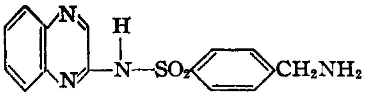
mido derivative of sulfaquinoxaline,[2] [2-(4-homosulfanilamido)-quinoxaline], was carried out.



This compound was synthesized by condensing N^4-phthaloyl-4-homosulfanilyl chloride[3] with 2-aminoquinoxaline[2] and hydrolyzing the resulting product.

The pharmacological activity of the product was kindly tested by D. Smith and O. Graessle of the Merck Institute. It was found to possess no bacteriostatic activity against *E. coli*, *S. aureus*, *Cl. Welchii* and *D. pneumoniae* Types I and II *in vitro* at concentrations in which marfanil was effective and did not prevent deaths due to *D. pneumoniae* Type I in the mouse when administered subcutaneously or intravenously in doses at which marfanil was slightly active.

Acknowledgment.—The authors are indebted to Dr. R. T. Major for his kind encouragement and advice.

Experimental

2-(N^4-Phthaloyl-4-homosulfanilamido)-quinoxaline.—A solution of 43.0 g. of N^4-phthaloyl-4-homosulfanilyl chloride and 16.8 g. of 2-aminoquinoxaline in 100 ml. of dry pyridine was heated on the steam-bath for two hours and then poured into water. The separated gummy material was taken up in 2.5 *N* sodium hydroxide, treated with Norite and filtered. The product was precipitated by acidification with glacial acetic acid, filtered and dried. The crude product weighed 24.7 g., m. p. 235–239° (48% yield).

A sample for analysis was recrystallized from glacial acetic acid, m. p. 246–247°. Calcd. for $C_{23}H_{16}N_4O_4$:[4] N, 12.61. Found: N, 12.90.

2-(4-Homosulfanilamido)-quinoxaline.—The hydrolysis of 26.7 g. of crude 2-(N^4-phthaloyl-4-homosulfanilamido)-quinoxaline to 2-(4-homosulfanilamido)-quinoxaline was carried out by heating with 8 ml. of hydrazine hydrate (85% in water) in 400 ml. of absolute ethanol for four hours. The solution was then cooled and the resulting precipitate filtered. This precipitate was taken up in 400 ml. of H_2O and 100 ml. of 2.5 *N* hydrochloric acid and heated on the steam-bath for one and a half hours. At the end of this time the solution was filtered. The filtrate was made alkaline with 30% sodium hydroxide, treated with Norite, filtered and acidified with glacial acetic acid. After concentrating the solution to dryness *in vacuo*, the residue (8 g.) was dissolved in 6 *N* ammonium hydroxide, treated with Norite and filtered. The filtrate was boiled until turbid. On cooling, light brown crystals separated; weight 4.8 g., m. p. 228° (25% yield).

A sample for analysis was recrystallized from glacial acetic acid, m. p. 230°. Calcd. for $C_{15}H_{14}N_4O_2S$: C, 57.31; H, 4.49; N, 17.83. Found: C, 57.55; H, 4.32; N, 17.85.

RESEARCH LABORATORIES
MERCK AND CO., INC.
RAHWAY, N. J.

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[2] Weijlard, Tishler and Erickson, THIS JOURNAL, **66**, 1957 (1944).

[3] Bergeim and Braker, *ibid.*, **66**, 1459 (1944).

[4] Microanalyses were kindly performed by R. H. Boos, J. H. McGregor and E. J. Thornton.

COMMUNICATIONS TO THE EDITOR

PENICILLIN YIELDS FROM NEW MOLD STRAINS

Sir:

Following ultraviolet irradiation of spores from a monoconidial isolate of the well-known strain X-1612 of *Penicillium chrysogenum*, a promising new strain, Wis. Q176, was obtained in June, 1945. This has consistently surpassed its parent in penicillin production, usually by a considerable margin.

