assignment of this rests on analogy to the previous case.

In vitro biological data on the 6-deoxy epimers (Ia, Ib) as well as on known 6-deoxy-6-demethyltetracycline[1,2,4] (Ic, a compound with no asymmetry at C.6) are presented in Table I.[15] The

TABLE I

Compound	Bioassay[a] *vs. K. Pneumoniae*[b]
6-Dimethyl-6-deoxytetracycline (Ic)	900
α-6-Deoxytetracycline (Ia)	700
α-6-Deoxy-5-hydroxytetracycline (Ib)	1400
β-6-Deoxytetracycline (Ia)	500
β-6-Deoxy-5-hydroxytetracycline (Ib)	400

[a] Expressed in oxytetracycline units/mg. *Cf.* R. C. Kersey, *J. Am. Pharm. Assocn.*, **39**, 252 (1950). In this assay 5-hydroxytetracycline is taken as the standard at 1000 units/mg. [b] Similar relative activities have been noted with other microörganisms.

reduced activity in the β-series may well be the result of conformational distortion.

(15) We are indebted to Mr. J. J. Smith and his associates for these data.

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RECEIVED MAY 24, 1962

HOT RADICAL EFFECTS IN AN INTRAMOLECULAR INSERTION REACTION

Sir:

Thermal decomposition of *p*-toluenesulfonylhydrazones of aldehydes and ketones in basic media gives rise to diazocompounds, which in aprotic solvents themselves undergo decomposition by a carbenoid process.[1] The decomposition of the tosylhydrazone of 2-butanone[2] in diethylcarbitol in the presence of sodium methoxide yields *cis*- and *trans*-butene-2, butene-1 and a trace of methylcyclopropane (see table). These compounds presumably are formed from methylethylcarbene by reactions that can be considered as intramolecular insertion reactions formally similar to the intermolecular insertion reactions of methylene itself.[3]

We wish to report that the thermal decomposition of methylethyldiazirine in the gas phase at ~ 160° also results in the formation of these hydrocarbons in ratios virtually identical with those reported by Friedman and Shechter.[2] There can be little doubt that this reaction proceeds *via* the formation of the carbene which supports a similar mechanism for the decomposition of the tosylhydrazones. Photolysis of methylethyldiazirine (3130 Å. radiation) also results in the formation of the same C_4H_8 hydrocarbons but in quite different ratios.

In the photolyses the relative yields of the products were independent of the pressure of the diazirine in the range 50 to 200 mm. To eliminate the possibility of secondary isomerization of the initially formed excited olefins, photolyses were carried out in the presence of added nitrogen, at pressures up to 2 atmospheres, without changing the ratios of the products. Thus the compositions shown in the table represent the *initial* rearrangement ratios from the photolytically produced carbene. Below 50 mm. some small variations in the product ratios were observed, which could be rationalized in terms of the secondary isomerization of the methylcyclopropane (initially formed with excess energy) to butenes. At 4 mm. the yield of methylcyclopropane had fallen to 1.0%, the yield of *trans*-butene-2 had risen to 42% and a trace of isobutene was detected.

TABLE I

% Composition	1[a]	2[b]	3[c]
Butene-1	5	3.6	23.4
trans-Butene-2	67	66.5	38.6
cis-Butene-2	28	29.5	35.6
Methylcyclopropane	0.5	0.4	2.4

[a] Friedman and Shechter (ref. 2). [b] This work, pyrolysis at ~160°. [c] This work, photolysis (3130 Å.).

The relatively high proportion of butene-1 and methylcyclopropane, and the near equivalence of the amounts of *cis*- and *trans*-butene-2 in the photolytic decomposition are in striking contrast to those from the pyrolyses. These differences are most reasonably explained by postulating that the carbene produced photochemically is vibrationally excited. The results, therefore, indicate a hot radical effect in intramolecular insertion reactions of carbenes previously only noted in intermolecular reactions.[4]

(1) J. W. Powell and M. C. Whiting, *Tetrahedron*, **7**, 305 (1959).

