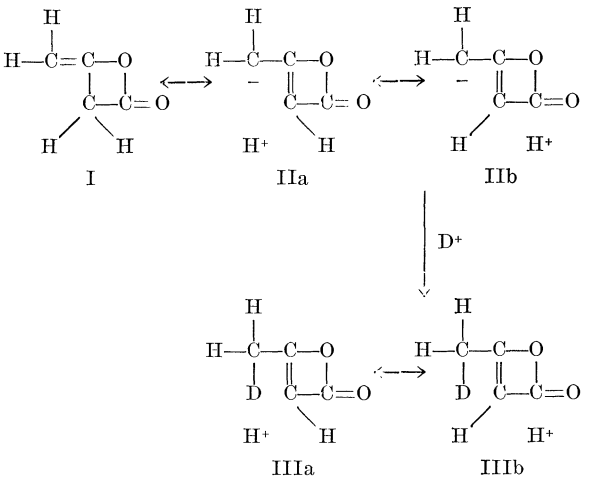
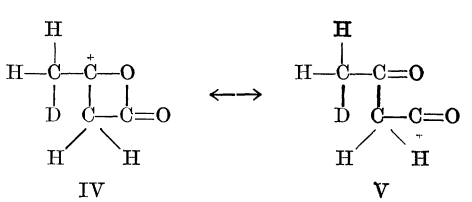
Hyperconjugation possibilities in the 3-butene β-lactone structure (I) include contributions from two structures IIa and IIb, either of which permit attack by a positive fragment, such as the proton or deuteron, at the exocyclic methylene carbon atom to give IIIa–IIIb.



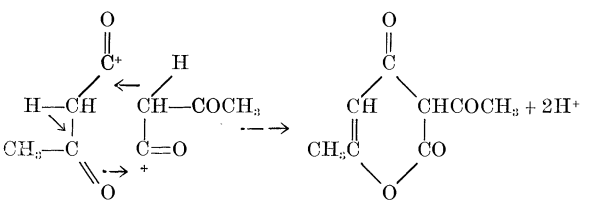
These hyperconjugation resonance structures involve no greater charge separation than previously considered resonance structures involving a cyclic oxonium atom. Moreover, since deuterium exchange with the hydrogen atoms involved in the "no bonds" has been shown (*5*) to be nonexistent, such structures as IIIa–IIIb are entirely consistent with the absence of α-deuteration during the methanolysis with methanol-d. In fact, only after it is known that there is no exchange of α-hydrogen atoms with deuterium is it likely that these hyperconjugation structures would be seriously considered.

Conversion of IIIa–IIIb to IV represents the normal course of the mechanism of addition reactions in which hyperconjugation is involved. Reactions of IV, such as combination with a methoxide ion, will obviously not give the acetoacetate structures actually obtained. Rearrangement of IV to the acylonium ion V provides the structural entity that does explain acetoacetate formation. Analogies for the two steps involved in the rearrangement of IV to V are known. The conversion of a carbonium ion (in which the carbonium carbon is linked to an oxygen atom) to a carbonyl group is postulated as one step in the gen-



erally accepted mechanism for the pinacol rearrangement (*6*), and formation of an acylonium ion from an ester is postulated as one step in accepted mechanism for Friedel-Crafts acylations and for the sulfuric acid catalyzed hydrolysis of ethyl 2,4,6-trimethyl-benzoate (*7*).

The acylonium ion V is structurally similar to the acetylketene structure. It can be regarded as the product formed by addition of a proton to acetylketene. The result is that the ease and convenience associated with reaction concepts based on acetylketene are readily transferred to concepts based on this conversion. For example, the formation of dehydroacetic acid from diketene can be formulated as follows:



Acceptance of this hyperconjugation-acylonium ion concept for the structure and reactions of 3-butenoic β-lactone will permit clarification of much of the confusion in the literature on diketene reactions.

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Blood Studies of Red Sindhi-Jersey Crosses: III. Effect of a Fixed Hot Environment on Blood Constituent Levels of Jerseys and Sindhi-Jersey Crosses

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One of the principal problems in the general program of developing strains of dairy cattle better adapted to subtropical climates has been to discover some easily measured morphological or physiological characteristic that could be used as an index of the animal's heat tolerance. The object of this study is to present the results of an attempt to correlate certain readily measured blood constituent levels (hemoglobin, hematocrit, plasma calcium, and plasma inorganic phosphorus) with heat tolerance.

