**The George Washington University**

***University Seminar on Reflexive Systems***

**Friday, January 22, 2016 from 10:00am – 12:00pm**

**Duques Hall, Room 651**

**2201 G Street NW**

**THREE VIEWS OF SECOND ORDER SCIENCE**

This panel discussion will report on a meeting held in Salem, MA, January 14-17, 2016, to decide on the chapters for a book on Second Order Science. All three panelists attended the meeting.

**Second-Order Science: A Vast and Largely Unexplored Science Frontier**

By **Karl Mueller**

Second-order science is based on an evolutionary differentiation of the overall science system into three levels which occurred from the 1950s to the present time. According to this differentiation the science system separated itself, due to its massive growth and expansion in the last sixty years, in a self-organized manner into a zero-order level of research infrastructures, traditional or first-order science and second-order science. Each of these levels covers, basically, all major scientific domains or academic disciplines like the life sciences, the social sciences, the environmental sciences or mathematics. The two new levels can be characterized by unique functions, namely by a catalytic function of zero-order science supporting first-order science and by a reflexive function of second-order science reflecting on first-order science. Second-order science is based on the operation of re-entry for a rich variety of building blocks X of first-order science: X RE X(X). These re-entries produce new research domains like in the case of models of models, cybernetics of cybernetics, sociology of sociology, management science of management science, logic of logic, functions of functions, etc. where all of these new second-order domains can and must be studied and analyzed scientifically.

The goal of the presentation is to provide an overview of second-order science as a largely unexplored new science domain and of potential approaches in second-order fields. We provide the necessary conceptual groundwork for explorations in second-order science. We discuss the differences between first- and second-order science, and we present a roadmap for the development of second-order science. The two main goals of second-order science can be seen in the quality control of normal or first-order science as well as in a high potential of novelty and innovations for first- and second-order science. The results of analyses in second-order science are usually characterized, depending on the underlying research question, by higher levels of robustness, by new perspectives, by wider integration as well as by higher generality. As first-order science advances, second-order science provides, due to its reflexive function for first-order science, a rich source of novel research and of quality control. Implications: Second-order science, along with zero-order science, should be viewed as major expansions of traditional scientific domains and as an internal scientific breakthrough towards a new wave of greatly needed innovative research.

**Karl H. Müller** was head of the Departments of Political Science and Sociology at the Institute for Advanced Studies (IHS) in Vienna (1997 – 2001), of the Wiener Institute for Social Science Documentation and Methodology (WISDOM) (2001 – 2014), Austria’s centre for research infrastructures in the social sciences and past president (2000 - 2015) of the Heinz von Foerster Society. Currently he is Director of the Steinbeis Transfer Centre New Cybernetics.

His recent research is focused on the evolution of second-order science and includes publications like „Towards a General Methodology for Second-Order Science“, in: *Journal of* *Systemics, Cybernetics and Informatics* 12, No. 5, 33 – 42, (with Alexander Riegler), „Second-Order Science: A Vast and Largely Unexplored Science Frontier”, in: *Constructivist Foundations*, Vol. 10, No. 1, 7 – 15, (with Brina Malnar), *Surveys and Reflexivity. A Second-Order Analysis of the European Social Survey (ESS).* Wien:edition echoraum, 2015 and especially *Second-Order Science. The Revolution of Scientific Structures.* Wien:edition echoraum, 2016.

**Second Order Science: Steps toward Unification of Science**

By **Stuart Umpleby**

The emerging field of Second Order Science attempts to take a holistic approach to science. We question whether methods developed for the physical sciences will suffice for the social sciences. Are differences between inanimate objects and thinking participants sufficient to warrant a different approach? Should we consider the effect that theories have on the behavior of social systems? Should linear relationships be supplemented with circular relationships? When studying social systems, is the scientist outside or inside the system? Specifying the differences between physical systems and social systems will advance the goal of unification in science.

**Stuart Umpleby** is Professor Emeritus in the Department of Management at The George Washington University. He has taught courses in operations research, organizational behavior, process improvement, systems thinking, and philosophy of science. Umpleby has published many papers in the fields of cybernetics and systems science. He is a past president of the American Society for Cybernetics. He currently serves as President of the Executive Committee of the International Academy for Systems and Cybernetic Sciences, an honor society created by the International Federation for Systems Research. Website: http://www.gwu.edu/~umpleby.

**Pluralism Versus Monism in Science**

By **Michèle Friend**

Scientists can be monists or pluralists. I am familiar with three pluralist practices and the accompanying discussions of those practices: in mathematics, in relativity theory and in chemistry. Along with some other philosophers I believe that pluralism, at least in these instances, is to be preferred over monism.

The reasons for preferring pluralism over monism vary in the different areas of research, as does the respect in which scientists are pluralist. Nevertheless, there are a few reasons for pluralism that are common to the listed disciplines. 1. The modern practice is pluralist. 2. We learn more by being pluralist than by being monist. 3. Pluralists raise different questions than monists do. 4. Negative and counter-factual information is better exploited, and is more ‘informative’ in a pluralist framework than in a monist one. 5. Pluralists are more scientifically open-minded than monists.

The reasons for preferring monism over pluralism in the above areas of research are as follows. 1. Some philosophers and scientists are convinced that there is one truth and one theoretic representation of that truth, and we are looking for it in science. Call this, ‘essentialism’. This will take some unpacking in the direction of truth, of laws, of ontology, of religion. 2. Monist theories are simpler and more elegant, or otherwise more aesthetically pleasing. 3. The evidence points to monism. 4. Monists are better predictors. 5. Monists have a better match between data and theory.

**Michèle Friend** teaches in the philosophy department at George Washington University. She has written two books in the philosophy of mathematics: *Introducing Philosophy of Mathematics* (Acumen 2007), *Pluralism in Mathematics, a New Philosophical Position in Philosophy of Mathematics* (Springer 2014). She has written articles in philosophy of relativity theory, and is presently working on a chapter for a book in philosophy of chemistry.