СРАВНИТЕЛЬНЫЕ ИССЛЕДОВАНИЯ

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A Comparative Analysis of Russian and Canadian Sociologies of Science and Technology

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Introduction

> [N]ow scientists in the laboratory are observed in basically the same way as 'savages' by an anthropologist.
> *Wolf Lepenies*

The sociological sub-discipline called sociology of science (SoS) has been around for about 80 years. It is one academic field, based on historical developments, in which national traditions offer unique voices for global sociology. How is the topic of 'science' and how are various 'sciences' studied differently or similarly from country to country? This paper offers a brief look at both Russian and Canadian contributions to SoS and technology studies and also a general overview that speaks to both sociology's 'scientificity' and its 'philosophicity.'

General Outline of Sociology of Science

The foremost quantitative indicators of the field SoS are citation indexes of academic publications. The first citation index was introduced by the American scientist Eugene Garfield in 1960 at his Institute for Scientific Information. The largest current index for social sciences, called the Social Sciences Citation Index (SSCI), is hosted by the ISI Web of Knowledge, which is an on-line academic database that is part of the Thomson Scientific

network. It is run by the Thompson family of Canada and is one of the world's largest information companies.

In addition to citation indexes, the idea of scientific networks[1] or 'invisible colleges[2]' identify the feature of various academic and research institutes and partnership collaborations, which display the relationships and activities that are part of 'doing science.' This includes the process of 'peer review' for scholarly publications, participation in scientific rituals such as attending conferences, critiquing and/or supplementing the contributions of colleagues, as well as supervising the work of younger colleagues and students (e.g. mentoring). It can take the form of participating on committees, both locally, within universities, or at national or international levels, which involves acquiring proficiency in scientific communication, as all of the above activities require. A second language is in most cases highly beneficial for scientists on the global stage. Additionally, there is the sociology of scientific textbook publishing (SoSTP[3]) that investigates how different authors or teams of authors present their findings to respective communities and societies via public or private schools. The current 'intelligent design movement' (IDM) in America is an example worth studying today from a SoS perspective for its promotion of textbooks that showcase a particular ideological viewpoint, rather than what has been accepted by most or even many figures in the scientific community. These topics constitute formal indicators of organized scientific research and development[4] that are studied by sociologists of science.

Other topics of significant importance in SoS are the mobility of scientists and scholars both domestically and in terms of international possibilities. The migration of certain types of scientists, for example, away from countries that do not possess the appropriate infrastructure to carry out experimental research, is a phenomenon that also includes civilisation comparisons. Which countries do scientists prefer to live and work in and why? The terms 'brain drain' and 'brain gain' have been coined to indicate the benefits and losses involved with global scholarly exchanges, emigrations and immigrations. Likewise, the sociology of organizations and of policy making is an important related field as it involves building programs, plans, and projects for improving the research and development capacities of a region or nation.

Alongside of these more or less empirical indicators of scientific and technological production, another topic that takes its dutiful place in SoS leans toward a more philosophical theme. What science 'means' for/to society and individuals is a significant sociological question in its own right[5]. The status of scientists in comparison to other workers in a society

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[1] "Self-organizing networks that span the globe are the most notable feature of science today." (Wagner, 2008: 2).

[2] Invisible colleges — "those informal networks of communication and collaboration that have always been essential for science and never less so than in this present period of rapid growth in science." (Barber, 1987: 591).

[3] The acronym is given merely to show that the realm of textbook publishing is a smaller branch, but a rather busy one, within the larger sub-discipline of SoS.

[4] "Formal scientific organization ranges from laboratories, departments, and institutions to central national or international scientific agencies. Informal organization includes teams, research groups ("invisible colleges"), disciplinary and interdisciplinary elites, and, on a most comprehensive level, the whole scientific community." (Ben-David and Sullivan, 1975: 208).

[5] "By sociology of science is meant that aspect of sociology which is concerned with the study of, and the extent to which, science influences and is influenced by the prevailing values, attitudes, mores, habits, institutions, and customs of society, or of a given segment of society, at a specific time

determines which fields of the academy parents will encourage their children to pursue. If science has a low 'status,' then fewer new students will enter its domain, and vice versa. Many human-social scientists who are involved in reflexive methods confirm, as does Carl Rodgers, that "Our rules and methods for testing hypotheses are creations of the scientists themselves, and should be recognized as such[1]." In other words, science does not happen in a vacuum, but is rather a social-cultural activity. Thus, the question of how science is 'valued' is considered in SoS to be as important as all of the quantitative, structural and empirical approaches acknowledged above.

One might ask: if an academic discipline contains all of the above features, does it necessarily then count as a 'science?' Indeed, this paper accepts the identification of 'sociology' as a 'scientific' discipline on the basis of the criteria above; in sociology there are publications in discipline-oriented journals with peer reviewed publications, as well as invisible colleges and/or 'schools of thought,' committees, associations, and conferences dedicated to sociology, etc. The sub-discipline of SoS has investigated these themes over the past 80 years. We will now enter a brief discussion of the geo-history of this sub-discipline, especially as it is particularly illuminating in the case of Russian scholarship, both in its early conditions as well as today.

