On the Problem of Breathing, Eating, & Drinking Poison: An introduction to problem solving, nobility of purpose under adverse circumstances, and the search for truth with Sir Karl Popper on Prince Edward Island

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An introduction to problem solving, nobility of purpose under adverse circumstances, and the search for truth with Karl Popper

on

Prince Edward Island

In Honour of Dr Ron Matsusaki

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Eppur si muove[1]

1 "I, Galileo, son of the late Vincenzo Galilei, Florentine, aged seventy years, arraigned personally before this tribunal, and kneeling before you, Most Eminent and Reverend Lord Cardinals, Inquisitors-General against heretical depravity throughout the entire Christian commonwealth, having before my eyes and touching with my hands, the Holy Gospels, swear that I have always believed, do believe, and by God's help will in the future believe, all that is held, preached, and taught by the Holy Catholic and Apostolic Church. But whereas -- after an injunction had been judicially intimated to me by this Holy Office, to the effect that I must altogether abandon the false opinion that the sun is the center of the world and immovable, and that the earth is not the center of the world, and moves, and that I must not hold, defend, or teach in any way whatsoever, verbally or in writing, the said false doctrine, and after it had been notified to me that the said doctrine was contrary to Holy Scripture -- I wrote and printed a book in which I discuss this new doctrine already condemned, and adduce arguments of great cogency in its favor, without presenting any solution of these, and for this reason I have been pronounced by the Holy Office to be vehemently suspected of heresy, that is to say, of having held and believed that the Sun is the center of the world and immovable, and that the earth is not the center and moves.

Therefore, desiring to remove from the minds of your Eminences, and of all faithful Christians, this vehement suspicion, justly conceived against me, with sincere heart and unfeigned faith I abjure, curse, and detest the aforesaid errors and heresies, and generally every other error, heresy, and sect whatsoever contrary to the said Holy Church, and I swear that in the future I will never again say or assert, verbally or in writing, anything that might furnish occasion for a similar suspicion regarding me; but that should I know any heretic, or person suspected of heresy, I will denounce him to this Holy Office, or to the Inquisitor or Ordinary of the place where I may be. Further, I swear and promise to fulfill and observe in their integrity all penances that have been, or that shall be, imposed upon me by this Holy Office. And, in the event of my contravening, (which God forbid) any of these my promises and oaths, I submit myself to all the pains and penalties imposed and promulgated in the sacred canons and other constitutions, general and particular, against such delinquents. So help me God, and these His Holy Gospels, which I touch with my hands

I, the said Galileo Galilei, have abjured, sworn, promised, and bound myself as above; and in witness of the truth thereof I have with my own hand subscribed the present document of my abjuration, and recited it word for word at Rome, in the Convent of Minerva, this twenty-second day of June, 1633.

I, Galileo Galilei, have abjured as above with my own hand."

Legend has it that as Galileo rose to his feet, he said under his breath, *Eppur si muove* [*And yet, it moves*]. The remark captivated scientists and scholars for centuries, as it represented defiance of obscurantism and nobility of purpose in the search for truth under the most adverse circumstances [Hawking 2002, as cited in Galilei 1638, pp xi-xiii].

ABSTRACT

This paper introduces Karl Popper's approach to problem solving in the social sciences. These methods fundamentally represent the scientific method of the natural sciences. Popper's problem solving technique is outlined in six steps, including an introductory treatment of his solution to Hume's *Problem of Induction*. These six steps are then applied in the form of a test and logical deduction of our illustrative theory: *Cancer rates on Prince Edward Island have dramatically increased as a result of an extraordinary increase (900% in the past decade) in potato production, and a corollary increase of secondary agricultural inputs, namely a increase of chlorothalonil (trade name: Bravo) applications in less than ten years.* We conclude our theory is true and, in order to complete our demonstration of Popper's methods, open this theory to criticism and refutations. APPENDIX A offers a brief review of relevant literature on the philosophy of science, and APPENDIX B offers readers a brief introduction to the fundamentals of relevant island-based methods.

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Godfrey Baldacchino

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Key words: Popper, Hume, Hayek, truth, scientific method, philosophy of science, induction, economics, island studies, insularity, dependency, Prince Edward Island, closed societies, confederacy of dunces, commercial agriculture, cancer, chlorothalonil, Bravo, manufacture of consent.

Great spirits have always encountered violent opposition from mediocre minds. The mediocre mind is incapable of understanding the man who refuses to bow blindly to conventional prejudices and chooses instead to express his opinions courageously and honestly.

—Albert Einstein, in a letter to the department of Philosophy at the College of the City of New York, criticizing the refusal of the appointment of Bertrand Russell, 1940

In a time of universal deceit, telling the truth becomes a revolutionary act.
—George Orwell, *1984*, 1949

INTRODUCTION

1. Science = Problem Solving:

> The natural as well as the social sciences always start from problems, from the fact that something inspires amazement in us, as the Greek philosophers used to say. To solve these problems, the sciences use fundamentally the same method that common sense employs, the method of trial and error. To be more precise, it is the method of trying out solutions to our problem and then discarding the false ones as erroneous. This method assumes that we work with a large number of experimental solutions. One solution after another is put to the test and eliminated.[1]

2. Problem Solving[2] =All Life

> This procedure seems to be the only logical one. It is also the procedure that a lower organism, even a single-cell amoeba, uses when trying to solve a problem. In this case we speak of testing movements through which the organism tries to rid itself of a troublesome problem. Higher organisms are able to learn through trial and error how a certain problem should be solved. We may say that they too make testing movements—mental testings—and that to learn is essentially to try out one testing movement after another until one is found that solves the problem. We might compare the animal's successful solution to an expectation and hence to a hypothesis or a theory. For the animal's behaviour shows us that it expects (perhaps unconsciously…) that in a similar case the same testing movements will again solve the problem in question.[3]

3. Scientific Method = [0],

> I assert that no scientific method exists… To put it in a more direct way:
> (i) There is no method of discovering a scientific theory.
> (ii) There is no method of ascertaining the truth of a scientific hypothesis, i.e., no method of verification.
> (iii) There is no method of ascertaining whether a hypothesis is 'probable', or probably true.[4]

Our brief introduction to problem solving with Karl Popper is encapsulated within these three axioms. We trust the first two points are fairly straightforward: (1) *Science* is *problem solving*, thus it must begin with a *problem,* and (2) that *all things living* are constantly engaged in problem solving (*The Struggle for Life*).[5] Our third tenant, however, may appear to present an untenable and vicious circle, but Popper is merely emphasizing the critical point that, contrary to the assertion of many, there is no *single* way to solve problems. All problems and all solutions are unique, thus we have no single scientific method.

