The choice of a suitable microphone presented the greatest problem in our work. The aim of a portable and inexpensive outfit ruled out the condenser microphone as it is bulky and requires a separate power supply. The same is true of the ribbon and dynamic types of microphones. The carbon microphone is noisy and the inability to use it in any position, due to shifting of the carbon granules, proved it to be unsatisfactory. Theoretical and practical work demonstrated that the piezo crystal microphone was well adapted for our work. It is light, portable, inexpensive, does not require the use of any special transformer or batteries, and will operate in any position without any background noise or hiss. It is sensitive to the frequency level of heart sounds (50 to 160 vibrations per sec.).

Clinical tests with this amplifier have shown it capable of picking up the normal heart sounds and the usual murmurs in most individuals, unless these sounds are distant, and reproduces them through the loud speaker in sufficient volume to be audible in a room of moderate size, without any distracting hum. Further work is in progress with increased stages of amplification which are necessary to reproduce faint heart sounds.

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Acoustic Function in Pouch Young of the Opossum.

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Pouch young of the opossum were tested for reflex responses to acoustic stimuli, using a litter captured with the mother when they had attained an estimated age of 29 days (40 mm. C. R. length). The tests were begun when the litter was estimated 43 days old (63-64 mm. C. R.). Preliminary tests for vestibular reflexes show that these appear in pouch young of about 41 days (61-62 mm. C. R.), in general agreement with Langworthy.[1] The experiments on acoustic reflexes were begun on 5 young in the brood pouch and attached to the nipples in the normal manner. The pouch was opened only enough to permit observation of the young, the mother being held quietly on her back. Other factors than the acoustic stimuli were eliminated. During the course of the experiment 2 of the young were killed for neuro-histological study of the labyrinth and

[1] Langworthy, Orthello, *J. Comp. Neur.*, 1928, **46**, 201.

brain, so the later results were obtained on 3 experimental animals. As controls we used the mother of the pouch young and another litter of 4 free young 146 mm. long (C. R.) at the beginning of the experiments.

Preliminary tests consisted of shrill whistling, sharp handclaps, vibration of a tuning fork at C″ and rustling of the straw of the pen. These were applied as close to the pouch young as possible without introducing other factors such as rush of air, etc. A wind instrument known as the "organette", giving the notes C, E. G, C′, E′, G′, C″, E″, G″ and C‴, was used in a closer analysis of sounds which elicited reflex responses. The chords C′ E′ G′ C″ and E G C′ on this instrument were also used. Sustained notes could be produced when desired.

The mother responded to all tests save the tuning fork by twitching of the abdominal and other muscles. The control litter of free young responded to all tests save the tuning fork by startled movements. It was concluded that the volume of sound produced by the tuning fork was insufficient to bring forth responses. The same note, namely C″, from the "organette" elicited responses in the mother, the control litter and in pouch young beginning at 51 days of age. Rustling in the straw brought forth the most marked response of all stimuli from the mother and the control litter, but no response from the pouch young. It is a composite sound of small volume and the responses observed are tentatively regarded as conditioned reflexes.

No response to any of the acoustic stimuli was observed in the pouch young until they were 50 days old (71 mm. C. R.). The auditory canal was patent from about the 43rd day after birth. At 50 days the young responded by a definite contraction of the trunk musculature, simulating Coghill's total reaction pattern,[2] to shrill, sharp whistling. At 51 days the response to whistling was somewhat doubtful but there was a strong trunk movement when the shrill E′ note was sounded. Slight responses were obtained at this stage also to G″ and C″, but not to other notes. At 52 days E″, C′, G and the chord C′ E′ G′ C″ brought forth slight to moderate reflex movements, while C″, G′ and E′ elicited strong reactions of the trunk. At 53 days G″, E and C‴ also elicited trunk movements. At 55 days C and chord E G C′ brought forth similar responses.

In addition to the trunk reflexes the 55-day stage showed a movement of the pinna when middle C was sounded. At 56 days E′ and

[2] Coghill, G. E., Anatomy and the problem of behaviour, Cambridge University Press, 1929.

E″ elicited movement of the pinna, in addition to trunk movements, while C, E, G, C′, G′, C″ and G″ elicited similar movements of the tail, in addition to the trunk reflex. The pinna and tail responses are regarded as individuated reflexes, in Coghill's sense. At 57 days the tail movements were not observed, but most of the notes were followed by trunk and pinna reflexes.

It will be observed that notes of high pitch elicit the earliest reflexes and that, in general, the appearance of responses to other notes, as development progresses, is in the order of the descending musical scale to C. No tests have been made as yet below this note.

Histological study of the cochlea of pouch young at several stages of development shows that the organ of Corti differentiates gradually from base to apex. Terminations of cochlear fibers are present about the bases of the hair-cells as early as 29-day pouch young. The organ of Corti as a whole is, however, in an early stage of differentiation, and, as above stated, is non-functional at this stage. By the stage of 50-day pouch young it shows marked histological differentiation and the beginning of functional activity. This is long before the young normally leave the brood pouch, and, presumably, before they have any occasion to respond to acoustic stimuli.

The earlier responses to high notes are correlated with the differentiation of the organ of Corti in the more basal part of the cochlea, while the later responses to low notes are attained only when histological differentiation has reached the apex of the organ of Corti. The fiber tract to the midbrain acoustic center is well shown in pyridine-silver series of the brain of a 43-day specimen. It is present long before reflex responses to acoustic stimuli appear.

Peripheral end-organs and central pathways of the acoustic system, similar in general pattern to those of the opossum have been described in the frog tadpole,[3] but no experimental evidence with respect to their capacity to function has yet been obtained.

[3] Larsell, O., *J. Comp. Neur.*, 1934, **60**, 473.