That the mercapto groups are really bound to protein, and not merely the result of inefficient separation, was shown by ultracentrifugation with a colored azomercurial. At 60,000 r.p.m., the schlieren and color boundaries moved together.

The acetyl-S linkage of (II) is stable for days in aqueous solution at *p*H's as high as 9.5. Conversion of (II) into (III), if desired, can be accomplished in a few minutes in dilute sodium hydroxide, *p*H 11.5. Preliminary experiments indicate that some nitrogenous bases also work at *p*H's much nearer 7 (*e.g.*, imidazole).

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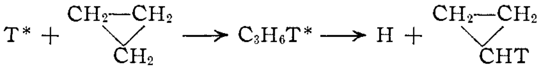
RECEIVED MAY 25, 1959

HIGH ENERGY EXCHANGE REACTION OF TRITIUM ATOMS WITH CYCLOPROPANE

Sir:

Our recent experiments with tritium atoms slowing down from very high energies in the presence of cyclopropane show a substantial incorporation into the organic molecule by reaction (1), in which the asterisk designates an energetic species



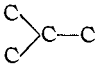
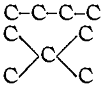
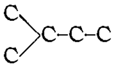
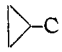
$$T^* + \underset{CH_2}{\overset{CH_2-CH_2}{\diagdown\!\diagup}} \longrightarrow C_3H_6T^* \longrightarrow H + \underset{CHT}{\overset{CH_2-CH_2}{\diagdown\!\diagup}} \quad (1)$$

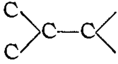
Previous experiments with thermal deuterium atoms have failed to show any exchange of D for H in the cyclopropane molecule.[1]

Gaseous mixtures of He^3 and cyclopropane, with oxygen or He^4 sometimes added, have been irradiated with thermal neutrons to produce tritium by the reaction He^3(n,p)H^3. The resulting radioactive products have been separated and measured with a proportional counter on the outlet end of a gas chromatographic column.[2] The percentage of radioactivity incorporated in each radioactive product is shown in Table I for several runs, both with and without added gases.

TABLE I

RADIOACTIVE PRODUCTS OF THE GASEOUS REACTION OF ENERGETIC TRITIUM ATOMS WITH CYCLOPROPANE

	Per cent. total observed tritium[a]				
Gas Pressure, cm.	70.4Δ 2.0 He^3	31.4Δ 1.9 He^3	21.5Δ 1.9 He^3 8.6 O$_2$	10.1Δ 1.5 He^3 66.7 He^4	8.4Δ 1.9 He^3 24.3 He^4
Irradiation conditions n./cm.^{2}/sec.	6 days at 3 × 10^9	12 hr. at 2 × 10^{12}	12 hr. at 2 × 10^{12}	6 days at 3 × 10^9	12 hr. at 2 × 10^{12}
Product					
Δ	22.1	16.4	15.3	10.9	7.4
HT	31.2	47.4	58.3	30.1	54.9
CH$_3$T	2.5	6.8	6.0	1.8	6.8
C–C	6.2	4.7	4.0	7.8	6.4
C=C	1.5	1.8	1.8	2.0	2.0
C–C–C	12.0	6.5	4.1	13.7	6.8
C–C=C	2.1	2.5	2.2	1.8	1.7
	3.0	1.5	1.0	3.1	1.8
C–C–C–C	8.6	4.9	1.8	13.8	5.0
	Low			Low	
	5.4	4.0	1.5	7.8	3.7
C–C–C–C–C	1.4	1.7	0.7	1.8	0.9
	0.7	0.5	0.1	0.5	<0.1

[a] Smaller amounts (<1% each) have been observed for C≡C, C=C=C, C—C≡C, , *i*-C$_6$, *n*-C$_6$, and others.

In these systems, O$_2$ serves as a very effective radical scavenger.[3] The essentially unchanged yield of cyclopropane in its presence indicates that free radicals are not involved, and that the reaction goes through an intermediate as indicated in (1). Presumably the absence of observable exchange with thermal deuterium atoms is the result of a high activation energy for this reaction; the recoil tritium atoms react as "hot" atoms before reaching thermal energies. Moderating collisions with He^3 or He^4 serve to reduce the average energy of the tritium atom at the time of reaction,[4] and hence reduce the possibility of exchange during collision. This is reflected in the lower yield of cyclopropane in the He^4 experiments.

Such irradiations cause degradation of the parent molecules by ordinary radiation effects. In the 70.4 cm. Hg Δ run of Table I, the final gaseous mixture contained about 1% other hydrocarbons than the parent, principally ethane and propane. Runs for higher *nvt* irradiations showed a higher percentage of radiation damage. Quantitative explanations of the distribution of radioactivity will require separation of the energetic tritium atom reactions from the accompanying macroscopic radiation damage.

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RECEIVED MAY 15, 1959

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[1] H. I. Schiff and E. W. R. Steacie, *Canad. J. Chem.*, **29**, 1 (1951).

[2] R. Wolfgang and F. S. Rowland, *Anal. Chem.*, **30**, 903 (1958).

[3] J. K. Lee, B. Musgrave and F. S. Rowland, 134th A. C. S. Meeting, Chicago, Sept., 1958.

[4] See, for example, M. El-Sayed, P. Estrup and R. Wolfgang, *J. Phys. Chem.*, **62**, 1356 (1958).

OXAMYCIN, A COMPETITIVE ANTAGONIST OF THE INCORPORATION OF D-ALANINE INTO A URIDINE NUCLEOTIDE IN *STAPHYLOCOCCUS AUREUS*

Sir:

Oxamycin (D-4-amino-3-isoxazolidone, D-cycloserine), like penicillin, bacitracin, novobiocin and gentian violet, induces uridine nucleotide accumulation in *S. aureus*.[1] The nucleotides which accumulate are bacterial cell wall precursors.[2] Their accumulation, as well as protoplast formation,[3] is the consequence of inhibition of cell wall synthesis by these antibacterial substances.

The major compound isolated from oxamycin-treated cells had a slower mobility in several solvents than UDP-GNAc-lactyl-(L)ala-(D)glu-(L)-lys-(D)ala-(D)ala,[4,5] the principal compound which

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[1] J. Ciak and F. E. Hahn, *Antibiotics and Chemo.*, **9**, 47 (1959).

[2] J. T. Park and J. L. Strominger, *Science*, **125**, 99 (1957).

[3] J. Lederberg, *J. Bacteriol.*, **73**, 144 (1957).

[4] In this abbreviation UDP refers to uridine diphosphate and GNAc-lactyl to an ether of acetylglucosamine and lactic acid (acetylmuramic acid). The peptide, for which the usual abbreviations are employed, is linked to the carboxyl group of the lactic acid. Its sequence recently has been determined.[5]

[5] (a) J. L. Strominger, *Compt. Rend. Trav. Lab. Carlsberg*, **31**, 181