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1 Popper 1999, p3
2 Popper 1992, pp vii-viii
3 Ibid
4 Popper 1956, pp 5-6
5 Darwin 1859

> There is no such thing as a logical method of having new ideas, or a logical reconstruction of this process. My view may be expressed by saying that every discovery contains 'an irrational element', or 'a creative intuition', in Bergson's sense. In a similar way Einstein speaks of the 'search for those highly universal laws . . . from which a picture of the world can be obtained by pure deduction. There is no logical path', he says, 'leading to these… laws. They can only be reached by intuition, based upon something like an intellectual love ('Einfühlung') of the objects of experience'.[1]

And although we may consider our assertion of the non-existence of scientific method was held by Einstein,[2] Whewell,[3] Russell, and Reichenbach,[4] we will not imply validation by resting on these laurels, we will, rather, illustrate the implications of this assertion with an applicable example:

Our present approach to problem solving, for example, may be described as an archipelago of inter-connected islands of theories and thought, namely the modern synthesis of evolutionary biology, cultural evolution, Austrian economics,[5] Icelandic freedom,[6] and Swiss democracy[7]—all within a framework which acknowledges

1 Popper 1959, p 37

2 Einstein's genius reminds us that a society's competitive advantage comes not from teaching the multiplication or periodic tables but from nurturing rebels…. And, as recent research into Einstein's personal papers shows, there's no better glimpse into his offbeat creativity than the way he puzzled out the special theory of relativity…. Einstein alienated so many professors that he was unable to earn a doctorate, much less land an academic job. At the age of 26, he was working as a third-class examiner at the Swiss patent office in Bern…. *Other scientists had come close to his insight, but they were too confined by the dogmas of the day*. Einstein alone was impertinent enough to discard the notion of absolute time, one of the sacred tenets of classical physics since Newton. "Imagination is more important than knowledge," Einstein later said. Indeed, if we are ever going to unravel the further mysteries of dark matter, come up with a unified theory, or discover the true nature of energy, we should carve that proclamation above all of our blackboards [italics mine, Isaacson 2007, pp35-36].

3 Scientific discovery must ever depend upon some happy thought, of which we cannot trace the origin; — some fortunate cast of intellect rising above all rules. No precepts will elevate a man of ordinary endowments to the level of a man of genius: nor will an inquirer of truly inventive mind need to come to the teacher of inductive philosophy to learn how to exercise the faculties which nature has given him (Whewell 1849, p 117).

4 See Reichenbach 1951

5 (a) Economics is not an intellectual game. Economics is deadly serious. The very future of mankind—of civilization—depends, in Mises' view, upon widespread understanding of, and respect for, the principles of economics (Kirzner 2006, p1).
(b) The assumption that *economists* (italics Hayek's) can find predictable solutions to economic problems is undoubtedly the most inhibiting force in… economics. It has led to the increasing isolation of theoretical economists from the day-to-day practitioners of the subject—the actual participants in an economy, the consumers and the producers (Hayek, Bartley, & Kresege 1991, pp 8-9).
(c) What made Vienna the distinctive city that it was, as much as any other the fount of Western culture, is a question to be kept in mind…What we might observe is that a milieu such as that in which Hayek [and Popper] spent his childhood and youth, a society in which family and associates, position and accomplishment, knowledge and history were so tightly intertwined, meant that the members of such a society were quickly and always apprised of what *mattered* [italics Bartley's].This is no small feat, as any teacher of the present generation of youth knows too well. It is the *significance* [italics Bartley's] of knowledge and information that leads to the evolution of understanding (Hayek, Bartley, & Kresge 1991, p 5).

6 "Size isn't everything by any means," he said aloud to the dog, as if suspecting her of entertaining high ideas. "Take my word for it, freedom is of more account than the height of a roof beam. I ought to know; mine cost me eighteen years' slavery. The man who lives on his own land is a n independent man. Hi is his own master. If I can keep my sheep alive through the winter and can pay what has been stipulated from year to year—then I pay what has been stipulated; and I have kept my sheep alive. No, it is freedom that we are all after, Titla. He who pays his way is a king. He who keeps his sheep alive through the winter lives in a palace" (Laxness 1946, p 13).

7 (a) British democracy owes its emergence to a sense of pride and independence among the upper nobility… Swiss democracy resulted not from the pride, independence, and individualism of an upper nobility, but from the pride, independence, and

the incessant noise, misinformation, and irrationality generated by *The Problem of Induction*,[1] *The Problem of Closed Societies,*[2] *The Problem of Manufactured Consent*[3], and *The Problem of Media Toxicity.*[4]

We are deluged with an unending torrent of clever "new" *interdisciplinary*, *intra-disciplinary, multidisciplinary*, and *pluri-disciplinary* fields of study. In economics alone, we have neoclassical economics, Austrian economics, behavioural economics, experimental economics, new institutional economics, ecological economics, and neuroeconomics—just to name a *few*. And yes, of course they are *all* in fact interdisciplinary—can you imagine a "monodisciplinary" science? Even physics must acknowledge the reality that humans conduct the experiments, interpret the results, and apply them within a social construct. I submit there is not a branch of science that is *not* multidisciplinary, *intra*-disciplinary, *inter*-disciplinary, or pluri-disciplinary.

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individualism of mountain farmers.

These completely different beginnings and traditions have led to quite different traditional institutions and quite different traditional systems of values (Popper 1958, pp 81-82).

(b) The problem is to provide incentives for those so entrusted to act on behalf of those who they are supposed to be serving—the standard principle agent problem. Democracy—contestability in political processes—provides a check on abuses of the powers that come from delegation just as it does in economic processes; but just as we recognize that the take-over mechanism provides an imperfect check, so too we should recognize that the electoral process provides an imperfect check. Just as we recognize that current management has an incentive to increase asymmetries of information in order to enhance its market power, increase its discretion, so to in public life. And just as we recognize that disclosure requirements—greater transparency—and specific rules of the game (e.g. related to corporate governance) can affect the effectiveness of the take-over mechanism and the overall quality of corporate governance, so too the same factors can affect political contestabilty and the quality of public governance (Stiglitz 2001, p 522 - 523).