Rusoff *et al.* (*1*) reported that higher hemoglobin, hematocrit, and plasma inorganic phosphorus levels exist in the blood of Sindhi-Jersey daughters than in their Jersey dams. Similarly, Blincoe *et al.* (*2*) re-

Table 1. Mean blood constituent levels of the breed groups before (period I), immedately after (period II), and 18 hr after exposure (period III) to a standardized hot environment of 105°F and 34 mm-Hg vapor pressure.

Breed group	Period I	S.E.*	Period II	S.E.	Period III	S.E.
			Hemoglobin (%)			
3/4 S, 1/4 J†	10.00	0.23	9.91	0.37	10.55	0.47
1/2 S, 1/2 J (F_1)	10.95	0.27	11.12	0.31	11.26	0.39
1/2 S, 1/2 J (F_2)	10.79	0.27	11.54	0.45	11.98	0.44
1/4 S, 3/4 J	10.50	0.30	10.84	0.27	11.21	0.21
J	10.00	0.24	10.15	0.21	10.23	0.21
			Hematocrit value (%)			
3/4 S, 1/4 J	36.86	1.37	37.32	1.60	38.77	1.73
1/2 S, 1/2 J (F_1)	36.79	1.27	37.00	1.60	38.36	1.56
1/2 S, 1/2 J (F_2)	38.57	1.51	39.43	2.28	41.60	4.01
1/4 S, 3/4 J	39.13	0.81	39.88	1.05	42.32	1.99
J	36.41	0.89	36.65	0.80	37.09	0.85
			Plasma Ca (mg %)			
3/4 S, 1/4 J	9.93	0.28	10.19	0.27	10.04	0.29
1/2 S, 1/2 J (F_1)	10.63	0.66	10.04	0.28	10.00	0.24
1/2 S, 1/2 J (F_2)	10.02	0.23	10.68	0.33	10.27	0.23
1/4 S, 3/4 J	10.12	0.18	10.44	0.15	10.29	0.16
J	10.49	0.21	10.62	0.27	10.24	0.19
			Plasma inorganic P (mg %)			
3/4 S, 1/4 J	6.34	0.35	6.47	0.28	7.24	0.29
1/2 S, 1/2 J (F_1)	4.61	0.36	4.36	0.40	4.87	0.23
1/2 S, 1/2 J (F_2)	5.36	0.16	5.64	0.26	5.59	0.33
1/4 S, 3/4 J	6.01	0.36	5.29	0.50	6.15	0.37
J	5.11	0.19	4.26	0.22	5.67	0.19

*Standard error of the mean. † S refers to Red Sindhi; J refers to Jersey.

ported higher hematocrit, hemoglobin, and erythrocyte values in Brahman (Indian evolved) than in Brown Swiss (European evolved) cattle. Since the Indian-evolved Zebu cattle and their offspring are reported to be more heat tolerant than the European breeds (*3*) it remained to be determined whether these or other blood constituents were in some way related to heat adaptability.

Twenty-six crossbred and 15 purebred Jersey heifers, 6 to 24 mo of age, were subjected to a standardized hot environment of 105°F dry-bulb temperature and 92°F wet-bulb temperature (34 mm-Hg vapor pressure) in a climatic chamber for a period of 6 hr at 2-mo intervals. Of the crossbreds, nine were ½ Sindhi, ½ Jersey (F_1); eight were ¾ Sindhi, ¼ Jersey; three were ½ Sindhi, ½ Jersey (F_2); and six were ¼ Sindhi, ¾ Jersey; the different types of crosses were treated as distinct groups in the subsequent analysis.

At each exposure test, three separate blood samples were obtained from each animal according to the following time schedule: (i) period I, 18 hr prior to subjection to high temperatures (to obtain a "normal" blood picture); (ii) period II, immediately after the 6-hr exposure period (to reflect the "short-term" physiological response of the animal to the high temperature); and (iii) period III, approximately 18 hr after the termination of exposure (to determine whether any "long-term" physiological responses, could be detected). This series of blood samples was obtained from each animal from one to three times during the year; blood constituent determinations were carried out according to techniques previously reported (*1*).

The average levels of the various blood constituents for the different breed crosses prior to (period I), immediately after (period II), and 18 hr after exposure (period III) to the standardized hot environment are shown in Table I (*4*). Within-breed, between-period differences in blood values were not significant (tested by means of *t*-tests; in most cases, *t* was less than 1.0).

From these results it appears that hemoglobin, hematocrit, plasma calcium, and plasma inorganic phosphorus levels are not appreciably altered by a 6-hr period of exposure to hot conditions; therefore, since levels of these blood constituents do not indicate a response to thermal stress, these measurements, as presently taken, could not serve as suitable indexes of heat tolerance.

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