The eight target articles in this special issue of BBS originated from a conference entitled Controversies in Neuroscience I: Movement Control, which was held in Portland, Oregon, on August 25–26, 1990. As the title of this conference suggests, it was intended to be the first of a series, focusing each year on a different area of neuroscience. Based on the success of this conference on movement, the second of the series, on neural transplantation, was held on December 8–10, 1991, and the third, on receptor mechanisms in the retina and brain, was held on October 31–November 1, 1992. The papers originating from the latter conferences will appear in BBS in the following years, and we hope to continue with conferences on the cellular basis of memory in 1993 and mechanisms of neuropathic pain in 1994. We also plan to publish these articles and commentaries in book form through Cambridge University Press.

In initiating these conferences, we decided that movement control was an appropriate topic to get the series started. Clearly, many areas of controversy in movement control are ripe for discussion. However, a more salient reason was that, of all the subdisciplines of neuroscience, movement control is probably the most multidisciplinary. Research in movement control includes approaches as varied as biomechanics, biophysics, neuroanatomy, neuromuscular physiology, and psychophysics; one of the goals of the "Controversies" series is to bring together researchers using different approaches to similar problems. Another reason for beginning with movement control was that movement is arguably the most important function of the brain and nervous system for the survival of the organism.

Of the many available controversial topics in movement control, why did we choose the eight topics addressed in the following articles? In selecting these topics, the conference organizing committee attempted to represent the control of movement at different levels of the nervous system. Thus, you will find the control of movement examined from the perspectives of muscle and joint biomechanics (Bizzi et al.), peripheral feedback (Gandevia and Burke), the spinal cord (McCrea), the brainstem (Robinson), the basal ganglia (Alexander et al.), the cerebellum (Bloedel), the motor cortex (Fetz), and the posterior parietal cortex (Stein). From these eight perspectives grew three broad issues: (1) localized versus distributed organization of the neural substrate for movement (McCrea, Fetz, Robinson, Stein, and Alexander et al.), (2) the roles of central and peripheral control of movement (Bizzi et al. and Gandevia and Burke), and (3) the structural/functional organization of the cerebellum (Bloedel).

There are two sides to any controversial issue – what is currently known and what is not. The task given to the authors of the following target articles was to focus on unresolved issues. As the reader will discover, the authors' compliance with this instruction varied considerably, although none can be said to have ignored it entirely. Nevertheless, this outcome says something about our willingness, as researchers, to grapple with difficult, unresolved issues. We have similar qualifications about the peer commentaries, which can be separated into three categories: those telling us how the commentators' own research relates to the observations presented in the target articles, those that strongly disagree with the position of the target authors, and those that deal more generally with the controversial issues raised in the target articles. These commentaries also hit or miss the mark to varying degrees.

The final issue we wish to address in this introduction has to do with the use of models. In most of the eight target articles, models of various operations or structures are presented to illustrate the authors' positions on controversial issues. The purpose of these models differs from article to article, however, so we thought it would be worthwhile to address the proper use of modeling.

Nicola Bernstein (1958) wrote about the modeling of motor function and organization. He pointed out that it is difficult to compare different models of the same system – to determine which model is "correct." The mere fact that one model can predict the behavior of a system under more conditions than another does not mean the first model is correct. Bernstein reasoned that the only strong inference one can obtain from a model is that it is wrong. Modeling involves the use of a construct, often mathematical, to describe a highly complex system. It must be kept in mind that a model is not a realistic description of the actual system being modeled, but a construct to help us think about the system and develop hypotheses to test our ideas. If a particular system were already understood, modeling it would serve little practical purpose. The presentation of a model is therefore evidence that the operation or structure being modeled is not understood.

The value of modeling is in provoking new lines of thinking about a particular problem, not in explaining how things actually work. As modelers of the nervous system and movement, we sometimes find it difficult to accept Bernstein's observations. We want our models to be right, not wrong. But it seems inevitable that most will be wrong, in their specifics, if not in general. Modeling is a necessary step to understanding, though, and we admire the fortitude of those authors who stick their necks out and let their peers "have a go" at their models.

We end our discussion of models with a caveat – that models should not produce stress, that is, they should willingly conform to the system they are attempting to describe. Humans and other animals cannot be described by the same rules as robots. The nervous system, in particular, that of humans, has been built up through evolution into a multilayered and redundant structure. A complete description of how the nervous system produces coordinated movement will have to include many different models, not one or even a few – different models for different types of movements, using different parts of the motor apparatus, in different environments. Attempts to stretch models beyond reasonable limits to predict the behavior of a system accurately can be costly and counterproductive. We must learn to accept the limits of our models.

A final question we feel compelled to address concerns how well this conference accomplished its goals, which were to: (1) address controversial issues, (2) bring together researchers using different approaches, and (3) produce a useful and influential publication. Overall, we could have done a better job of addressing controversial issues, and we seek better methods to attain this goal. We did a better job at the second goal, and we leave the readership to decide about the third.

**Paul Corder**
R. S. Dow Neurological Sciences Institute, Good Samaritan Hospital and Medical Center, Portland, OR 97209
Electronic mail: cord@ohsu.edu

**Vctor Gulslnke**
Institute for Information Transmission Problems, Russian Academy of Science, Moscow, Russia
Electronic mail: fab5@ipp.msk.su