1 See Hume 1739

2 Popper 1945. Also see Soros 2006

3 That the manufacture of consent is capable of great refinements no one, I think, denies. The process by which public opinions arise is certainly no less intricate than it has appeared in these pages and the opportunities for manipulation open to anyone who understands the process are plain enough.

The creation of consent is not a new art. It is a very old one which was supposed to have died out with the appearance of democracy. But it has not died out. It has, in fact, improved enormously in technic, because it is now based on analysis rather than on rule of thumb. And so, as a result of psychological research, coupled with the modern means of communication, the practice of democracy has turned a corner. A revolution is taking place, infinitely more significant than any shifting of economic power.

Within the life of the generation now in control of affairs, persuasion has become a self-conscious art and a regular organ of popular government. None of us begins to understand the consequences, but it is no daring prophecy to say that the knowledge of how to create consent will alter every political calculation and modify every political premise…It has been demonstrated that we cannot rely upon intuition, conscience, or the accidents of casual opinion if we are to deal with the world beyond our reach (Lippmann 1922, p 158). Also see Herman & Chomsky 1988.

4 A certain Canadian city was unable to receive any TV signals up until 1973, due to its location in a steep valley. Otherwise, it was similar to two cities in the vicinity used as control cases. A study by Williams (1986) suggests that the introduction of TV crowded out other activities, in particular those outside the home, such as sports' activities and visiting clubs. It also reduced the reading abilities and creative thinking of children and fostered more aggressive behavior and stereotyped ideas about gender roles. TV also reduced the problem solving capacities of adults (Frey, Benesch & Stutzer 2005, p 8).

> Herbert Simon, in his entry 'behavioural economics' in *The New Palgrave Dictionary of Economics and Law*, 1998, pointed out that the term 'behavioral economics' is a sort of pleonasm, for what else is economics about than a study of human behavior. How could it possibly be that all the work done in departments of psychology, sociology and anthropology are irrelevant to economics? The discovery of behavioral economics in the past decade or two is really a return to reality from an untenable position that the rational optimizing model is the only framework for economics (Shiller 2000, p 4).

Yes, this reasoning is sound, but it does not follow its own truth to the complete and logical conclusion, because even 'economics'[1] does not exist. Consider the first sentence of the first chapter of the first book of Marshall's (1890) *Principles of Economics*: "Political Economy or Economics is a study of mankind in the ordinary business of life." Although we're getting closer to the heart of the matter, Marshall did not consider the biosphere, atmosphere, nor lithosphere part of *the ordinary business of life*. Thus 'externalities' such as pollution, extinction, and deforestation were outside the so-called subject of 'economics' and were left to 'other subject matters' to deal with, and thus, we begin to understand that the so-called 'science' of economics has generated convenient but life-threatening *myths*. Moreover, we begin to understand the absolute truth of *On the Non-Existence of Subject* Matters, a paper Sir Karl Popper delivered at a meeting of the Fellows of the 'Center for Advanced Study in the Behavioral Sciences' at Stanford, California, in November of 1956:

> As a rule, I begin my lectures on Scientific Method by telling my students that scientific method does not exist. I add that I ought to know, having been, for a time at least, the one and only professor of this non-existent subject within the British Commonwealth.
>
> It is in several senses that my subject does not exist, and I shall mention a few of them.
>
> First, my subject does not exist because subject matters in general do not exist. *There are no subject matters; no branches of learning—or, rather, of enquiry: there are only problems, and the urge to solve them* [italics mine]. A science such as botany or chemistry (or say, physical chemistry, or electrochemistry) is, I contend, merely an administrative unit. University administrators have a difficult job anyway, and it is a great convenience to them to work on the assumption that there are some named subjects, with chairs attached to them to be filled by the experts in these subjects (pp 5-6).

1 There is only one social science.... While scientific work in anthropology and political science and the like will become increasingly indistinguishable from economics, economists will reciprocally have to become aware of how constraining has been their tunnel vision about the nature of man and social interaction. Ultimately, good economics will also have to be good anthropology and sociology and political science and psychology (Landa 1999, p 7).

Again, when it all comes down in the end, *all life is problem solving,*[1] and "*no man can be a pure specialist without being in the strict sense an idiot*" (Shaw 1903, ln 41).

If we consider *The Problem of Global Warming*, for example there is no *single* academic department able to solve this problem, as the problem spans ecology, economics, political science, physics, evolutionary biology, etc. It is not critical to accept the assertion that subject matters do not exist, but it may be critical to understand *why* subject matters may not exist, as this false and misguided assumption has inhibited and continues to inhibit our ability to find a meaningful solution. It is thus, by use of the same logic, equally important to understand why no single scientific method exists.

Generally speaking, the particular methods employed will depend upon the nature of the enquiry and the ultimate purpose of the particular problem solving endeavour (the solution's intended audience). Let's consider the solution to a single, relatively simple problem as presented to three separate audiences: The opportunity to study Islands at the one and only Master's program in island studies presents several enticing value propositions and a few potential problems as well: A prospective student must decide if the investment in time and money is a feasible and/or worthwhile pursuit. Would this quest bear the fruits of knowledge, reveal hidden truths, and offer illuminating island elixirs? Would the journey offer a rare and valuable islander's perspective? An *Earth Island* perspective? Opportunities? Solutions to critical problems? Exotic sojourns?

Naturally, the considerations are manifold, many of which may or may not be fully formed and articulated in the mind of the prospective student, but one consideration which must be addressed, either directly or

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At bottom, this procedure seems to be the only logical one. It is also the procedure that a lower organism, even a single-cell amoeba, uses when trying to solve a problem. In this case we speak of testing movements through which the organism tries to rid itself of a troublesome problem. Higher organisms are able to learn through trial and error how a certain problem should be solved. We may say that they too make testing movements – mental testings – and that to learn is essentially to try out one testing movement after another until one is found that solves the problem. We might compare the animal's successful solution to an expectation and hence to a hypothesis or a theory. For the animal's behaviour shows us that it expects (perhaps unconsciously or dispositionally) that in a similar case the same testing movements will again solve the problme in question [all italics Popper's 1999, p3].

indirectly, is *The Problem of Tuition*. If the candidate has the financial means to address this problem independently, the methodological treatment of this problem solving endeavour may pass unconsciously in an intuitive moment with a decision to simply register, pay tuition, and begin classes.