Russia's Contribution to International Sociology of Science

A precursor to SoS was established in Russia with the topical name of 'science studies' (*naukovedeniye*). A. A. Bogdanov wrote at the beginning of the 20th century about the organization of science in Russia[2], which is now widely accepted as a precursor to 'systems theory.' Following that, I. Borichevsky published an article titled "Science Studies as an Exact Science," which addressed the character and purpose of science and mentioned 'sociology of science' (1926) for the first time[3]. The field of 'science studies' (SS), in contrast to SoS, involves a wide variety of aspects in its approach to science, for example, politics, economics and ideology. SS began as an attempt to 'scientifically' study science itself and thus it provides an example of 'reflexive' thought at the outset. But it also focuses/focused on 'positive' methods of investigation, which goes beyond either being either a philosophy of history or a reflexive sociology of knowledge.

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and place. Its task is to ascertain how science was able to free itself from the other controlling forces of society; how it is able to be objective in its methods when other intellectual endeavors are enmeshed in preconceived judgments and biases; how, in spite of its relative objectivity of method, subjectivity sometimes overcomes the uses to which science is put; what is the role of the scientist in society, – his world-views, his detachment from society, his conflicts with accepted socio-ethical norms; what are the importance and the activities of scientific foundations, institutions, and organizations in furthering or retarding scientific activity; and so on." (Gittler, 1940: 351).

[1] (Coulson and Rodgers, 1968: 67).

[2] "The first systemic interpretation of scientific activity as one variety of organized human activity is to be found in A. A. Bogdanov's work, 'A general science of organization', published in 1912." (Mirskaya, 1972: 281).

[3] "On the one hand, it is a study of the inherent nature of science, a general theory of scientific cognition. On the other hand, it is a study of the social purpose of science, of its relations with other types of social creativity. It is something we could call a sociology of science. This area of knowledge does not yet exist; but it must exist: it is required by the very dignity of its object, i.e., of the revolutionary power of exact knowledge." (Borichevsky, 1926: 786).

A major step from SS to SoS came through contributions by social historians of science. In particular, a Soviet delegation of Marxist thinkers, including Nikolai Bukharin and Borris Hessen, travelled to England for an international congress in 1931, which deeply influenced the 'western' study of the social history of science, and consequently also global SoS. As the British historian of science, J. D. Bernal wrote, "the contribution its [U.S.S.R's] delegation made to the History of Science Congress in London in 1931 had a profound effect in revealing a new approach to science as a social and economic phenomenon, rather than as an expression of absolute and pure thought. It may be said that this impact has set going a whole new school which together with its critics has established the importance of the social history of science" (1969 [1954]: 1181–1182).

Following the unique Soviet contribution to the history and SoS in England in 1931, Bernal visited Russia and ideologically raved about the 'scientific planning' that the government there was undertaking. Bernal noted that "A widespread understanding of the relation of science to social progress and a determination to act on it will be needed before science can be made safe for the world" (1969 [1954]: 1292). Here we note a significant theme in Marxist SoS that focuses on the social impact of science and likewise on the practical connection between scientific practices and everyday life, for example, in the case of promoting ethics and humanitarian values. Bernal, along with many later sociologists of science, recognized the potential danger to society from natural-physical sciences and the need to protect ourselves from its excesses.

Bernal also recognized some of the differences in approach and strategy between the natural-physical sciences and the human-social sciences. "It is not only in the subject matter but also in method that the social sciences differ from the natural sciences" (1969 [1954]: 1030), he wrote. Even though Bernal's historical Marxist influence was not ultimately that effective on SoS globally, he nevertheless understood that human-social sciences offer an alternative approach to reality than the natural-physical sciences. "[T]he social sciences differ from both the physical and biological sciences in that man is himself part of the society he is studying," he claimed, "and hence [that] the observer and the observed become so confused that a really scientific approach is difficult if not impossible" (1969 [1954]: 1021). Though on the one hand Bernal seemed to deny the scientificity of human-social sciences, on the other hand he recognized that all natural-physical sciences involve a social impact due to their connection with the society in which they originate and are constructed or developed.

Robert Merton, the founder of SoS in North America noted that, "the connections between science and society...[are] close to the heart of Marxist sociology" (in Barber, 1952: 15). Merton is also widely considered as one of the main international founders of SoS[1], in terms of establishing proper criteria and limits of responsible quantitative analysis in the sciences. Merton pointed out the *ethos* of science as a system of norms and values which are legitimized by institutions. His key insight, however, which would open up the field, was a simple one: "Science is public, not private" (1973: 450). This idea has spread far and wide in contributing to understanding both what 'science' is and what it means to people around the world today.

Worthy of note here is that Merton was a student of the eminent Russian-American sociologist Pitirim Sorokin at Harvard University and drew upon Sorokin's approach to the meaning of 'science' and 'sociology' in his writings. Sorokin's approach to science was

[1] "The definition of the object and method of the sociology of science, its academic institutionalization, its spread and popularization, can be almost entirely attributed to Merton" (Statera, 1998: 61).

unique in that he dealt with cultural and civilisational factors as unavoidable themes in his writings. In his later years he eschewed the 'quantophrenia' and 'testomania' that he felt was rampant and excessive in empiricist American sociology as it tried to validate its scientificity.

