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## *GUEST EDITORIAL*

It isn't often that someone appears on the neurophysiological scene and completely reshapes it in his own mold. David Adair Robinson has had such an influence on the vestibular and oculomotor systems. His influence was dramatically illustrated by the presentations at a recent conference in his honor at Eibsee, Bavaria, in September 1993. The papers in this issue are a few from the many presented at that symposium.

Virtually all of the eye-movement measurements used in the papers presented at Eibsee were acquired with the electromagnetic technique that Dave introduced in 1963. Not only is this transducer used for human and animal experiments, but it also has become commonplace in many neurological clinics. It is difficult to imagine what many of our experiments would be like without the eye coil.

The engineering approach so fundamental to many of the papers at Eibsee can also be traced to Dave, who first introduced engineering concepts to explain how the brain controls eye movements. His earliest contributions using differential equations to describe the forces that move the eyeball allowed him to make predictions about premotor command signals that drive saccades and smooth pursuit. He then set about testing his model, becoming the first oculomotor scientist to record single-unit activity in behaving monkeys. Later, he revolutionized the notions of saccadic control by proposing an imaginative local feedback circuit that elegantly accounted for the eye's amazing ability to land accurately on a target of interest. This model was no figment of Dave's imagination, for it was based on the neural elements and connections that were known at that time. Because its elements could be identified in the brain, the "bang-bang" model generated many experiments designed to confirm or refute it. Today, 20 years after its publication, controversy still rages as to which neural elements actually are in the feedback loop or, indeed, whether it exists at all.

All of the readers of this journal are well aware of how Dave's powerful modeling talents have helped us to better understand the vestibulo-ocular reflex. Dave was the first to appreciate the need for a neural network to perform the mathematical integration of the head-velocity signals in the vestibular nuclei to the eye-position commands on motoneurons. He also suggested that the brain stem could be thought of as a matrix operator that converted the signals in canal coordinates to the coordinate system of the pairs of extraocular muscles. In the course of modeling the actions of the extraocular muscles, he provided information that is helpful in the diagnosis and management of strabismus. More recently, Dave used learning algorithms to construct circuits that suggest how the brain may be wired to perform various oculomotor functions such as integration. Just the introduction of models (and Dave has one for just about every oculomotor and vestibular phenomenon!) has forced us all to think about our data more critically and not be satisfied with phenomenological descriptions alone.

As a consequence of his engineering approach to neuroscience, Dave has changed our scientific vocabulary. It was he who coined such familiar descriptors as "local feedback loop" and "burst generator." He described the forces that drive the eye as acting on the "eye movement plant." For saccades, he modeled those forces as a pulse and step and later described dysmetric saccades as resulting from "pulse-step mismatch." The pulse and step were kept balanced by the "cerebellar repair shop." Finally, of course, there is the legendary "oculomotor integrator," which has a finite "time constant" and therefore is considered to be "leaky."

Dave's engineering approach has also had dramatic effects in the clinic. Not only has he provided physicians with a method to measure eye movements, he has also encouraged them to think of oculomotor circuitry as a control system. It is impressive that the leading neurology text on eye-movement disorders is couched in Robinsonian concepts. And as we saw at Eibsee and in the publications in this issue, the new generation of oculomotor physicians considers quantitative neuroscience as the only way to attack interesting problems.

Dave has been described as "the pope of eye movements." After a pope retires, there is a convocation of cardinals, such as the meeting at Eibsee, to elect his successor. But there can be no real successor to David A. Robinson. As excellent as the contributions at Eibsee were, none of the current generation of oculomotor scientists is likely to make the seminal contributions that Dave has. The vestibular and oculomotor communities owe him a debt we can never repay. However, we can at least all join in wishing him a rich retirement in which there is always another river to canoe, another bird to see, another coral reef to discover, and another mountain to climb.

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