The method will differ, however, depending upon necessary audiences. If the student requires parental financial assistance, they may need to be able to articulate the reasons for their desire to study islands and forward persuasive arguments. Perhaps the parents would like their hopeful progeny to jot down some of the goals associated with their desire to continue a formal education. If the student requires financial aid or a grant, the method becomes even more formalized. Perhaps they will be required to write an essay, detailing the basis for their desire to study islands, what they hope to accomplish in doing so, and what contributions they would endeavour to make. Likewise, a psychologist may, for example, initially 'test' a theory in her own mind, or simply verbally run it past a colleague for criticism; or, perhaps she will submit this theory formally in an APA journal for criticism from a much broader audience. Let's also briefly consider a more complex problem solving endeavour:

> Evolutionary biology is a historical science It is very different from the exact sciences in its conceptual framework and methodology. It deals, to a large extent, with unique phenomena, such as the extinction of the dinosaurs, the origin of humans, the origin of evolutionary novelties, the explanation of evolutionary trends and rates, and the explanation of organic diversity. There is no way to explain these phenomena by laws. Evolutionary biology tries to find the answer to "why" questions. Experiments are usually inappropriate for obtaining answers to evolutionary questions. We cannot experiment about the extinction of the dinosaurs or the origin of mankind. With the experiment unavailable for research in historical biology, a remarkable new heuristic method has been introduced, that of historical narratives. Just as in much of theory formation, the scientist starts with a conjecture and thoroughly tests it for its validity, so in evolutionary biology the scientist constructs a historical narrative, which is then tested for its explanatory value. Let me illustrate this method by applying it to the extinction of the dinosaurs, which occurred at the end of the Cretaceous, about sixty-five million years ago. An early explanatory narrative suggested that they had become the victims of a particularly virulent epidemic against which they had been unable to acquire immunity. However, a number of serious objections were raised against this scenario, which was therefore replaced by a new proposal, according to which the extinction had been caused by a climatic catastrophe. However, neither climatologists nor geologists were able to find any evidence for such a climatic event and this hypothesis also had to be abandoned. However, when the physicist Walter Alvarez postulated that the extinction of the dinosaurs had been caused by the consequences of an asteroid impact on earth, all observations fitted this new scenario. The discovery of the impact crater in Yucatan further strengthened the Alvarez theory. No subsequent observations were in conflict with this theory. The methodology of historical narratives is clearly a methodology of historical science.[1]

1 Mayr 2004 pp 32-33

(I) THE METHOD OF THE SOCIAL SCIENCES, like that of the natural sciences, consists in trying out tentative solutions to those problems from which our investigations start. Solutions are proposed and criticized. If a proposed solution is not open to objective criticism, then it is excluded as unscientific, although perhaps only temporarily.

(II) If the proposed solution is open to objective criticism, then we attempt to refute it; for all criticism consists in attempts at refutation.

(III) If a proposed solution is refuted through our criticism we propose another solution.

(IV) If it withstands criticism, we accept it temporarily; and we accept it, above all, as worthy of further discussion and criticism.

(V) Thus the method of science is one of the tentative attempts… to solve our problems which are controlled by the most severe criticism. It is a critical development of the method of 'trial and error'.

(VI) The so-called objectivity of science lies in the objectivity of the critical method; that is, above all, in the fact that no theory is exempt from criticism, and further, in the fact that the logical instrument of criticism—the logical contradiction—is objective.[1]

1 Popper 1992, pp. 66-67

APPLICATION

Following is an example of Poppers six-step methodological approach to the social sciences at work in a simplified, yet very practical application. Before embarking on a discourse on scientific method, however, please note

> (1) my present design… is not to teach the method which each ought to follow for the right conduct of his reason, but solely to describe the way in which I have endeavoured to conduct my own…. This tract is put forth merely as… a tale, in which, amid some examples worthy of imitation, there will be found, perhaps, as many more which it were advisable not to follow, I hope it will prove useful to some without being hurtful to any, and that my openness will find some favour with all… It is possible I may be mistaken; and it is but a little copper and glass, perhaps, that I take for gold and diamonds. I know how very liable we are to delusion in what relates to ourselves, and also how much the judgements of our friends are to be suspected when given in our favour.[1]
>
> (2) False facts are highly injurious to the progress of science, for they often endure long; but false views, if supported by some evidence, do little harm, for every one takes a salutary pleasure in proving their falseness: and when this is done, one path towards error is closed and the road to truth is often at the same time opened.[2]

With this disclosure in mind, our investigation does *not* begin with observations, measurements, or statistical data.[3] Our investigation begins with a problem:

(I) Cancer rates on Prince Edward Island have increased sharply over the past decade, and, since there seem to be a fair number of people in disagreement over possible causation,[4] perhaps this strikes us as a problem worthy of our attention. We propose an initial solution as a *theory* which we will subject to tests and open to others for their criticism and tests. This brings us to a minor stumbling block and source of unnecessary confusion:

Theory = Hypothesis = Conjecture = Thesis.[5]

In many contemporary research settings, the variations in the definitions of these terms are often-misunderstood, disregarded, or used interchangeably. Thankfully, there's no need for confusion or intimidation by the arbitrary interchange between these terms, as this represents an inconsequential and thoroughly avoidable

1 Descartes 1637, p 1
2 Darwin 1883, p 1
3 Popper 1992, pp 67-68
4 See IU 2008
5 Anon 1999, p 2

matter of semantics. This confusion is further exacerbated by the fact that a more recent etymological evolution of Thesis = Dissertation. Thus, will stick with *theory,* as this term's relatively common usage and relatively clear meaning may serve us well:

"Every scientific theory is a system of sentences… or ASSERTED STATEMENTS or, for short, simply statements."[1]

Thus, the which we propose for our demonstration is quite simply, a statement:

Cancer rates on Prince Edward Island have significantly increased (26% in four years) as a result of a significant increase (700% in less than thirty years) of chlorothalonil applications.[2]

Many assert researchers must present the basis upon which their theory was founded; this notion is misguided.[3] Although our theory is based on a simple, logical deduction, associated problems relating to the difficulty of establishing causation are significant, yet not insurmountable.