Sorokin claimed that, "the scientists of Ideational culture would be more interested in the study of spiritual, mental, and psychological phenomena...[while] Scientists of Sensate culture would probably be more interested in the purely material phenomena" (1937–1942: 13). That is to say, in advocating a return from the pinnacle of Sensate culture to open-up discussion of Ideational themes, Sorokin rejected a purely materialistic approach to the study and practice of science. Not only did he support the inclusion of philosophy (to which we'll return below) in discussions of sociology's contribution to human understanding, but also recognition of the selective social pressures that impact the way science is done and the topics that are chosen for research.

Sorokin placed great focus on the surrounding social environment in which science was produced, which indeed became the basis for sociologists of science, including Merton, to follow. Sorokin noted that, "Scientific theory thus is but an opinion made 'creditable' and 'fashionable' by the type of the prevalent culture" (1937–1942: 455). On the one hand, Sorokin demonstrated here what was later to be called an 'externalist' perspective, i.e. that what influences science most is what is happening in the societal or institutional environment in which science is conducted. On the other hand, Sorokin recognized that science divorced of any practical connection with reality via the everyday lives of people would lead to a 'dehumanisation' of the academy that appealed only to scientific-technical knowledge, at the cost of philosophical-spiritual knowledge. This was a lesson that Sorokin had gained during his studies and revolutionary political activities in early twentieth century Russia, along with his suffering under exile from his native land.

Looking forward in history, several figures have been influential in the professionalization and institutionalisation of Russian SoS, who have been influenced not only by Sorokin and Merton, but also by the increasing international knowledge production in SoS, especially since the 1960's. These include: S. A. Kugel, who was founder of the Centre for Sociology of Science and Science Studies of the Russian Academy of Sciences (RAS), I. I. Lieman (*Science as a Social Institute*, Leningrad, 1971), A. A. Zvorykin (The Elaboration of the Sociology of Science as a Basis for its Improved Organization, 1970), **V.** Zh. Kelle and S. R. Mikulinsky (eds. *Sociological Problems of Science,* Moscow, 1974), I. A. Maizel (*Sociology of Science: Problems and Perspectives*, 1974), M. G. Iaroshevsky (*Social-Psychological Problems of Science*, Moscow, 1973). In more recent years, E. Z. Mirskaia of the RAS — Moscow has made a significant contribution, while the most important organizational contribution has been made by Kugel and the RAS in St Petersburg.

Kelle and Mikulinsky speak of the field as follows: "The subject of the sociology of science is the functioning of science as a social institution in the framework of a defined society" (1974: 10). Apparently not much has changed in the definition of SoS in Russia in the past thirty years even though Russian society has undergone significant changes. Topics studied by today's scholars in SoS have converged on the social-cultural conditions in post-Soviet Russia.

Among the main features of contemporary Russian SoS are the topics of 'management' and 'organization,' following the trend of planning science during the Soviet era. Given the absence of sociology as a mature and open academic discipline in Russia for much of the 20th century, it is not surprising that ideas in this sub-discipline of sociology were guided by political and economic concerns, rather than issues related to civil society or to humanity

as a supra-political category. Additionally, topics such as migration, mobility and scientific elites are frequently cited in the literature. The Russian SoS landscape has thus maintained its closeness to the historical field of 'science studies,' while also making its move to join the international community with particularly 'sociological' studies of science that are based on humanitarian values and which employ an anthropic methodology.

Canadian Sociology of Science

The main figure in contemporary Canadian SoS is Yves Gingras, who holds the Canada Research Chair (CRC) in the history and sociology of science (HSS) at the University of Québec at Montreal (UQAM). This special Chair was inaugurated in order to study the development of scientific and academic disciplines in universities around the world between 1700 and 2000. The various fields of Gingras' interests include investigating the formation and transformation of university disciplines and of universities in general from a historical and sociological perspective[1]. Gingras is a French-Canadian historian and sociologist who demonstrates that the French-Canadian approach in this field is far more advanced than scholarship in English-Canada.

In 1997, Gingras co-founded the Observatory of Sciences and Technologies (OST), where he is currently the scientific and academic director. Gingras aims to provide an interdisciplinary vision that is both historical and sociological regarding the existence and transformation of scientific knowledge. HSS thus focuses on clarifying and explaining to the public topics of various scientific and academic fields in the university. Among Gingras' contributions include studies on *Speaking Sciences* (2008), *The Origins of Scientific Research in Canada* (1991), *Science and Medicine in Québec* (1987), of the global university rating system, the effect of marketing on universities[2], the dialogue between science and religion, the lack of a Canadian Association for the Advancement of Science (CAAS), about sociology and Québec society, about technology, views of 'progress' and many other related themes.

Gingras notes that, "Nowadays, no 'serious' paper in sociology of science can begin without *stating* (not *arguing*) that 'technical, social, economic, etc., factors are inextricably bound together'" (1995: 125). Here, Gingras is keeping safely within the traditions of American, British and Russian SoS. However, when he notes that, "In addition to the limits imposed on action and strategies by the *habitus* and the amount of social and intellectual capital possessed by the actors, the dynamics of knowledge production *in the scientific field* is also guided by criteria of communicative action" (1995: 141), he moves beyond the single-language traditions of these other countries to embrace the 'communicative turn' in sociology, drawing on hermeneutics and linguistics. Influenced more by European, especially French, rather than American or British views, Gingras establishes a cross-cultural approach to science and technology (S&T) studies.

