* zone. For this reason, and because *Omphalotrochus* had not been reported from beds below those correlated with the American Wolfcamp formation, Knight suggested that the "*Omphalotrochus* beds of the Timan arch [Russia] should be included with the *Pseudoschwagerina* beds and that they, together with the intervening *Cora* beds, are the Russian equivalent of the American Wolfcamp series" (*2*). He tentatively referred the entire interval to the basal Permian, but so far as is known, this suggestion has not been adopted by Russian geologists. The purpose of this note is to record other occurrences of *Omphalotrochus* and to mention the implications of these findings in correlation of strata of late Paleozoic age.

The west Texas Wolfcamp formation contains, among other fossils, *Pseudoschwagerina* and *Omphalotrochus*. *Omphalotrochus* has been collected recently from the upper part of the *Uddenites* zone, directly below the Wolfcamp formation, but *Pseudoschwagerina* appears to be lacking from this zone.

Most American geologists dealing with upper Paleozoic stratigraphy consider the Wolfcamp formation to be the approximate equivalent of the Russian *Pseudoschwagerina* zone and classify it as lower Permian or Permian (*?*). The age of the *Uddenites* zone has been a controversial subject, some stratigraphers considering it Permian and others Pennsylvanian (Upper Carboniferous). Most published opinion at present favors a Pennsylvanian age.

The presence of *Omphalotrochus* in the *Uddenites* zone, below *Pseudoschwagerina,* suggests that the range of the genus is similar in Russia and west Texas. According to last-known stratigraphic assignments of the Russian type Permian section (*1*), *Omphalotrochus* is not a "guide fossil" to the Permian but would rather be indicative of late Carboniferous age. If the *Uddenites* zone is considered Permian, then the Moscow basin is the only area where *Omphalotrochus* occurs below rocks that a large group of geologists classify as basal Permian. An alternative is to consider the *Omphalotrochus* zone as a faunal facies of the lower part of the *Pseudoschwagerina* zone—essentially what Knight suggested.

Within the United States, *Omphalotrochus* is known from California, Nevada, Wyoming, Arizona, New Mexico, west Texas, north-central Texas, and Kansas. It ranges from the *Uddenites* zone to Permian beds, correlated with the Leonard formation, above the Wolfcamp. My study suggests that there are more than the two species now described from North America. Discrimination of these several species may show that they have value for regional correlation. *Omphalotrochus ferrieri* Girty and *Omphalotrochus conoideus* Girty, described from the Phosphoria formation, probably should be referred to another genus.

The geographic distribution of species of this genus needs further study. For example, *O. whitneyi* (Meek) from California (McCloud limestone-Permian?) may occur in west Texas. A specimen similar to *O. whitneyi* has been illustrated from the Donetz basin, and the species has been reported from the Timan area (*3*). If these and the American form are conspecific, this species ranges from latitude 65°N to 32°N.

Omphalotrochus obtusispira (Shumard), from west Texas (Hueco limestone-Permian?) has been reported from Peru (*4*). A remarkably similar species, *O. gerthi* Wanner, has been named from Indonesia (*5*). Insofar as one can tell from illustrations, these two named species could be conspecific. If this is so, the species has a geographic range not only from 32°N latitude to 15°S latitude, but also halfway around the world.

These afore-mentioned ranges are remarkable for any benthonic animal, living or fossil. If the possible identity of species and their distributions mentioned are substantiated, they will support the idea of widely uniform climatic conditions and interconnected shallow migration routes during late Paleozoic time.

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1 July 1954.

An Ultra-Fine-Grained Light-Sensitive Film of Optional Density

The following technique has been developed by the writer to produce an extremely dense and fine-grained light-sensitive dispersion of a silver halide that responds to development and fixing—although, as might be expected, the light sensitivity is not great.

A layer of collodion is spread upon a sheet of glass and stripped off after drying. This film is floated, with the assistance of a support, on the surface of a solution containing either the halide or the silver salt, while the solution containing the other ion is carefully poured on top of the film.

Since the diffusion rate through the film is proportional to the concentration, a precipitate of silver halide coats the side of the film opposite the solution that is too concentrated. By altering the concentration of one solution, however, a colloidal deposit forms within the body of the film itself and, if time enough is allowed, almost any desired density may be attained. The grain is so fine that it selectively scatters blue light and is not resolved by an ordinary microscope.

It would seem that a medium with these properties could be put to many interesting uses. It should prove expedient for constructing reticules and diffraction gratings photographically and for other applications requiring photographic miniaturization.

An interesting observation made during these experiments is that if the collodion is poured directly onto an aqueous surface and allowed to spread into a film, a molecular orientation apparently takes place at the interface which renders the film impermeable to the diffusion of ions.

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