Morris and Lecar proposed a simple model to explain the observed electrical behavior of the barnacle muscle fiber (Morris and Lecar 1981). Their model involves only a fast activating Ca^{2+} current, a delayed rectifier K^+ current, and a passive leak. They tested the model against a number of experimental conditions in which the interior of the fiber was perfused with the Ca^{2+} chelator EGTA in order to reduce activation of the K_{Ca} current. Their simulations provide a good explanation of their experimental measurements. The model translates into two equations:

$$C\frac{dV}{dt} = -g_{Ca}m_\infty(V - V_{Ca}) - g_K w(V - V_K) - g_L(V - V_L) + I_{app}, \tag{2.30}$$

$$\frac{dw}{dt} = \frac{\phi(w_\infty - w)}{\tau}. \tag{2.31}$$

Here m_∞ is the fraction of voltage-dependent Ca^{2+}channels open, and this is a function of voltage but not time. Furthermore, w is the fraction of open channels for the delayed rectifier K^+ channels, and the conductances g_L, g_{Ca}, and g_K are for the leak, Ca^{2+}, and K^+ currents, respectively. We use w rather than the previously used f_O for the fraction of open channels for historical reasons. The functions

$$m_\infty = 0.5[1 + \tanh((V - v_1)/v_2)], \tag{2.32}$$

$$w_\infty = 0.5[1 + \tanh((V - v_3)/v_4)], \tag{2.33}$$

$$\tau = 1/\cosh((V - v_3)/(2 \cdot v_4)), \tag{2.34}$$

Table 2.4 Morris–Lecar Oscillator Parameters (Type II)

Parameter	Value
C	20μF/cm^2
V_K	−84 mV
g_K	8 mS/cm^2
V_{Ca}	120 mV
g_{Ca}	4.4 mS/cm^2
V_{leak}	−60 mV
g_{leak}	2 mS/cm^2
$v1$	−1.2 mV
$v2$	18 mV
$v3$	2 mV
$v4$	30 mV
ϕ	0.04/ms