In this particularly Canadian SoS/HSS view, Gingras says, "I would like to note that the ethic of communication built into this reflexive model of knowledge production is that in sociology of science — as in any science conceived as a practice regulated by the logic of

[1] http://www.chss.uqam.ca/PROGRAMMEDERECHERCHE/tabid/54/language/en-US/Default.aspx

[2] "Marketing Can Corrupt Universities" – http://www.universityaffairs.ca/marketing-can-corrupt-universities.aspx

a field — one condition for playing the game is to continue to argue and counter-argue, experiment and counter-experiment (or, in history, do archival research), in order to show the shortcomings of the position of the 'opponents.' In other words, although, as Aristotle wrote a long time ago, 'we are all in the habit of relating an inquiry not to the subject-matter, but to our opponent in argument,' we should replace straw-man rhetoric and vague references to 'sociology' or 'society' as a whole by careful analysis of the actual content of the papers produced by colleagues" (1995: 147).

Thus, Gingras is both promoting the fields of SoS/HSS and encouraging a professional climate wherein discussions, debates and arguments can be conducted on a 'level' playing field that will help us to decide the 'scientificity' or authenticity of theories, methods, experiments and approaches to given topics. In other words, Gingras is appealing to the logic of 'reasoned consensus,' which requires (in neo-institutional theory's terms) that scientists follow 'the rules of the game' in order to help us obtain common communicative ground.

While it may be presumptuous to suggest that Canadian thinkers are among the world's leaders in terms of incorporating the 'linguistic and hermeneutic turn' into such fields as SoS, it is hardly something to scoff at due to the bilingual aspect of the Canadian national landscape. The awareness of 'communication' when discussing S&T is identified as a significant factor in establishing consensus views or finding common ground when dealing with scholars around the world, i.e. when discussing SoS on a global scale. Thus, we can now turn to consider the possibility of establishing common ground in the field of SoS and will return below to other Canadian contributions to sociology and philosophy of S&T.

Sociology of Science Today

The field of SoS today is faced with similar challenges to other sociological domains. Questions of how to combine quantitative with qualitative approaches, micro- and macro- or even meso- levels, reflexive and positive methods, empirical, theoretical and historical-comparative strategies in a common or united view remain. What is worth noting is that SoS has made significant progress in certain ways that allow it confidence enough to be called a scientific and academic discipline (cf. Sociology as a Scientific and Academic Discipline — SaSAD, Sandstrom, 2010).

We must remember, as Bernard Barber notes, that "until the 1960s the sociology of science did not exist nor was even conceived of as a specialty in sociology" (1987: 130-1). In a later text, Barber admits that "besides a decent amount of cognitive consensus, the sociology of science has achieved all the essential characteristics of an institutionalized scientific field: regularized university courses of instruction, special journals, special funding agencies, special professional associations and specialized scholarly conferences" (1990: 247). What this means is that SoS in many ways does fulfil the criteria of being called a scientific and academic discipline in the University, regardless of the depth of penetration it has made in sociology programs or in sociology courses at institutions around the world.

A general definition of the field is given as follows, by Ben-David and Sullivan, in an article titled "Sociology of Science," though it is more than thirty years old: "Sociology of science deals with the social conditions and effects of science, and with the social structures and processes of scientific activity. Science is a cultural tradition, preserved and transmitted from generation to generation partly because it is valued in its own right, and partly because of

its wide technological applications. Its most distinguishing characteristic is that the primary purpose of its cultivators, the scientists, is to change the tradition through discoveries" (1975: 203). Newer definitions of the SoS field add views along with the variety of sciences studied and speak of poly-paradigmatic approaches, but they also raise the issue of what science means to people in the face of many non-scientific or extra-scientific realms in the Academy demanding their rightful legitimacy as socially important types of knowledge production.

The classical political-economic argument about which is best, planning science (J. Bernal[1]) or letting the market determine science (M. Polanyi) has given way to the recognition that 'big science' cannot function without massive funding, which must come from either private, or more probably public sources. As Barber notes, "large government support of science by all societies that can afford it is likely to be with us permanently" (1987: 131). The notion of science taking place in a 'mass society' is connected with the way that we view science and what it means in our lives (cf. G. Grant on 'mass society' below). We can also take from the field what Merton suggested, i.e. that scientists (including sociologists) compete for status, rather than only for income, wealth or power. There is thus a social aspect to participating in science, either in the academy or outside of it as places of human interaction. Since science happens inside societies, it can be studied sociologically.

Merton's contribution to the field includes the notions of internalist and externalist approaches, or of insider and outsider knowledge, which partially determine appeals to scientific and philosophical legitimacy and authority. For example, why should sociologists defer to the ideas of biologists, e.g. who call themselves socio-biologists, when the topic of discussion is human society and not (other) animal or plant 'societies'? The typology C.U.D.O.S.[2] (i.e. Mertonian norms), and the so-called Matthew effect , the latter which describes the way credit is given for scientific work[3], also still figure heavily in contemporary SoS discussions.

