

Spin Traps



Give your radicals some life!

The problem of the detection and identification of short-lived free radicals has been a subject of extreme interest. This important area of research was facilitated by the recent development of the technique of *spin trapping*.¹ This technique involves the trapping of a free radical by an addition reaction to produce a more stable radical, detectable by esr, whose hyperfine coupling parameters enable identification of the initially trapped radical. An example is the reaction of a radical with a nitron to form a stable nitroxide radical.

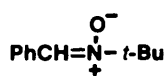


The addition product is called a "spin adduct."

The following applications of spin trapping agents have been developed:

- 1) atom trapping¹
- 2) gas-phase free radical trapping²
- 3) spin trapping of radicals in solids³
- 4) mechanistic investigations^{1,4-10}
- 5) detection of intermediates in electrochemical transformations¹¹
- 6) study of radical polymerizations^{12,13}
- 7) study of free radicals in cigarette smoke^{14,15}
- 8) detection of important intermediates in biological oxidation-reduction reactions¹⁶
- 9) synthesis of a variety of nitroxides which might be difficult to obtain by conventional synthetic methods

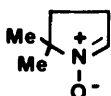
Since each spin trap has advantages and disadvantages¹ depending on its intended application, it is desirable to have a variety of traps from which to choose. Aldrich now offers three very useful spin traps: *N-tert-butyl-α-phenylnitron* (PBN), 2-methyl-2-nitrosopropane (N-t-B), and 5,5-dimethyl-1-pyrroline-1-oxide (DMPO).



PBN

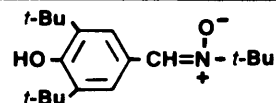


N-t-B



DMPO

An interesting bifunctional spin trap, α-(3,5-di-*tert*-butyl-4-hydroxyphenyl)-*N-tert*-butylnitron, was used by Pacifici and Browning to distinguish between carbon- and oxygen-



centered radicals.¹⁷ The radicals produced nitroxides and phenoxides, respectively. Later it was shown that an equimolar mixture of PBN and 2,4,6-tri-*tert*-butylphenol gave similar results more conveniently.¹⁸

A large research effort continues in order to find new applications for spin traps. Much emphasis is being placed on quantitative work and elucidation of mechanisms, especially in biological systems.

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For an excellent review on the related area of spin labels, see C.F. Chignell, *Aldrichimica Acta*, **7**, 1 (1974).

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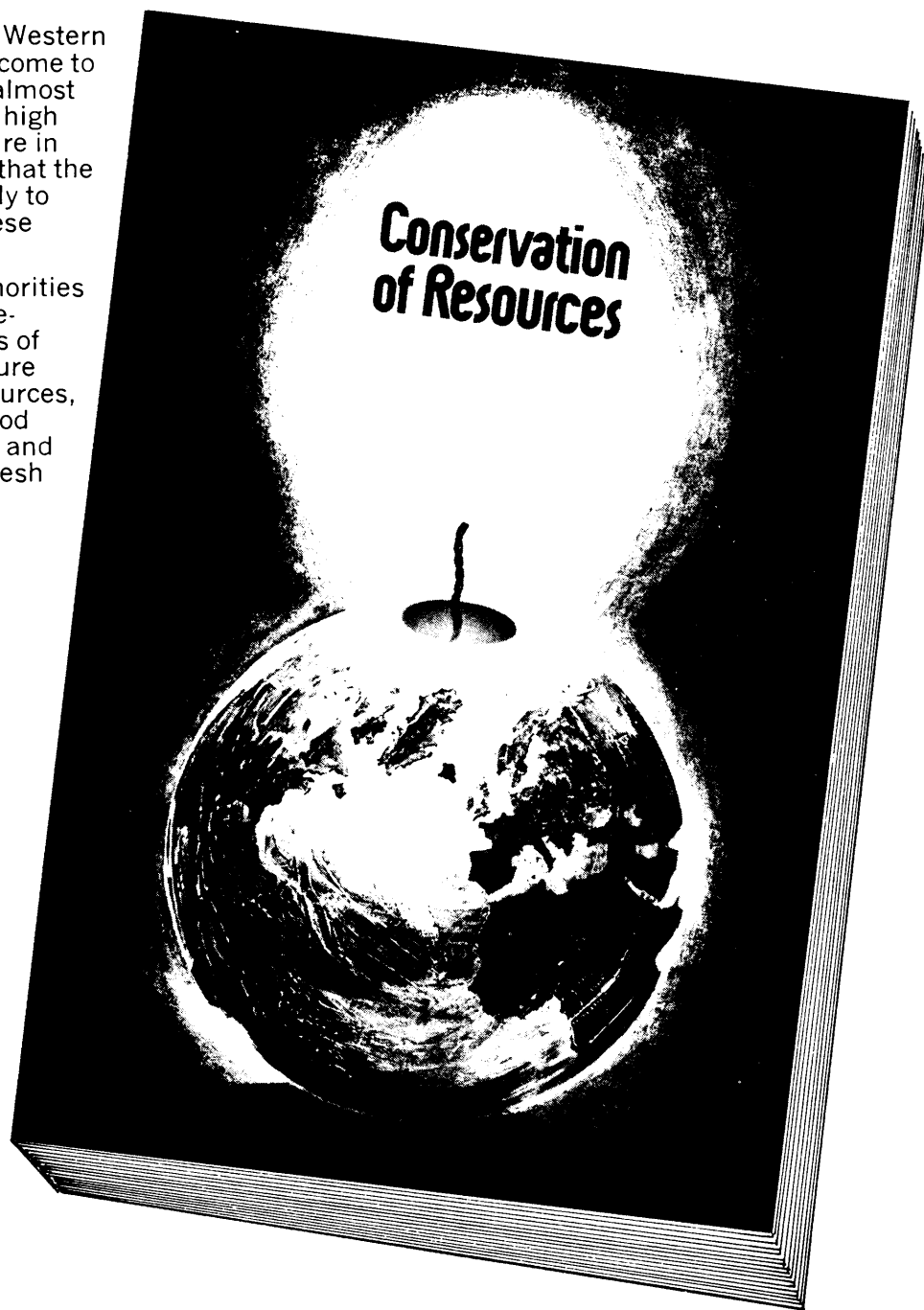
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