LONG-TERM VARIATIONS IN THE SOLAR DYNAMO. P. A. Gilman, High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO 80307

There seems to be little doubt that the sun's observable magnetic field is maintained by a convectively driven nonlinear dynamo. However, the theory of the solar dynamo is not good enough yet to make theoretical predictions about its long term behavior, except by use of ad hoc and highly parameterized models. Recent dynamo calculations based more directly on the laws of fluid motion have revealed significant contradictions in the assumptions on which earlier models were based. We will review some of the history of solar dynamo theory, show where the difficulties arise and how they might be resolved. We will also discuss the possibility that the envelope of the solar cycle is inherently unpredictable, due to the stochastic nature of the motions driving the solar dynamo, and the feedback of the induced magnetic fields on the flow.

Two goals of solar dynamo research that are important for the topic of this meeting are to understand how that part of the sun's magnetic field which reaches interplanetary space varies with the envelope of the solar cycle, and to estimate how much and what kind of variations in solar luminosity might be expected. In both cases, the observational clues are fragmentary, and the theory is not yet sufficiently developed to make reliable quantitative inferences. We will suggest what might be useful for making further progress.