What SoS today also requires is taking seriously the field known as history and philosophy of science (HPS), although both historical and philosophical approaches to science differ from sociological ones[4]. Since SoS can draw on the social aspects discussed by influential thinkers about science such as Karl Popper, Thomas Kuhn, Imre Lakatos and Paul Feyerabend, its chosen grammar is indebted to these historians and philosophers of science that have helped SoS better understand its particular disciplinary field. Thus, concepts such as 'prediction,' 'verification,' 'falsifiability,' 'paradigm shifts' and 'scientific research programs' all fall within the purview of SoS to investigate and consider as they relate to the human-social realm.

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[1] "Once science became a large-scale enterprise the dominant system of science planning was that of the scientific project and the grant to provide money for it. A team research, to be effective, must be sufficiently large and costly. The normal way of financing it, is not to order it to be done, but to leave it open for bids or what might be called scientific tenders. Then, those scientists who may be competent, but certainly have to be businesslike and trained in sales methods and lobbying, put forward schemes for research and secure a budget for a certain number of years" (Bernal, 1969 [1954]: 1296).

[2] Communalism, Universalism, Disinterestedness, Organized, Skepticism.

[3] "The Matthew effect consists of accruing greater increments of recognition for particular scientific contributions to scientists of considerable reputation and the withholding of such recognition from scientists who have not yet made their mark" (Merton, 1973: 446).

[4] "The sociology of science is clearly different from both the philosophy of science and the history of science. It is an attempt to view science – its methods, thought-models, accomplishments, acceptance, and so on – in the light of a social situation. The field as here conceived can be divided into four large divisions: sociology of scientific knowledge, the sociology of the scientist, the sociology of scientific institutions and organizations, and the sociology of applied science" (Gittler, 1940: 352–353).

The dearth of ideas, topics and the specific linguistic concepts that SoS has generated in recent years suggests that the field is growing, developing and building towards better ways of understanding the relationship between sciences (both natural-physical and human-social) and human societies. A. Comte stated that, "All science aims at prevision" (1974 [1822]: 167). What we can expect from SoS as a scientific and academic sub-discipline, therefore, is an expansion onto the global stage, in line with sociological developments in general.

Globalising the Sociology of Science Conversation

Some people have claimed to trace the origins and development of certain types of knowledge or certain ideas or innovations to a particular socio-cultural source. When it comes to considering 'science' as a global phenomena, for example, A. Comte said that "of all the social forces in existence that of scientific men is alone European" (1974 [1822]: 133). Yet a broader approach can admit that 'sociology,' though the term was coined in Europe, today is no longer limited to a Euro-centric vision. "[S]ociology developed as a part of the broader intellectual tradition of self-examination and self-inquiry that developed in Europe in the wane of the Reformation and Enlightenment[1]," notes S. N. Eisenstadt. The fact that sociology originated in Europe but is now practised and taught as a scientific and academic discipline all over the world attests to the pseudo-universality of the field as a study of the identities and relationships of individuals and societies.

The potential for shifting to an 'anthropic'-oriented SoS (Fuller, 2006), away from a mainly un-reflexive or positivist SoS offers a re-turn to a European, or better, to a 'globally-oriented' way of thinking, rather than to an American-oriented brand (Mertonian) of SoS. This possibility is opened-up because empirically-oriented SoS is most common in the United States, whereas the Russian and Canadian traditions offer a more philosophical approach to understanding 'science' and 'society' (see argument below). What is most evident in these latter two traditions is a particular style[2] of language and communication that categorises SoS as an example promoting both the philosophical and the scientific dimensions in sociology, which are also inevitably related to theology or to worldview.

What the current sub-discipline SoS offers as a field is a type of 'reflexive sociology' (cf. Gouldner, 1970) that builds upon sociology of knowledge and philosophy of history, and which takes sociology itself as a topic of study, given that sociology is practiced as a 'science.' In this way, SoS offers an integrative, synthesizing approach to science that considers itself critically at all levels of activity and location[3] and thus also how it relates to other disciplines

[1] (Eisenstadt, 1980: 28).

[2] "And the style! Most of the other domains of social sciences are clogged with jargon and wooden tongues, desperate to imitate the boredom of exact science. Ours is light and swift, much closer to the humanities. And do you know why? Because it does not have to imitate the natural sciences. To be more exact, we are happy to imitate their content but not their style. This is what explains the originality, the humor, the intensity of our field that will become, I hope, a perfect hybrid between the natural sciences, the social sciences, and the humanities" (Latour, 1993: 388).

[3] "The idea that there is a single, unified scientific rationality is highly dubious. What has been promoted as scientific objectivity, as the 'view from nowhere,' turns out to have always been a 'view from somewhere.' The recognition that rationality is not disembodied but positioned has significant implications for understanding science and scientists. It means that the customary conventions of practical reasoning that scientists resort to in the different locations have to be taken more seriously.

and fields of knowledge in the Academy. Local, regional, national, international and global sciences are all objects of study for SoS because science is always done by people who live in more or less distinct groups or communities. At each of these levels a sociological approach to science is possible and can therefore be insightful, which is what gives the field its legitimacy[1].

By focussing on the borders and boundaries of sociology as a scientific and academic discipline, a cooperative sociology for the 21st century can be achieved that is both confident of its own contribution to knowledge and humble in what it can achieve autonomously. SoS thus sets its goal upon what the Gulbenkian Commission, headed by Immanuel Wallerstein promoted: more inter-disciplinary collaboration in the academy. In this sense, "persons who have degrees from multiple disciplines" (1996: 71) are welcome in SoS discussions, both in order to understand the inner workings of various scientific and technical fields and also in order to generate shared knowledge that is not limited to specialists alone, but involves the public.