(2) L. Friedman and H. Shechter, *J. Am. Chem. Soc.*, **81**, 5512 (1959).

(3) W. E. Doering, R. G. Buttery, R. G. Laughlin and N. Chaudhuri, *ibid.*, **78**, 3224 (1956).

(4) H. M. Frey, *ibid.*, **80**, 5005 (1958).

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RECEIVED APRIL 14, 1962

AN ISOTOPE EFFECT DURING THE COUNTERCURRENT DISTRIBUTION OF ARABINOSE-1-C^{14}

Sir:

Insofar as we know, the literature lacks any reference to an isotope effect influenced by the position of C^{14} in a sugar—or other solute—undergoing countercurrent distribution. For this reason, we wish to report the data below.

D-Arabinose-1-C^{14} (K = 0.11) moved more slowly than unlabeled D-arabinose (Fig. 1) during countercurrent distribution in cyclohexane–95% ethanol with the result that specific activity decreased with increasing number of the tubes of the train constituting the sugar zone. D-Arabinose-1-C^{14} and unlabeled L-arabinose also were partly resolved (Fig. 2); similarly L-arabinose-1-C^{14} and unlabeled D-arabinose were partly separated. In all cases, such plots of log specific activity against fraction number for tubes containing this pentose were linear and were never parallel to the abscissa, an index of resolution.[1] When radioactivity resided on carbon 5, the mobilities of the radioactive and unlabeled D-arabinose were indistinguishable, after 350 or 800 transfers. Neither D-xylose-1-C^{14} (K = 0.26) nor D-ribose-1-C^{14} (K

(1) K. A. Piez and H. Eagle, *J. Am. Chem. Soc.*, **78**, 5284 (1956).

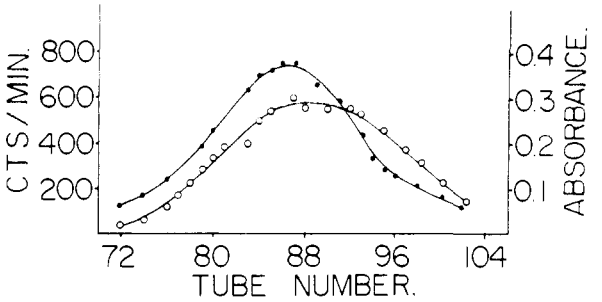

Fig. 1.—Resolution of D-arabinose-I-C^{14} and unlabeled D-arabinose in the all glass countercurrent apparatus of Craig and Post with upper and lower phase volumes of 10 ml. The solvent system was an equilibrated mixture of 2 parts of cyclohexane with 1 part 95% ethanol at 22 deg. The upper phase composition, by volume in per cent. of water, ethanol and cyclohexane, was 0.8, 15.5 and 84.5 as determined by matching spectra of synthetic mixtures of the components using the Perkin–Elmer infrared spectrophotometer, Model 21. The corresponding composition of water, ethanol and cyclohexane in the lower phase was 2.5, 48 and 49: ●, radioactivity, measured with an end window Geiger counter; ○, absorbance at 370 millimicrons of the arabinosylamine.[3] Twenty mg. of unlabeled D-arabinose mixed with 4 microcuries of labeled pentose constituted the sample for the 880 transfer distribution shown here.

= 0.14) were separated, even partially, from their unlabeled counterparts. Plots of log specific activity against tube number for xylose-1-C^{14} and D-ribose-1-C^{14}, linear and parallel to the abscissa.