First, our logical deduction:

1. Data in support of a non-linear mechanism for carcinogenicity demonstrate exposure to chlorothalonil yields carcinogenicity amongst mammals.
2. Men, women, and children are mammals.
3. Therefore exposure to chlorothalonil is a mechanism for carcinogenicity amongst men, women, and children.
4. Men, women, and children throughout Prince Edward island are exposed to carcinogenic levels of chlorothalonil which demonstrate a mechanism for carcinogenicity.[4]
5. Therefore exposure to chlorothalonil on Prince Edward Island demonstrates a mechanism for

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1 Tarski 1941, p 3

2 See Delaney 2006, (1). Also see Mittelsteadt 2006 (1) ; Abassi 2004 ; Novaczek 2007

3 Popper 1959, pp 7-9; Also see Whewell 1849

4 With about 7,000 fields spanning 110,000 acres, [Prince Edward Island] produces more than a billion kilograms of potatoes every year, making PEI one of the most intensely-farmed areas in Canada…. The crops are sprayed about 20 times per year—every four days in blight season—and the three main fungicidals used on the potatoes have been classed as carcinogens by the U.S. government….
In a 1999 Environment Canada study… chlorothalonil, also called Bravo, was present in every air sample taken on the island—even in the control area which was at the end of a wharf away from any fields. The study also found that concentrations of the fungicide were just as high or higher on days when no spraying occurred as on days when it did [italics mine, Delaney 2006, p 1]; Also see Novaczek 2007.

carcinogenicity, morbidity, and mortalities amongst men, women, and children on Prince Edward Island.

In light of the aforementioned difficulty in regards to establishing causation, our next step is to attempt to determine if our theory is true, but first we must define *truth*[1] in contradistinction with *certainty*:

> Knowledge consists in the search for truth—the search for objectively true, explanatory theories… It is not the search for certainty. To err is human. All human knowledge is fallible and therefore uncertain. It follows that we must distinguish sharply between truth and certainty. That to err is human means not only that we must constantly struggle against error, but also that, even when we have taken the greatest care, we cannot be completely certain that we have not made a mistake.
>
> In science, a mistake we make—an error—consists essentially in our regarding as true a theory that is not true… to combat the mistake, the error, means therefore to search for objective truth and to do everything possible to discover and eliminate falsehoods. This is the task of scientific activity. Hence we can say: our aim as scientists is objective truth; more truth, more interesting truth, more intelligible truth. We cannot reasonably aim at certainty. Once we realize that human knowledge is fallible, we realize also that we can never be completely certain that we have not made a mistake.[2]

(II) We proceed and endeavour to determine if our theory is true by attempting to *refute* (or *falsify)* our theory and by opening it to refutation and falsification attempts by others.

(III) If our theory is refuted, we propose another in our attempt to solve the problem.

(IV) If our theory withstands criticism, we will accept it as *true*, but the theory will remain forever held tentatively, and will remain open to criticism:

1. What, then, are we to trust? What are we to accept? The answer is: whatever we accept we should trust only tentatively, always remembering what we are in possession, at best, of partial truth (or rightness), and that we are bound to make at least some mistake or misjudgement somewhere.[3]
2. We can never excel others in our reasonableness in a way that would establish a claim to authority.[4]
3. No theory is final.[5]

(V) Let's consider competing theories and all known attempts to refute and falsify our theory. To our best knowledge, they may be encapsulated in the following three critiques:

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1 Popper 1963, p 21. And: I'm a stodgy old scientist who believes, naively, that there exists an external world, that there exist objective truths about that world, and that my job is to discover some of them. (If science were merely a negotiation of social conventions about what is agreed to be ``true'', why would I bother devoting a large fraction of my all-too-short life to it?) (Sokal 1996c, pp 2-3).

2 Popper, 1992, p 4

3 Ibid, p 391

4 Ibid, p 227

5 Ibid, p 261

1. PEI is known nationwide for… beaches, a friendly people, lighthouses…, and for its staggeringly vast potato production. But the… island may soon come to be associated with another, far less benign feature: some of the highest rates of cancer and asthma in the country. *Despite repeated assertions from government officials that the statistics don't provide any proof* (italics mine), many PEI residents believe that heavy pesticide use on the island's potato farms is causing high rates of cancer and other diseases.[1]

   [Recall that all knowledge is uncertain, proof is impossible, and thus this common line of criticism is invalid (be it of naivete or intentional political propaganda. Thus these untestable and thus unscientific 'assertions' may be rejected without further consideration]

2. Labchuk points out that because PEI is densely populated—the most densely-populated province in Canada, by far—the potato fields are interspersed among the homes, hospitals, daycares and schools, which means that people are constantly within range of the sprays [True: PEI has no provincial land-use policy]. *But experts disagree on whether this chemical exposure has resulted in unusually high cancer rates on the island* [italics mine].[2]

   [These 'experts' represent the grave danger of subjectivism,[3] authoritarianism,[4] totalitarianism, and the manufacture of consent), and may also be rejected as unscientific.][5]

3. Dr. Ron Matsusaki, emergency room physician at Western Hospital in Alberton, says that in all the years he's worked as a doctor both in Canada and the U.S., he hasn't seen cancer rates that come even remotely close to what he's seeing in the West Prince area of PEI. He says he has no doubt that these cancers are caused by "an insane amount" of chemical pesticides. Every second household in Mimnegash, a fishing village in West Prince surrounded by potato fields, has been afflicted with cancer, according to Matsusaki. "West Prince is a laboratory for rare and aggressive cancers. It's not uncommon to find people who have up to ten family members with cancer, that's how crazy it is here." West Prince resident Noralee Harper believes her five year-old-son contracted B cell lymphoma when her family lived next to a potato field. She's convinced the chemicals seeped into the well the family used, adding that there are no government regulations in place for testing pesticide levels in the island's drinking water. Though her son is in remission now, she says she's lucky because she knows families who have lost more than one child to cancer. "With each month that goes by, we hear of somebody new we that know personally who's been diagnosed with cancer. It's like the common cold, like a natural part of life. Living here, we worry non-stop, it's a daily concern." The only doctor to speak out about the link between pesticides and high cancer rates on the island, Matsusaki says that although he has received a letter of acknowledgement from the Canadian Medical Association, many of his colleagues in the medical profession as well as the Mayor of Mimnegash are "in denial" about the severity of the situation. He believes non-Hodgekins lymphoma is the most common cancer in West Prince, followed a close second by renal cell cancer, a particularly aggressive cancer that doesn't present symptoms until it's in the latter stages. PEI Health Minister Chester Gillan said in January that he's willing to look at research backing Matsusaki's claims, and *if he receives scientific proof*