Canadian Social-Humanitarian Approaches to Science and Technology

The most significant contributions to understanding S&T by Canadians leading up to Gingras' Centre have not come from sociologists themselves, but rather from figures with backgrounds in related social-humanitarian fields. A brief discussion of three main figures follows.

Marshall McLuhan (1911–1980) is dubbed the 'patron saint' of Wired Magazine (1993), which focuses on the influence of S&T on culture. McLuhan's book *The Medium is the Message* (1967) is famous for expounding on the impact of electronic-age media on people around the world, the 'global village,' and in local settings. His observations and analyses of media were at the cutting-edge of technology studies in the 60s and are still relevant today.

McLuhan said: "Paradoxically, the electronic age of cybernation is unifying and integrating, whereas the mechanical age had been fragmenting and dissociating... In moving from the mechanical to the electronic age, we move from the world of the wheel to the world of the circuit. And where the wheel was a fragmenting environment, the circuit is an integrating environmental process" (2003: 47). One consequence of McLuhan's insights into the power of electronic media and communications capacities is the features it adds to developing S&T on a global rather than only on a national scale. Nations are exposed more quickly to progress made in scientific and technical fields worldwide through the ICTs that have become intertwined with global, regional and local academic and scholarly work.

"In our present time there are many countries in the world that are leapfrogging out of 10,000B.C. into the twentieth century," wrote McLuhan. "Many countries are doing this, leap-

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It also implies that different scientific traditions and practices, in different historical and geographical settings, deploy different understandings of evidence, demonstration, proof, objectivity, and so on. Scientific rationality cannot be conceived of independently of temporal and spatial location" — David Livingstone (Putting Science in its Place: Geographies of Scientific Knowledge, 2003: 184).

[1] "The sociology of science has by now become an international scholarly specialty. Frenchmen such as Bruno Latour, Austrians such as Karen Knorr-Cetina, and Dutchmen like Arie Rip all arc valuable workers in this specialty. The sociology of science now has its own international professional society, the Society for Social Studies of Science, and it has two professional journals, *Social Studies of Science*, founded and edited by Edge and MacLeod at Edinburgh, and *Science and Technology Studies*, the infant journal of the Society for Social Studies of Science, edited by Susan Cozzens" (Eisenstadt, 1980: 133).

frogging out of prehistory into post-history. Just psychically, what is the consequence of skipping thousands and thousands of years of Western history? No one knows. It hasn't been thought about" (2003: 88). McLuhan here opened up a vision of development that allows countries to embrace S&T innovations that are available in the global 'market' for people to integrate into their social-economic-cultural-political surroundings. The reality of such S&T diffusion and integration, however, depends heavily on the infrastructures, systems and resources (both human and material) available in a nation's current landscape. One can easily fault McLuhan for presenting an idealistic vision that is often very difficult to achieve in reality.

One of the greatest contributions that McLuhan offered to 'understanding media,' the title of perhaps his most important work is that which he terms the 'extensions of man.' McLuhan considered "technologies as extensions of our own bodies, of our own faculties, whether clothing, housing, and the more familiar kinds of technologies like wheels, stirrups, extensions of various parts of the body. The need to amplify the human powers in order to cope with various environments brings on these extensions, whether of tools or furniture. These amplifications of our powers, sorts of deifications of man, I think of as technologies" (2003: 57). Expressed in this way, we may come to understand science itself as a tool that helps us to improve human society, with the aid of SoS. Seen in this light, S&T enable us to improve the conditions of our (natural or artificial) environment by understanding our inevitable connection with it through the extensions of our human-made artefacts locally and around the world.

"Electricity made possible the extension of the human nervous system as a new social environment," stated McLuhan. "If the wheel is an extension of feet, and tools of hands, back, arms, electromagnetism seems to be in its technological manifestations an extension of our nerves and becomes mainly an information system. It is, above all, a feedback or looped system" (2003: 48–49, 62). Thus, in our studies of knowledge societies and in the so-called 'information-age' featuring S&T, we can learn much from McLuhan's foresight into the human factor that is always-already involved.

McLuhan's focus on communication, media, culture and technology, however, may never have happened if the social scientist Harold Innis (1894–1952) had not come to Russia in 1945 at the invitation of Soviet Embassy in Ottawa and the RAS, which was celebrating its 220th anniversary[1]. It was there that he realized various countries and peoples actualize different 'systems' of governance and priority, in terms of politics, economics, ideology, science and religion. This recognition led him to change the focus of his scholarly studies from history and economics to communication, which in turn impacted the work of McLuhan, who was a colleague of Innis' at the University of Toronto. Both were part of what later became known as the 'Toronto school of communication.'

