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### Changes in the Growth of Skeletal Muscle Following Thyroidectomy in the Sheep.

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A comparative study of skeletal muscle from 5 normal sheep and 11 thyroidectomized animals was undertaken, to determine whether definite structural changes in the fibers are present which would account for the development of the pot-belly and general muscular weakness in cretins. Following early thyroidectomy, the normal development of cytoplasm is prevented, and the ratio of muscle to sarcoplasm in the cretin remains more nearly like that in the young animal, than that in the normal of the same age. No degeneration of the fibers is evident, and all the structures of normal muscle are demonstrable.

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### Auditory Conditioned Reflexes in the Thyroidectomized Sheep and Goat.

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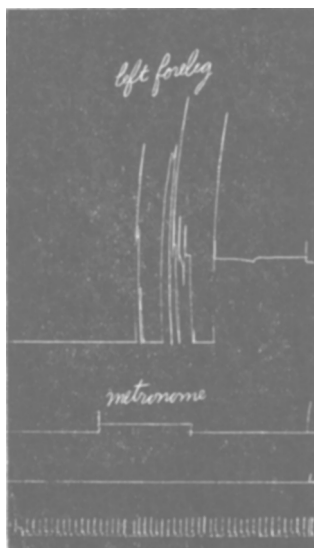
The lethargy of the cretin sheep or goat, and its apparent indifference to its environment, suggest a fundamental defect in cerebral function, but when the animal is subjected to simple learning tests the deviation from the normal, under experimental conditions, is less striking. For example, the animal, unless it is suffering one of its recurrent periods of prostration, learns the maze with a single *cul de sac* as well as the control. It is only when the blind alley is reversed in position, at every trial, that striking deviations from normal behavior appear. The extreme complexity of the animal's response in the labyrinth makes the analysis of the data in physiological terms very difficult. For this reason the maze studies have been abandoned in favor of the conditioned motor reflex method.<sup>1</sup>

A systematic investigation of cerebral activity involves, accord-

ing to Pavlov,<sup>2</sup> two problems, a study of the analyzers (receptors with their central terminations) and of the mechanism for the formation of temporary nervous connections. In a preliminary study<sup>3</sup> it was demonstrated that the formation of a simple tactile conditioned reflex was effected as easily in the cretin as in the normal sheep. Secondary conditioned reflexes of proprioceptive origin added to the primary tactile reflex were observed in both operated and control animals. Since the alternating maze problem exhibited marked differences between cretin and normal, which were shown neither in the simple maze nor in the formation of the simple conditioned reflex, it was decided to attempt to form more difficult conditioned reflexes, viz., discriminative and delayed reflexes to the sound of the metronome. It was necessary at first, however, to discover whether or not the auditory analyzer in the cretin could be employed in building up simple conditioned reflexes.

Two cretin sheep and a cretin goat were trained to respond by a movement of the left foreleg to the sound of the metronome by combining the conditioned auditory stimulus with an electric shock (unconditioned stimulus) applied to the shaved skin of the foreleg. An auditory reflex was easily formed in all three thyroidectomized animals, and the figure illustrates the conditioned response of one of the cretin sheep to the metronome at 60 beats per minute. The time record is in seconds.

FIG. 1.



Results so far obtained with the conditioned reflex method indicate that in the thyroidectomized animal three analyzers (tactile, proprioceptive, and auditory) may be employed in the formation of temporary nervous connections, and that these connections are readily formed, when the reflex to be established is of the simple or simultaneous type. Having demonstrated the possibility of forming simple auditory reflexes in the cretin sheep and goat, we are now attempting to establish the more difficult discriminative and delayed conditioned reflexes.

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<sup>1</sup> Liddell, H. S., *Am. J. Psychol.*, 1926, xxxvii, 418.

<sup>2</sup> Pavlov, I., *Lancet*, 1906, ii, 911.

<sup>3</sup> Liddell, H. S., and Simpson, E. D., *PROC. SOC. EXP. BIOL. AND MED.*, 1926, xxiii, 720.