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1 Delaney 2006, p 1

2 Ibid

3 Popper , pp xxxi-xxxii. Also see Sokal 1996b, pp 126-129 ; Chomsky 1997.

4 A lot of the blame for this state of affairs rests, I think, with the scientists. The teaching of mathematics and science *is* often authoritarian; and this is antithetical not only to the principles of radical/democratic pedagogy but to the principles of science itself. No wonder most Americans can't distinguish between science and pseudoscience: their science teachers have never given them any rational grounds for doing so. (Ask an average undergraduate: Is matter composed of atoms? Yes. Why do you think so? The reader can fill in the response.) Is it then any surprise that 36% of Americans believe in telepathy, and that 47% believe in the creation account of Genesis? (1996c, pp 8-9).

5 Popper 1945 ; Herman & Chomsky 1988 ; Sokal 1996 ; Fuller 2000 ; Stiglitz 2001, p 474 ; Shaw 1903, lns 5-11.

that pesticides are poisoning PEI residents he'll act swiftly to ban the offending chemicals [italics mine].[1]

[Again, scientific proof (certainty) is, and forever will be, impossible to establish. This invalid logic may stem from the time-inconsistent incentives faced by politicians. In other words,

(1) the successful politician owes his power to the fact that he moves within the accepted framework of thought, that he thinks and talks conventionally. It would be almost a contradiction in terms for a politician to be a leader in the field of ideas. His task in a democracy is to find out what the opinions held by the largest number are, not to give currency to new opinions which may become the majority view in some distant future;[2]

(2) politicians do not find any attractions in a view which does not lend itself to party declamation, and ordinary mortals prefer views which attribute misfortune to the machinations of their enemies. Consequently people fight for and against quite irrelevant measures, while the few who have a rational opinion are not listened to because they do not minister to any one's passions.[3]

The points regarding notions of 'proof' and 'proving' theoretical propositions are extremely important, and once grasped, may serve as valuable problem solving tools themselves, especially in in light of our scholarly duty to, like Pyrrho[4] always be on the look-out and never hesitate to offer our criticism;[5]

For example, several years ago, our present author reviewed *Hollywood Economics: How Extreme Uncertainty Shapes the Film Industry*,[6] and although the complex arguments and quantum mathematics appeared vaguely sound, there was sufficient smoke (displayed ignorance of *The Problem of Induction*, hubris, and authoritarian assertions[7]) to suspect fire an warrant a thorough, critical investigation:

It would have been hard to imagine at the outset that by applying *high-brow* mathematical and statistical

1 See Delaney 2006, p 1

2 Hayek 1982

3 Russell 1928, p 3

4 Sceptic: A seeker of truth. One who, like Pyrrho and his followers in Greek antiquity… holds that there are no adequate grounds for certainty as to the truth of any proposition… Those who deny the competence of reason, or the existence of a justification for certitude, outside the limits of experience. The difference between the two usages becomes clearer when considering 'sceptic's' Latin origin (scepticus): inquiring, reflective, assumed by the disciples of Phyrrho as their distinctive epithet…to look out (Oxford English Dictionary 1997).

5 If our civilization is to survive, we must break with the habit of deference to great men. Great men may make great mistakes…Their influence, too rarely challenged, continues to mislead those on whose defence civilization depends, and to divide them. The responsibility for this tragic and possibly fatal division becomes ours if we hesitate to be outspoken in our criticism of what admittedly is a part of our intellectual heritage. By our reluctance to criticize some of it, we may help to destroy all of it (Popper 1945, preface).

6 De Vany 2004

7 Under the influence of passing moods, our critics may have fumbled towards conclusions. They may have acted from impulse and prejudice, and used their status to ennoble their hunches. They may have built up their thoughts like inebriated amateur potters. Unfortunately, unlike pottery, it is initially extremely hard to tell a good product of thought from a poor one. It isn't difficult to identify the pot made by the inebriated craftsman and the one by the sober colleague… *A bad thought delivered authoritatively, though without evidence of how it was put together, can for a time carry all the weight of a sound one. But we acquire a misplaced respect for others when we concentrate solely on their conclusions–which is why Socrates urged us to dwell on the logic they used to reach them* [italics mine, de Botton 2001, pp 30-31].

science we would end up *proving* Goldman's fundamental truth [all italics mine].[1]

Then, perhaps with a heightened sense of scepticism, a fatally flawed, critical assumption the author had made became apparent and lead to a sound falsification of *Hollywood Economics*' central thesis.[2]

Presently, we will return to the final, sixth stage of the test of our theory:

(VI) As Popper notes, "We… leave it to the competition between theories to eliminate the unusable ones."[3] The previously detailed three-point summary of criticisms directed toward our theory (which represent, to the best of our knowledge, all known criticisms to date) do not forward a single *competing theory*, thus we may tentatively accept our theory as *true*. In other words, if it were reasonable to believe that, for example, island dairy production facilities or Tim Horton's Coffee had been laced with some known carcinogen for the past several decades, then the establishment of causation may be more difficult to *reasonably* determine, but since we have no competing theories, we accept our theory as true and therefore valid.