In shake flask tests, 77% of the single spore lines from Q176 likewise exceeded X-1612 in yield. The best of these lines was Q176A8; 76% of the single spore lines from this culture also outperformed X-1612, two of them giving yields somewhat greater than any flask yields reported in this communication. Strains Q176 and Q176A8 have also been tested in shake flasks by the Department of Agricultural Bacteriology and a similar increase in yield over X-1612 was obtained.

Table I summarizes results obtained on strains Q176 and Q176A8 in both shake flasks and tanks. The shake flasks were 500-ml. Erlenmeyer flasks with 100 ml. of a medium containing per liter 40 g. of lactose, 20 g. of corn steep liquor solids, 3 g. of $NaNO_3$, 0.5 g. of KH_2PO_4, and 0.25 g. of $MgSO_4 \cdot 7H_2O$. They were incubated in a shaker at 23°. The tank fermentations were made at 23° with 55 gallons of medium in 80-gallon tanks,

TABLE I

PENICILLIN YIELDS ON VARIOUS CULTURES

Expt.	X-1612 units/ml.[a]	Q176 units/ml.	Q176A8 units/ml.
	Shake Flask Fermentations		
1	67	212	...
2	78	115	215
3	94	125	178
4	107	...	129
5	120	155	205
	Tank Fermentations		
1[b]	367[c]	...	337
2	427	728	...
3	501	920	...

[a] *S. aureus* cup assay. [b] A different lot of corn steep liquor was used for each of the tank experiments. [c] Each tank yield figure is the mean yield of duplicate tanks which differed in yield by from 4 to 18%.

agitated by 18-inch propellers running at 270 r. p. m., and aerated at the rate of 200 liters per minute. The medium used contained 4% corn steep liquor solids, 4% lactose, and 1% calcium carbonate.

It will be seen that although shake flask yields varied considerably in every experiment, both Q176 and Q176A8 surpassed X-1612. In the tank tests Q176 gave yields higher than those thus far obtained with any other culture. Q176A8, however, failed to surpass X-1612.

The fundamental studies on variability in *Penicillium notatum* and *P. chrysogenum* of which these strains were a by-product will be reported in detail elsewhere. Upon request, transfers of any of the cultures mentioned in this note will be sent to laboratories engaged in penicillin research or production.

DEPARTMENTS OF BOTANY AND BIOCHEMISTRY
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RECEIVED DECEMBER 7, 1945

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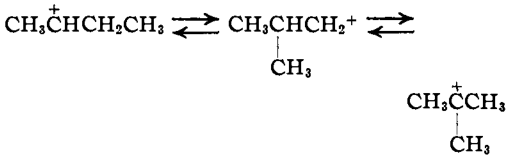
[1] With the assistance of O. H. Calvert, Eugene Dulaney, J. J. Stefaniak, F. B. Gailey and F. G. Jarvis.

THE MECHANISM OF PARAFFIN ISOMERIZATION

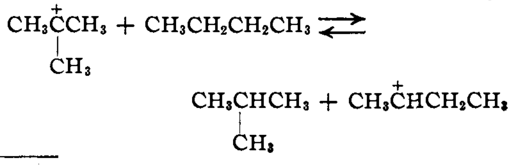
Sir:

It has been shown[1] that under controlled conditions paraffin hydrocarbons do not undergo isomerization in the presence of aluminum halide catalysts unless traces of olefins or their equivalent are present. These results suggest that the isomerization may proceed by a chain mechanism similar to that proposed[2] for the alkylation of isoparaffins with olefins. Thus, it is postulated that isomerization of n-butane proceeds by a sequence of reactions which may be expressed as follows in terms of carbonium ions[3] as has been done[4] in the case of alkylation mechanism.

