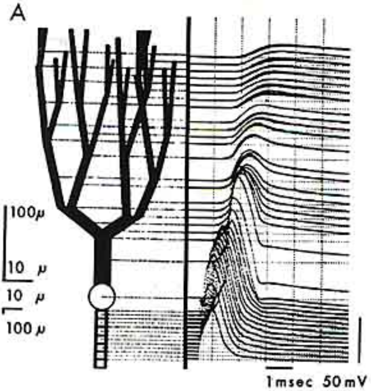

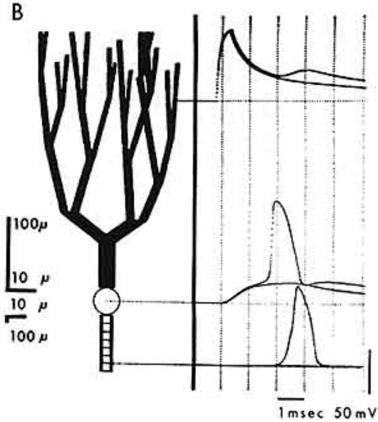

FIG. 3. A: Numerical solution for membrane potential against time throughout the 62 compartmental model in the case of simulated antidromic invasion of the Purkinje cell. All compartments of the dendritic tree are passive. Since the lowermost node in the axon has a boundary condition of an 'open end' (short circuited to the equipotential extracellular field), the action potential of the distal three nodes is distorted. The invasion of the soma and lower dendritic branches is clearly illustrated. As expected, the invasion is blocked at the base of the dendritic arbor and produces a slight depolarization on the most peripheral branches. This remote electrotonic invasion produces an after-depolarization at somatic level. B: Orthodromic activation of the model by parallel fiber synaptic input on the uppermost dendritic branches of the tree (horizontal distribution). At the right, numerical solution for membrane potential against time indicates a large depolarization at the peripheral dendritic branches which produces a prolonged EPSP at somatic level. A second slightly longer input (0.05 ms) produced an orthodromic action potential with 2 ms latency which propagated along the axon.

dritic tree. This possibility allowed us to obtain cinematographic display for visual analysis of spatio-temporal events in different situations. Figure 4 shows the pictorial display of membrane potential at 1.0 ms point of time, and on the right side the conventional electrophysiological displays of membrane potential time courses at each neuronal compartment.

The large depolarization of the uppermost branches is evident in Figs. 3 B and 4. As shown on the right, the EPSP generated at lower spatial compartments shows the expected changes in amplitude and time course. In this case the input produced a just threshold EPSP at the soma which fired after a delay of about 2 ms from the onset of parallel fiber input.

For comparative purposes a second parallel fiber input of identical strength and duration, but with markedly different spatial pattern, was applied as shown in Fig. 5. In this case, integration of an asymmetrical vertical input (as an idealized case of an 'off beam' Purkinje cell activation from a parallel fiber strip; LLINÁS, 1971) was produced by the activation of five spines, for 0.5 ms, on the main trunk and each right side branch. The overall spatial pattern of depolarization displayed on the left in Fig. 5 is self-explanatory and was taken at 2.5 ms after parallel fiber activation. The conventional electrophysiological display of the membrane potential demonstrates the functional properties of such input distribution. First of all, as analyzed in detail by RALL (1970), the

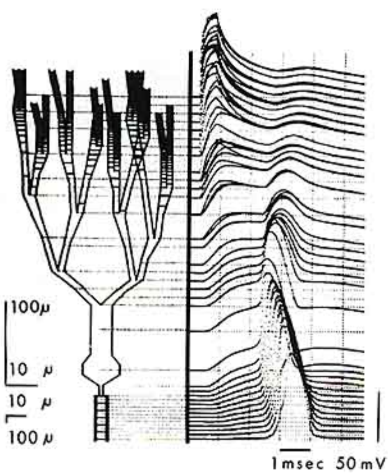

FIG. 4. Numerical solution for a just threshold orthodromic activation of Purkinje cell model. At the left schematic representation of the Purkinje cell, the density of 'hatching' is a function of the spatial distribution of potential at 1 ms after the onset of computation. On the right is continuous display of computed potential against time at the different neuronal compartments. Time and voltage calibration as indicated.