1 Ibid, p. 28
2 See Funk 2007d
3 1992, p 28

DISCUSSION

We will not make any presumptions regarding the general acceptance of this logical proof, but if readers find the plausibility of the democratic rejection of truth (at the provincial level on Prince Edward Island), and thus passive, acquiescent, and institutionalized self-destruction difficult to entertain, we apologize that the scope of this brief introduction does not facilitate treatment of institutionalized irrational human behaviour. In the meantime, we may consider two relevant conjectures, then view a snapshot of a two-island comparative study:

> (1) It is customary to suppose that the bulk of our beliefs are derived from some rational ground, and that desire is only an occasional disturbing force. The exact opposite of this would be nearer the truth: the great mass of beliefs by which we are supported in our daily life is merely the bodying forth of desire, corrected here and there, at isolated points, by the rude shock of fact. Man is essentially a dreamer, wakened sometimes for a moment by some peculiarly obtrusive element in the outer world, but lapsing again quickly into the happy somnolence of imagination.[1]

> (2) History shows that our theories have been wrong more often than right, resulting in the demise of whole civilizations when we have misinterpreted what is happening to us….
>
> It would be comforting to believe that humans have been prescient enough to understand what is happening to themselves and act accordingly. But… the way the mind understands the external environment—the beliefs humans construct to explain the external world are frequently incorrect, particularly if the changes are creating really novel situations. And clearly, humans have evolved environments radically different from anything that existed before.[2]

Now here's our snapshot, a brief compare and contrast of the independent modus operandi on Iceland with dependent modus operandi on Newfoundland with three outlined points:

> (1) The North Atlantic island communities of Iceland and Newfoundland have much in common. Both are resource-based, export-oriented economies with fish as the major staple… Both are sparsely populated islands of approximately 100,000 km^2, with most of the settlements scattered in small communities along the coast, leaving the interior virtually uninhabited….
>
> There are also fundamental differences. Newfoundland… is one of ten provinces in Canada, whereas Iceland is an independent nation. Newfoundland has experienced high unemployment and low income per capita, while Iceland has enjoyed almost full employment and considerably higher income per capita. *Newfoundland has depended on transfer payments from the federal government for over forty years, with approximately half of the provincial government's revenue coming from federal sources* [the ratio is similar on PEI and this is no coincidence.[3]

1 Russell 1928. Also see Herman & Chomsky 1988

2 North 2007, p 26

3 Institutional factors in the form of direct democracy (via initiatives and referenda) and federal structure (local autonomy) systematically and sizeably raise self-reported individual well-being in a cross-regional econometric analysis. This positive effect can be attributed to political outcomes closer to voters' preferences, as well as to the procedural utility of political participation possibilities. Moreover, the results of previous microeconometric well-being functions for other countries are generally supported. Unemployment has a strongly depressing effect on happiness. A higher income level raises happiness, however, only to a small extent (Frey & Stutzer 2000a, abstract). Also: Benz & Frey (early release).

Newfoundland and Iceland have experienced fundamental differences in history, politics, and religion. *In Newfoundland there have been relatively rigid religious cleavages and class divisions*; Iceland has experienced these… to a much lesser degree…. *Icelanders knew that they came to the island as independent settlers, whereas the immigrants to Newfoundland [and PEI] were beholden to the colonial power to protect them* (Jónsson 1995, p 269-270).

(2) [In Newfoundland], in 1949, after two referendums, a slim majority agreed to Confederation with Canada. Confederation, with its promise of a vastly improved standard of living as a result of Canadian social welfare programs and lower prices, gained its greatest support in rural areas, where incomes were lowest.

Confederation confirmed both the hopes of its advocates and the fears of its opponents. *Its immediate impact was to increase personal disposable income and consumer spending through social welfare programs, the most important of which were family allowance and unemployment insurance*.

Joseph Smallwood became the first premier of the province and held his position until his electoral defeat in 1972. Smallwood defended Confederation, first and foremost, *on the basis of the transfers it would bring about to families….*

In 1954 the Newfoundland Department of Welfare began a program which assisted people in isolated communities to move to larger communities…. it continued until 1975.

In the early 1950's… Smallwood launched a massive program of industrialization. The purpose of the program was both to create economic growth and to reduce the level of dependency on the fisheries. This program of industrialization largely failed to create the income and jobs expected, and the provincial government had to inject massive funds to keep alive the new enterprises.

Smallwood showed little faith in the fisheries and did not appear to have seen the tremendous potential provided by the offshore grounds of Newfoundland (Ibid, p 279-280).

Recall that this discourse has suggested that, in light of difficulties associated with whole-systems complexity, the study of islands may be primary, paramount, perhaps even utterly necessary for human survival; that islands may serve us well as lighthouses, as socio-economic and ecological models far more representative and descriptive than mathematical models; that island-based analysis enables us to break through myths, and grasp global complexity and uncertainty that is beyond our reach.

The three points above which summarize the essence of this discourse do not merely tell the tragic tale of *The problem of Sustainable Economic Development on Newfoundland*.

Therefore, it is true that cancer rates on Prince Edward Island have increased significantly as a result of a significant increase of chlorothalonil applications.

We do not, however, follow the misguided assertion that we must attempt to ascribe a probability to the truth or validity of our theory in order to attempt to justify our conclusion. It is simple true, and we may offer no more nor more less, because

> the question whether inductive inferences are justified, or under what conditions, is known as *The Problem of Induction* [italics and capitalization mine].[1] The problem of induction may also be formulated as the question of the validity or the truth of universal statements which are based on experience, such as the hypotheses and theoretical systems of the empirical sciences….
>
> Scientific statements can only attain continuous degrees of probability whose unattainable upper and lower limits are truth and falsity'.[2]
>
> At this stage I can disregard the fact that the believers in inductive logic entertain an idea of probability that I shall later reject as highly unsuitable for their own purposes. I can do so because the difficulties mentioned are not even touched by an appeal to probability. For if a certain degree of probability is to be assigned to statements based on inductive inference, then this will have to be justified by invoking a new principle of induction, appropriately modified. And this new principle in its turn will have to be justified, and so on.
>
> Nothing is gained, moreover, if the principle of induction, in its turn, is taken not as 'true' but only as 'probable'. In short, like every other form of inductive logic, the logic of probable inference, or 'probability logic', leads… to an infinite regress.[3]

This rejection of inductive methods represents the essence of Popper's monumental solution[4] to Hume's *Problem of Induction*.[5] "There is dangerous innocence in the expectation of a future formed on the basis of probability. Any accident to which a human has been subject, however rare, however distant in time, is a possibility

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1 THE PROBLEM OF INDUCTION
According to a widely accepted view… the empirical sciences can be characterized by the fact that they use 'inductive methods', as they are called. According to this view, the logic of scientific discovery would be identical with inductive logic, i. e. with the logical analysis of these inductive methods. It is usual to call an inference 'inductive' if it passes from singular statements (sometimes also called 'particular' statements), such as accounts of the results of observations or experiments, to universal statements, such as hypotheses or theories. Now it is far from obvious, from a logical point of view, that we are justified in inferring universal statements from singular ones, no matter how numerous; for any conclusion drawn in this way may always turn out to be false: no matter how many instances of white swans we may have observed, this does not justify the conclusion that all swans are white (Popper 1959, pp 3-4).