Innis travelled to Russia for one month hoping to understand the economic and political systems of the Soviet Union, which at that time were still achieving great results in terms of industrial production and scientific progress. He was, by all indications, especially from his 'idea file' (1980), deeply impressed in Russia by the confrontation of ideas that were unfamiliar to his North American environment and how he could hope to make sense of

[1] "The decision to celebrate the 220th anniversary of the Academy of Sciences is an indication of a broad statesmanlike approach to a world problem of understanding, and recognition of the possibilities of using science as a common approach – almost the only universal common basis left. Nationalism inevitably creates inefficiency and bigotry even in science and the enormous literature in the various fields in different languages becomes a major handicap... probably no countries have more to learn through exchange of information than Canada and Russia" (Innis, 1981 [1945]: 78).

them. "To be trained in a subject which has its roots in the West and which has suffered from the characteristic disease of specialization and to realize suddenly that a vast powerful organization built around the efforts of 180 million people has arisen with little interest in this specialization is to find oneself compelled to search for possible contacts in the broader approach of its history" (1981 [1945]: 73). It was in this search for possible contacts with a broader history that Innis turned his research to focus on the following idea, which had been one of his main discoveries in Russia: the main task of science (and of most other things) is communication of information and new knowledge.

The careful focus on language and communication brings us back to the work of Gingras discussed above, and leads us forward to consider the relationship between countries in terms of making a comparative SoS, as we are attempting herein. Taking two nations with significantly different cultural and social histories, such as Russia and Canada, and comparing their views on S&T would seem a nearly impossible task if not for the help that we are offered through the medium of scholarly communication, journals, books, conferences, exchanges and the like. But why should we want to share with and to learn from other knowledge traditions, other schools of SoS or technology studies, unless we believe that both we and they have something to offer?

As Innis wrote in 1945, "Cooperation between Russia and the Anglo-Saxon world becomes the major problem of the West" (1981 [1945]: 76). This statement should of course be interpreted in the context of the post-WWII geo-political atmosphere in which Innis was writing. Nevertheless, the situation today, especially in light of the above discussion of the significant contribution that Russian (and Soviet) scholars have made to the field called SoS, indicates a possibility for re-starting the communication between scholars and scientists that was more or less closed during the Cold War.

If we wish to take the advice of Innis, who was reflecting on his time in Russia about how to overcome communication barriers, we might read as follows: "Our first duty is to conserve and strengthen our heavily depleted intellectual and spiritual resources" (1981 [1945]: 81). In other words, there is a need in each nation or community to first discover and understand itself, its own unique cultural identify before it can hope to share its contributions with the world. What makes Canada and Russia unique in the world scientific and intellectual communities? We leave this question open.

Upon returning from the deeply ideological confrontation with Soviet communism in Russia, Innis commented on "the necessity for a much broader approach in economic history" in contrast to the danger of "a very narrow approach such as we seem to get nothing else but"[1] in Canada, or North America generally speaking. What he sought was an integration of views, wherein each could benefit from each 'other,' in terms of academic fields, national traditions and scientific systems, yet which found its greatest value communicatively in coming home to share that knowledge with local people. Innis is an example of a scholar who was enticed on several occasions to teach and do research at the esteemed University of Chicago, but who instead stayed home and became a Canadian scholar of the highest level. His commitment to his homeland, as well as his scholarly method of 'going to the spot,' i. e. covering thousands of kilometres in journeying across Canada, and sometimes around the world to do research, offers an example of 'brain circulation' perhaps fitting for the Russian predicament in science and society today.

A third figure who has impacted Canadian views of science, technology and history is the social philosopher George Grant (1918–1988). Grant lamented the scientization

[1] (Creighton, 1957: 122).

and technologization of society in so far as he thought it came at the cost of less generally educated citizens with respect to social-humanitarian concerns. He felt that the more S&T were placed at the centre of the new university's model of success, the less room there would be for subjects that helped people understand their humanity and not just the tools by which they lived.

"Canadian philosophers indeed have joined as fully as any part of the Western world in making philosophy the servant rather than the judge of men's scientific abilities," he wrote. "Young Canadians have quite logically drawn the correct conclusions from such an attitude. If philosophy is merely the servant of science, then they are better occupied studying with the master rather than with the servant" (1998: 161). Here Grant identifies the danger of hyper-industrialisation, in the industrial age, as well as what might now be called hyper-technologization, in the electronic-information age. If our best students study computer science, engineering and bio-technology, then social-humanitarian fields will inevitably suffer. Yet perhaps a learning focus on natural and applied sciences will supply society with more tools for development, which every nation appears to be seeking.

Grant, however, thought that 'applied science' was already over-developed in Canada (1998: 173) and that comparatively under-developed fields ought therefore to be promoted by educational policy-making bodies. "[S]ome of our energy must be diverted from technology," he wrote, in order to avoid the idea of "faith in salvation by the machine" (1998: 172). Though on the one hand Grant worried about the mechanization of society and that it would lead to the 'dehumanization' of humanity, on the other hand he wanted, as did McLuhan, to help people understand what they needed to do and to know in order to protect themselves from problems and excesses, such as the ideology of scientism.

One way to do this was to teach more philosophy and also more general, 'foundational' knowledge about daily human life, societies, cultures and communication between peoples. "We need more social science to cure the ills which [natural] science has created" (1998: 97), he said.

Grant warned of the pressures or stresses people faced as the 'pace' of society increased, due to S&T advances. "A society that is committed to technology," he noted, "is committed to continual change" (1998: 102). And "we are now living in the mass scientific society and this is something totally new in the experience of the human race" (1998: 51). These observations made 40–50 years ago still resonate with today's society, in so far as the Internet, e.g. e-mail, social and professional networking, and electronic libraries, has fundamentally changed the landscape in which R&D relating to S&T is done.

