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Stability of Acid-Base Equilibrium of Blood in Animals Falling in
Different Age Periods.*

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The following data have been obtained by a review of experiments conducted some years ago. At such periods of investigation changes in the acid-base equilibrium of the blood were ascertained by determining the alkali reserve of the blood plasma by the method of Marriott.⁴ This technic was in use during the period of the development of the more accurate method of Van Slyke, which statement serves as an explanation for not having employed in these experiments this more dependable method for ascertaining changes in this fundamental equilibrium of the animal organism.

The following observations have been made on a series of 89 dogs which on the basis of their ages may be divided into 3 age groups. Group I, is represented by 21 puppies not over 6 months in age. Group II, by 33 adult dogs that varied in age from 1 to 6 years, while Group III, is composed of 35 old or senile animals varying in age from 9 years to 19 years and two months.

Control studies of the animals in the respective groups have shown all of the animals with the exception of 6 dogs falling in the senile group (Group III) to be free from evidence of renal injury. The urine of 6 animals referred to contained a constant trace of albumin, broad hyaline casts and occasional red cells. The elimination of phenolsulphonephthalein in an hour period by these animals was below the normal value for this evidence of renal function, giving readings as low as 28

* Observation of a similar order have appeared from this laboratory in past years.^{1,2,3}

¹ MacNider, W. deB., *Science*, 1921, **53**, 141.

² MacNider, W. deB., *J. Exp. Med.*, 1926, **43**, 53.

³ MacNider, W. deB., *J. Exp. Med.*, 1917, **36**, 1.

⁴ Marriott, W. McKim, *Arch. Int. Med.*, 1916, **17**, 840.

and 22%. There was no retention of non-protein nitrogen. The determinations of the reserve alkali of the blood for the animals of all 3 groups including those dogs in Group III which gave evidence of renal impairment were normal and varied between 8.05 and 8.15. Such determinations were made in duplicate on 6 different days.

The experimental procedure employed to ascertain the stability of the acid-base equilibrium of the animals has consisted in giving the dogs subcutaneously 0.25 cc of a 2% solution of morphine sulfate and following the initial period of excitement when the animals gave evidence of a variable degree of narcosis, they were then given, by the open method of administration, chloroform for a period of 45 minutes. The following results have been obtained in the animals of the respective groups. In Group I, represented by the puppies, the reserve alkali has shown a reduction in all of the animals and in 6 of the 21 dogs a reduction from the normal of 8.15 to 7.75. In this group regardless of the degree of depletion in the alkali reserve a return to a normal equilibrium has been re-established within 1 hour and 20 minutes following the discontinuance of the anesthetic. In Group II, represented by 33 adult animals, there occurred no reduction in the alkali reserve in 11 members of the group. In the remaining 22 dogs in which a depletion was effected the determinations did not depart from the normal readings of from 8.1 or 8.5 to a reading lower than 7.85. In this adult group (Group II) the restoration of the alkali reserve to the normal was slower than in the group of puppies (Group I). With 3 exceptions a readjustment was only established within 1 hour and 50 minutes. In Group III representing the older and senile animals with the exception of the 6 animals that gave evidence of

renal impairment, the use of the anesthetic body induced a rapid reduction in the alkali reserve to a point indicating a greater degree of depletion, 7.85 to 7.65, than had occurred in the adult animals of Group II. In this respect the instability of the acid-base equilibrium of the blood resembles the type of reaction obtained in the puppies of Group I. However, in the ageing and senile animals of Group III there is a marked delay in the restoration of this balance. With 4 exceptions a time limit of 2 hours and 40 minutes was necessary for the equilibrium to be re-established. In this respect, the senile animals of Group III differ from the puppies of Group I. Finally, falling in Group III, as has been indicated, 6 dogs gave evidence of renal impairment which was shown by a reduction in the elimination of phenolsulphonaphthalein and by certain abnormal changes in the urine. The use of the anesthetic body in these animals for a period of 45 minutes has failed to induce a reduction in the reserve alkali of the blood below that figure which the respective animals had established as their normal. This has varied from 8.0 to 7.9. It would appear that in such animals even though the normal alkali reserve readings were at a low normal, 8.0, or at a point below this, 7.9, they had become through some mechanism established as stabilized values.

Conclusions. 1. Adult dogs varying in age from 1 to 6 years give greater evidence of stabilization in the alkali reserve of the blood than do young dogs, puppies, with an age limit of 6 months or older and senile animals varying in age from 9 years to 19 years and 2 months. 2. In certain instances dogs with evidence of renal injury may stabilize against strain the alkali reserve of the blood at a point below the normal determination for such a value.