Because arabinose-5-C^{14} did not show the isotope effect, it was unlikely that mass alone could account for the data. An isotope effect not dependent on mass alone has been reported previously by Piez and Eagle,[1] who observed that C^{14} on carbons 1 or 2 more than on carbons 3 or 4 decreased the rate of release of amino acids from Dowex 50 during pH gradient elution. These investigators attributed this isotope influence during ion exchange to an inductive effect, C^{14} being less electronegative than C^{12}. Thereby, the nearer the isotope was to the charged centers of the amino acid the less acid they became. If our reasoning is correct C^{14} on carbon 1 would be expected to alter the dipole moment of the sugar through an inductive effect and, as a consequence, the distribution coefficient in the cyclohexane system would be changed. Possibly several forms (for example the aldehyde and one or more chain forms) comprise the arabinose sample undergoing distribution, but arabinose 1-C^{14} contributes to the more slowly migrating components of the equilibria during countercurrent distribution. Since the isotope effect was not observed with similarly labeled xylose and ribose, it might be that the corresponding equilibria are too one sided for the effect to be discernible in countercurrent distribution in cyclohexane–ethanol. Differences in migration have suggested that at least two isomeric forms of a pure reducing sugar are present during dialysis through thin films.[2] In the studies reported here, the broader than theoretical distribution for the chemically pure unlabeled arabinose

(2) L. C. Craig and A. Pulley, *Biochemistry*, **1**, 89 (1962).

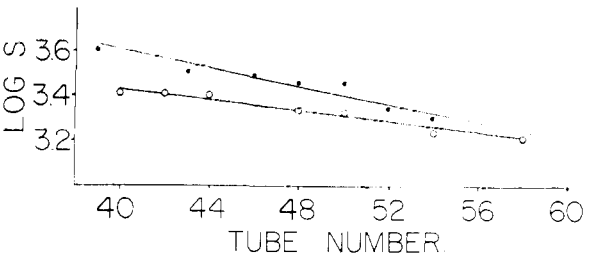

Fig. 2.—Plots of log specific activity, S, against tube number, X, in accordance with $\ln S = [(M_1 - M_2)X/\sigma^2] + [(M_2^2 - M_1^2)/2\sigma^2]$ derived from the ratio of two curves (absorbance, C^{14}-activity) assuming the normal distribution and that they have the same standard deviation σ, but M_1, the mean of the absorbance curve differs from M_2, the mean of the C^{14} activity curve; thus, the slope of the line is the index of resolution. Upper line plots D-arabinose-1-C^{14} mixed with unlabeled L-arabinose while the lower line compares the mobility of L-arabinose-1-C^{14} mixed with unlabeled D-arabinose. In each case there were 600 transfers in the solvent system described in Fig. 1.

(Fig. 1) and the deviations from linearity of the plots of log specific activity *versus* fraction number (Fig. 2) are consistent with such polymorphism.

The specific activity of the mixture of inert and labeled pentose, the sample for countercurrent distribution, was kept between 37 and 40 microcuries per millimole. Isotopic sugars were purchased from Calbiochem. The radiochemical purity of both D and L arabinose-1-C^{14} was found to be higher than 99% when mass calculated from observed characteristic absorbance and absorbance index[3] was compared with the mass computed from radioactivity and sample specific activity. In addition, isolated arabinose from tubes representing the peak, right or left side of the curve such as that in Fig. 1 moved more slowly, on redistribution, than the corresponding unlabeled pentose or unlabeled enantiomer. Although, for radiochemical impurities to account for the above data, similar impurities would be required to reside in both D-arabinose-1-C^{14} and L-arabinose-1-C^{14}; then, both enantiomers must, in addition, yield the above purity through the absorbance of their arabinosylamines and their specific activities.

(3) R. E. Timell, C. P. J. Glaudemans and A. L. Currie, *Anal. Chem.*, **28**, 1916 (1956).

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RECEIVED MAY 11, 1962

BORON-CONTAINING ANALOGS OF ISOQUINOLINE

Sir:

Some years ago Snyder, Reedy, and Lennarz[1] prepared the cyclic oxime (I) as a derivative characteristic of *o*-formylphenylboronic acid. Since this ring system bears an obvious analogy to 2,1-borazaronaphthalene (II) which is known[2] to be aromatic, and since borazarophenanthrene is known

(1) H. R. Snyder, A. J. Reedy and W. J. Lennarz, *J. Am. Chem. Soc.*, **80**, 835 (1958).

(2) M. J. S. Dewar and R. Dietz, *Tetrahedron*, **15**, 26 (1961); *J. Org. Chem.*, **26**, 3253 (1961).