Fig. 3. Laminar mixing length criterion.

of enclosed laminar flames in a state of steady diffusion when an arrangement identical to that in the mixing studies is used. Systematic experiments with those flames have established the existence of critical relative velocities of the reactants above which steady diffusion flames are excited into a state of vibration. The vibrations may be stable or unstable. Details of these experiments have been presented elsewhere¹.

The experimental work on isothermal mixing was carried out by Mr. W. S. Hall. The two investigations are being continued.

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¹ Deckker, B. E. L., and Srinivas, R. A., *Low Frequency Self Excited Vibrations of Enclosed Laminar Diffusion Flames*, Spring Meeting, Western States Combustion Inst., Denver (April, 1966).

PHYSIOLOGY

Negative Pressures in Knee Joints

GUYTON^{1,2} established the concept of a negative interstitial tissue pressure, and observations which I have made on the knee joints of rabbits, cats, dogs and man have supported this idea. One hundred and sixty-eight observations were made on normal knees, thirty-six in cats, thirty in rabbits, ninety-two in dogs and ten in man. The pressure was found to be between -2 and -10 mm of mercury in no less than 165 of these observations; the exceptions were one cat where a pressure of -14 mm of mercury was found—though the contralateral knee had a pressure of -7.5 mm of mercury—and one cat and one dog both of which had a pressure of +1 mm of mercury—though there was no detectable clinical effusion.

This negative pressure was maintained in the animals when saline was infused at a constant rate. In each animal the critical level of this rate of infusion was well defined, and was related specifically to the size of the joint and approximately to the body weight of the animal; above this level intra-articular pressure rose.

Marked variations in intra-articular pressure, said to occur on movement³, have not been found in normal joints in man or experimental animals when the joint was moved actively or passively while bearing no weight nor when it was involved in the movement of walking in man. The pressure in the knee joint was seen to be minimal just short of full extension, when there was a small amount of fluid in the joint and when the intra-articular pressure was above zero. It was seen to be maximal in full flexion. This rise in pressure was associated

with the tone in the quadriceps muscle and the strain on the lateral expansions from the patellar tendon. Section of the femoral nerve reduced the rise in pressure while section of the femoral nerve and the medial and lateral patellar expansions almost abolished intra-articular pressure on knee flexion.

Raising the intra-articular pressure had little effect on the clearance of iodine-131 from the joint as long as pressures above 40 mm of mercury were not used. Above this level clearance of iodine-131 from the joint was reduced. Human serum albumin iodated with iodine-131 had a faster joint clearance at pressures between 10 and 55 mm of mercury, an observation which may be of importance when considering the clearance of large molecules from joints after injury.

Exercise of the knee joint in man was associated with a rise in intra-articular pressure up to 5 mm of mercury after 20 min on a bicycle with fixed wheels, using a 5 kg friction in an untrained man, and after 45 min in a fit parachutist. This rise in intra-articular pressure was associated with changes in the electrical response of both the ipsilateral and the contralateral muscles acting on the knee joint. This may help to explain the stiffness following exercise and the contralateral symptoms of patients with joint effusions and apparently normal contralateral joints.

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¹ Guyton, A. C., *Circulat. Res.*, **12**, 399 (1963).

² Guyton, A. C., *Circulat. Res.*, **16**, 452 (1965).

³ Eyring, E. J., and Murray, W. R., *J. Bone Jt. Surg.*, **46A**, 1235 (1964).

Daily Torpor induced in White-footed Mice (*Peromyscus* spp.) by Starvation

WHITE-FOOTED mice have frequently been reported to be heterotherms or incipient hibernators with variable body temperatures¹⁻³ and two species have been found in a state of torpor in outdoor nest boxes in winter⁴. In a systematic study of *Peromyscus eremicus*, daily torpor was interpreted as a summer phenomenon occurring at moderate ambient temperatures in response to aridity⁵.

As a result of finding that a wide variety of types of periodic dormancy exists among small animals⁶, we undertook to examine systematically daily torpor in five species of white-footed mice. It is our intention to define a physiological pattern of daily torpor common to the genus.

The species studied were: *Peromyscus crinitus*, *P. boyleyi*, *P. eremicus*, *P. maniculatus*, and *P. leucopus*. Daily torpor has been observed in two other species in our laboratory⁷. This torpor occurs at all seasons of the year when starvation is sufficient to reduce significantly the body weight, and this is particularly so when animals have become fat under laboratory conditions. Daily torpor is considered a special pattern of temperature regulation with some similarities to "classical" hibernation. Torpor makes survival possible when the animals are confronted with limited resources of energy—regardless of whether this is the result of low temperature or lack of moisture.

Body temperatures were recorded for a total of 112 cycles of torpor from fifteen individuals, three of each species. The metabolic rates were simultaneously recorded during several of these cycles.

While the animals were under 'Nembutal' anaesthesia (70 mg/kg) a 30 gauge copper-constantan thermocouple was implanted in the peritoneal cavity just behind the kidneys. The leads were implanted subcutaneously on both sides of the body and emerged at the back of the neck and were connected to a recording potentiometer. The animals were placed in 1,000 cm³ clear plastic cham-