Eq. 1 $$\mathrm{CH_3CH_2CH_2CH_3} + \mathrm{R^+} \xrightarrow[\mathrm{HCl}]{\mathrm{AlCl_3}} \mathrm{CH_3\overset{+}{C}HCH_2CH_3} + \mathrm{RH}$$

Eq. 2 

$$\mathrm{CH_3\overset{+}{C}HCH_2CH_3} \rightleftarrows \mathrm{CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}HCH_2^+} \rightleftarrows \mathrm{CH_3\underset{\displaystyle CH_3}{\underset{|}{\overset{+}{C}}}CH_3}$$

Eq. 3 

$$\mathrm{CH_3\underset{\displaystyle CH_3}{\underset{|}{\overset{+}{C}}}CH_3} + \mathrm{CH_3CH_2CH_2CH_3} \rightleftarrows \mathrm{CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}HCH_3} + \mathrm{CH_3\overset{+}{C}HCH_2CH_3}$$

The reaction of Eq. 1 serves only to initiate the chain and the reactant, $\mathrm{R^+}$, need therefore be present in small amount only. The chain initiating ion, $\mathrm{R^+}$, may be produced in several ways. It may be formed by the addition of hydrogen chloride or hydrogen aluminum tetrachloride ($\mathrm{HAlCl_4}$, probably the true catalyst) to an olefin which is present in the paraffin as an impurity, or which is added as such, or which results from cracking of the paraffin. It may also be introduced in the form of an alkyl halide.

Dehydrogenation of the paraffin by reaction with the hydrogen chloride or hydrogen aluminum tetrachloride offers yet another means of obtaining the necessary chain-initiating ion:

Eq. 4 $$n\text{-}\mathrm{C_4H_{10}} + \mathrm{HCl} \xrightarrow[\mathrm{AlCl_3}]{} s\text{-}\mathrm{C_4H_9^+} + \mathrm{Cl^-} + \mathrm{H_2}$$

Experimental evidence in support of this reaction may be found in the observation that minor quantities of hydrogen are actually formed during the initial stages of butane isomerization with a supported aluminum chloride catalyst and hydrogen chloride.[5] The rearrangement of the s-butylcarbonium ion (Eq. 2) finds analogy in the rearrangement of olefins in the presence of acidic substances.[6] The reaction of Eq. 3 (as well as that of Eq. 1) is similar to the hydrogen–halogen exchange reaction which occurs when isoparaffins are contacted with s- or t-alkyl chlorides in the presence of aluminum chloride.[3]

In accordance with the lesser tendency of normal paraffins to undergo the exchange reaction, higher temperature or otherwise more severe reaction conditions are necessary for isomerization of normal paraffins than are required for the alkylation of isoparaffins.

It is evident that the mechanism herein proposed is also applicable to the isomerization of cycloparaffins.

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RECEIVED[7] AUGUST 31, 1945

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[1] H. Pines and R. C. Wackher, THIS JOURNAL, **68**, in press (1946).

[2] L. Schmerling, *ibid.*, **66**, 1422 (1944).

[3] In accordance with current theory, carbonium ions are used in this paper as the active equivalent of alkyl halides or of olefins plus hydrogen halide.

[4] P. D. Bartlett, F. E. Condon and A. Schneider, THIS JOURNAL, **66**, 1531 (1944).

[5] H. S. Bloch, unpublished results.

[6] F. C. Whitmore, THIS JOURNAL, **54**, 3274 (1932). See also Egloff, Hulla and Komarewsky "Isomerization of Pure Hydrocarbons," Reinhold Pub. Corp., New York, N. Y., 1942, Chap. II.

[7] Original manuscript received June 7, 1945.

LIGHT-FIELD ULTRAMICROPHOTOGRAPHY OF LYOGELS

Sir:

In a recent publication (*Ind. Eng. Chem.*, **37**, 786 (1945)) we reported on a new microscopic technique with ultra-illumination by incident light resulting in a dark-field effect, which has proved to be of particular value in the study of lyogels.

Since then we have made a great number of color microphotographs of such preparations, using Kodachrome A film. Due to the absence of any grain in the developed film, the color photographs lend themselves very well to considerable