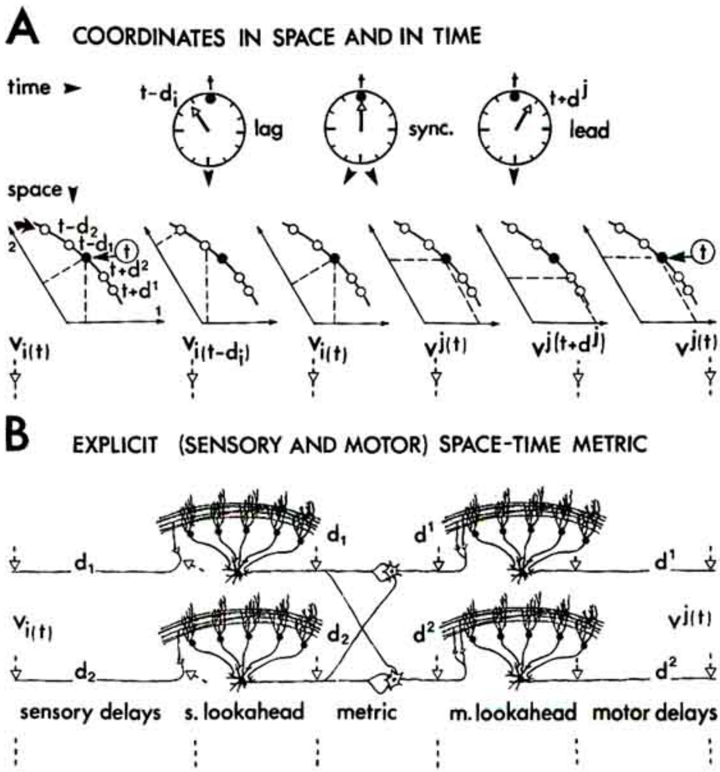

Fig. 5. Circuitry schematics of an explicit space-time metric tensor, implemented by a neuronal network. The function of temporal lookahead modules is to compensate for delays both in the sensory and in the motor pathways. A: The space and time information inherent in neuronal signals existing at time t, is shown in Newtonian space-time frame. The centralized clock-time is shown in the top row of clocks, the Euclidean space-coordinates are shown in the second row of oblique frames. In the vectorial symbolism (third row) the covariant v_i and contravariant v^j components are appended with time-indices, representing the clock-times that the vectorial components refer to. These vectorial components are carried by neuronal signals in the circuitry shown in B at the locations marked by arrows. B: Network implementation of the explicit space-time metric. Each of the 'stacks' of five Purkinje cells symbolize a 'lookahead module'. The sensory covariants first undergo a temporal lookahead d_1 and d_2 to compensate for the corresponding delays in sensory paths. This is followed by a metric transformation into contravariant components. Lastly, the components of the motor vector are also extrapolated in time, to compensate for the delays d^1 and d^2 occurring in the outgoing motor paths.

into the one in Fig. 5 in order to account for the fact that delays occur, not just in the sensory, but also in the motor pathways.

If paths in the sensory system contain delays d_i, the sensory signals arriving at the central processor at time t will not be those components of the covariant vector $v_i(t)$ that belong to the coincidence-time t, but the 'lagging' components of $v_{i(t-d_i)}$ which refer to the locations of the target at the times $t - d_i$. Thus, the $v_{i(t-d_i)}$ components have to be advanced by a 'lookahead' *via* the Taylor-assemblies to provide an identical set of predictions d_i that cancel out the delays d_i. Such a predictive 'lookahead module' is schematically depicted in Fig. 5B and later in the paper by a stack of Purkinje cells connected to a cerebellar nuclear neuron (from the computer model of Fig. 1 in ref. 20). If a simultaneity of the covariant components of $v_i(t)$ is re-established in the CNS (all components referring to the space-time event point at t), the covariant-contravariant transformation from $v_i(t)$ to $v^j(t)$ can be implemented by a network-matrix serving as a metric tensor. However, assuming that the contravariant components are carried by motor pathways that imply delays d^j, the space-time coincidence-point at t