Let us close this section by noting again the turn to communication that each of these three Canadian scholars highlighted. As a result of their research and writings, we may discover that 'doing SoS' today requires more attention to the diverse languages involved in the global scientific and technological communities and that listening to understand 'foreign' ideas involves advocating a kind of 'reflexive sociology' that was not as easy to witness in the SoS of decades past. "Why is it that in all of the great civilizations there have always been philosophers and that indeed we often judge the greatness of a society by the greatness of its philosophy?" (1998: 33) Grant asked. The message from these three voices is that a sociology which leans only on positive, empirical, quantifiable data or 'facts' and which ignores the reflexive, interpretive, qualitative reality of human-social existence will inevitably only represent a partial and not a holistic view of S&T development and how it affects the lives of individuals and societies.

Russian and Canadian 'Philosophical' Sociologies of Science

Today a rejection of the ideology of positivism in human-social sciences is possible, partly as a result of studies in HPS and SoS. This has resulted in support for the 'scientificity' of sociology, not only as a 'positive science,' but also as a 'reflexive science.' We suggest the latter aspect of all human-social science also embraces the 'philosophicity' of sociology, that is, the inevitable philosophical dimension present in every sociological theory and method.

The Russian and Canadian schools of SoS can help contribute to a reflexive global SoS by offering approaches that differ from the dominant positivistic American school. Indeed, they propose to approach S&T using both philosophical and sociological frameworks.

What both the Russian and Canadian sociological traditions put forward is a combination of approaches that include quantitative, empirical, interpretive and historical-comparative theories and methods. With such a diversity of disciplinary options, they can afford to involve philosophy alongside and partnered with sociology in order to better understand S&T and its effects. They can contribute to better understanding the meaning of S&T in the daily lives of people, by taking into account the political, economic, ideological, and cultural dimensions.

As L. N. Tolstoy once wrote: "the study of things as they exist can only be a subject for science in so far as that study helps towards the knowledge of how men [sic] should live" (1989: 152). Viewed in this way, SoS can also add to the knowledge of how people live by involving ethics and values, markets and planning in S&T.

In the case of Russia, the possibility of overcoming its imperialistic political past and its current distance from the centre of the global scientific community are driving factors in wanting to promote a new sociology of S&T. One cannot speak of science or technology in a neutral way in Russia without confronting the historical materialism and the party-line scientism mandated for more than half the 20th century under Soviet rule. The so-called 'scientific and technological revolution' in Russia is impressed on much of the literature from the 60s–80s. The opportunity now to speak of Russia's current situation in the electronic-information age offers new ways to break with the past and to open up constructive global dialogue involving Russian scholars.

In the case of Canada, a desire to forge an alternative path from the dominant U.S.American tradition of quantitative and empirical SoS leads to the possibility of listening to a quieter, perhaps more balanced and diverse voice. The work of such figures as McLuhan, Innis and Grant prepares the path for approaches to S&T that focus both on the interpretation and communication of what human-social development 'means' in various cultural-linguistic contexts. Such a view shows that neither scientism nor hyper-technologization of society is likely to lead to healthy results.

Concluding Remarks:

This Journal presents a new opportunity for Russian scientists and scholars to display their writings and to share their knowledge with the rest of the world, in both Russian and English languages. The opportunity to discover an unknown or little known, yet nonetheless decorated scientific tradition should be reason enough for non-Russian readers to engage this publication with new thoughts, ideas, questions, and commentary regarding S&T and sociology in Russia.

This article has presented a brief view of both Russian and Canadian sociologies of science in an attempt to open-up dialogue about these two national traditions in light of current global conditions. It has also engaged questions related to technology, which are distinct from science, yet which often compliment SoS because technological progress draws upon advances in sciences made around the world. There is undoubtedly much that has been left out in this brief analysis and many more figures and viewpoints that could have been included. Nevertheless, as an introductory comparison it has aimed to provide a starting point from which further study and conversation can occur.

Due to the artificial 'curtain' that was constructed between Russia and much of the rest of the world in the 20th century, Russia has not featured prominently in international journals related to SoS and its books have only rarely been translated into other languages. Nevertheless, it is believed that Russia's experiences and its strong traditions in scientific knowledge production from the Soviet period until today could serve as an archetypical example of how politics, religion, culture and society influence S&T development. We just need to put in the work to understand what contribution Russian SoS can make today.

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Export Structure, Technological Capability and Comparative Performance of India and China in US market[1]

Contemporary trade theories suggest association between technological capability and gains from export. Export structure of India and China with reference to the structure of US import suggests that higher Chinese gains cannot be explained by technological capability. When overall movement of US import is compared with that of shares of India and China, it appears that they have better share of the market during downswing. The trend is most pronounced in case of China. The paper offers an explanation to the paradox by defining X-advantage that gives a country the advantage of downwardly flexible factor price.

Keywords: Asian NIEs, India-China, Technology and Trade, Comparative advantage, Export structure, X-efficiency, X-advantage.

[1] The data has been updated till 2006. There is no significant variation from the conclusion arrived at in this paper.