INTRODUCTION

Transition from rest to locomotion was studied when threshold train of electrical stimuli was delivered to the mesencephalic "locomotor region" of the tiger salamander *Ambystoma tigrinum*. Impulses of single hindbrain neurons were recorded during the extended transitory period before movements started. Most of the records both contained the stochastic component and obeyed certain rules. These rules depended on the parameters of the train and varied among neurons. Therefore it was essential to consider each record separately.

METHODS

Parieto-occipital craniotomy was made under MS-222 anesthesia in 4 postmetamorphic animals. Animals were kept then in refrigerator. One to three experiments were performed with an animal on 3d to 8th day after surgery. The head was fixed and the body was immersed in cool water. The monopolar negative stimuli of 1 ms duration were delivered via the glass micropipette with tip diameter about 2 μm filled with 0.5M NaCl. Stimuli 5 to 16 μA were applied with inter-stimulus intervals (ISIs) 80 to 500 ms during 15 s. Extracellular recording was done with 5-20 MOhm micropipettes filled with 2M NaCl. The output of AC-amplifier was digitized at 10 kHz, and data was acquired on PC. Impulses of single neurons were identified and transformed to point processes off line. Records of 14 neurons were examined; 80 of them contained more than 20 impulses.

RESULTS

Some neurons responded to trains that did not elicit locomotion. A portion of interimpulse intervals (Is) during the sub-threshold trains with ISI<500 ms contained *k>1* stimuli. Two or three (**Fig. 1**) *k*-values alternated commonly throughout a train. Most impulses were time locked to stimuli with latency L that scattered mainly in the range 20 to 50 ms. L-distribution was unimodal or contained two modes 8-15 ms apart. Stronger stimuli could shift the shortest latencies up to 12-15 ms (**Fig. 2, 3, 4, 5**). In addition, delayed impulses could appear 60 ms or more after the stimulus (**Fig. 1**).

The rate of firing was either augmenting or decrementing during near-threshold trains. The stabile (**Fig. 1**) or the decrementing rate was common during sub-threshold trains although the augmenting firing encountered as well. The trend could develop gradually by changing occurrences of *k* and *k-1* intervals so that neuron switched between more and less stable states. The value of *k* was commonly 6 to 2 in various records.

However in many trials especially during near-threshold trains, the abrupt transformation of I and *k* and L (**Figs. 5, 6, 8, 9**), or I and *k*, or at least either *k* or L was observed. For example, *k*-alternation between 3 and 2 transformed to that between 3 and 4 in decrementing records. In augmenting trials *k* began to alternate between 1 and 2 instead of 3, 2 and 1 (**Fig. 5**), or switched to alternation between 1 and 0 (**Figs. 6, 8**). In the 0-state two impulses originated during one ISI.

Modal latency of the time-locked impulses could shift by 5-10 ms or even more (**Fig. 6**) during a train. Delayed impulses appeared either in the middle or in the last part of ISI (**Figs. 2, 4, 6, 7, 8**). The middle and pre-stimulus impulses could encounter up to 100-200 ms after the stimulus (**Fig. 9**). These delayed impulses staggered with time-locked ones mainly in a non-regular fashion (**Figs. 1, 9**) but particular patterns arose in a few records (**Fig. 7**).

Neurons with background discharge (BD) used to accommodate it to the train (**Fig. 10**). In addition, time-locked impulses were inserted into BD (**Fig. 11**). In one silent neuron non-locked activity was evoked at ISI 1000 ms (**Fig. 12**). At ISI 500 and 200 ms the portion of impulses coupled to stimuli with latency around 50 ms although the train remained sub-threshold (**Fig. 9**)

Interimpulse intervals followed passively *k*-alternations in neurons that gave time-locked responses with latency around 20 ms. When the time-locked impulses were intermingled with the delayed impulses, the intervals were mostly less then ISI×*k* but more than ISI×(*k-1*) (**Figs. 1, 5**). Small portion of *k*- and (*k-1*)-intervals even could be of the same duration (**Fig. 9**). This partial stabilization was achieved due to certain relation between fluctuations of L and *k*. The rule was conserved during the record although neither *k*-alternation nor L-scattering was predictive (**Figs. 1, 6, 7**). The passive or stabilizing behavior could depend on current and ISI.

SUMMARY

Several features characterize behavior of single hindbrain neurons when sub- or near-threshold train of stimuli is delivered to the mesencephalic "locomotor region". Latency of time-locked synaptic responses scatters non-regularly. Long latency responses are more common than short latency ones. Interimpulse intervals that contain *k-1*, *k* or *k+1* stimuli alternate inadvertently. Delayed impulses in the middle or near the end of ISI intermingle with the time-locked ones. Firing is unsteady, in particular, a neuron can fire two impulses per ISI. Certain rule can link two or more features of the activity during particular train or a few trains. Generally, the closer is the train to the locomotor threshold the higher is an average rate of firing. The time course of firing can be either augmenting or decrementing, and it can either change gradually or undergo abrupt transformation. Variability and instability of neuronal behavior during extended transition from rest to locomotion introduce some constraints on the understanding of the events in the brain stem.