2 Reichenbach 1930, p 186

3 Popper 1959, pp 31-35

4 See Popper 1959

5 See Hume 1739

we must ready ourselves for."[1] Furthermore, this illumination on the deficiencies of probability theory also captures the essence of Cournot's earlier (1838) insight: economics and the social sciences at large have been erected upon a false and sandy foundation. And, although Cournot's and Popper's (and Russells and Reichenbach's and Hayek's and Taleb's, etc.) realization does find its way to the meek and the few, it generally does not find its way to the mighty nor the many, as it does not serve authoritarian institutional interests. And this problem is ancient: Einstein and Popper have both proposed it is borne of an innate yearning for certainty which began with the philosophy of Plato.[2] But Cournot's realization did find its way to an author, hedge fund manager, and professor of Uncertainty Science at NYU:

> I am now convinced that, perhaps, most of econometrics could be useless—much of what financial statisticians know would not be worth knowing. For a sum of zeros, even repeated a billion times, remains zero; likewise an accumulation of research and gains in complexity will lead to naught if there is no firm ground beneath it.[3]

Funk 2007a;c;d;e examined *The Problem of Induction* in greater detail, but we will illuminate and contextualize this important matter by illustrating the plague of pseudo-scientific inductive inferences by briefly returning to Newfoundland. Kurlansky chronicles the Canadian governments religious faith in one of Britain's most authoritarian *and influential* (and thus, inherently dangerous) scientists in Huxley, and, furthermore, the modeling of their fisheries policies on Huxley's authoritarian, inductive logic to the very bitter end: the collapse of the great Newfoundland cod fishery.

> At the 1883 International Fisheries Exhibition in London, which was attended by most of the great fishing nations of the world, Huxley delivered an address explaining why overfishing was an unscientific and erroneous fear: "Any tendency to over-fishing will meet with its natural check in the diminution of the supply,… this check will always come into operation long before anything like permanent exhaustion has occurred."….
>
> For the next 100 years, Huxley's influence would be reflected in Canadian government policy. An 1885 report by L.Z. Joncas in the Canadian Ministry of Agriculture stated:
>
> > The question here arises: Would not the Canadian fisheries soon be exhausted if they were worked on much larger scale and would it be wise to sink a larger amount of capital in their improvement?…. As to those fishes which, like cod, mackerel, herring, etc. are the most

1 De Botton 2001, p 90
2 Popper 1945
3 Taleb, 2001, p 114. Also see Taleb 2007

> important of our sea fishes, which form the largest quota of our fish exports and are generally called commercial fishes—with going so far as to pretend that protection would be useless to them —I say it is impossible, not merely to exhaust them, but even noticeably to lessen their number… *For the last three hundred years fishing has gone on in the Gulf of St. Lawrence and along the coast of our Maritime Provinces, and although enormous quantities of fish have been caught, there are no indications of exhaustion* [italics mine] (pp 121-123).

We trust now that it *is far from obvious, from a logical point of view, that we are justified in inferring universal statements from singular ones, no matter how numerous; for any conclusion drawn in this way may always turn out to be false: no matter how many instances of cod we may have observed, this does not justify the conclusion that cod is inexhaustible.*[1] Every inductive inference is inextricably embedded with unquantifiable uncertainty illustrated by this inductive disaster.

Two subsequent opportunities for *correction of error*:

> Only a decade after reassuring the Canadians and the world that the waters around Great Britain "show no sign of exhaustion," such a thing being scientifically impossible, the British discovered that the cod stocks in the North Sea had been depleted (p 144).

Returning to the problem of breathing, eating, and drinking poison on Prince Edward Island: Extending this research and/or building upon the arguments herewith merely yields diminishing margins of return: again, our theory is true. We may, however, always seek further confirmation (and refutation). If our problem solving interests extend beyond scientific inquiry and into Darwin's *Struggle for Life* (a natural extension, as noted in the introduction), the next step to consider would, naturally, entail developing the arguments herewith into a legal motion, and filing a class-action law suit (naming Syngenta—the manufacturer of chlorothalonil—the Provincial Government of Prince Edward Island, and, perhaps, the Federal government). Although it could be argued that this marks a line of demarcation from the realm of so-called 'scientific method', the methods for a legal case of such magnitude (possibly several hundred million $CAD?), would be under such scrutiny, and in the hands of what must by definition *not* be scientific theorists (a jury), that our conclusion must yield truth beyond the slightest (and most liberal) shadow of a doubt. In this case, we could seek data which detail per-capita cancer instances by postal code, then plot this data (on a per capita basis) upon a map of Prince Edward Island. It may also prove fruitful to

1 Popper 1959, Chapter 1

compare this map to an existing map: The provincial land-use map which details potato production. We could also go into the field and collect primary empirical data by sampling and testing well water (island-wide, of course) as thoroughly as time, money, and reason permit. And naturally, you may wish to gather evidence in the form of testimony from the likes of two individuals noted in this paper: former PEI physician Dr Ron Matsusaki and U.S. senior toxicologist Dr Timothy F. McMahon.

Yet always bear in mind mind, despite the assertions of Professors De Vany, Chinneck,[1] and many others, even the most convincing, seemingly unquestionable evidence could never prove nor disprove our theory. We sought only truth and we found it.

1 1988, p 2

FUTURE RESEARCH

Many assert research is incomplete without the inclusion of (1) a review of literature pertaining to your problem, attempted solutions, and competing theories and (2) a proposal for future research. Both assertions are false. Your sole task is to test a theory and make a *contribution to knowledge*. Everything else is gravy (though potentially helpful, possibly excess fat). Remember, there is no method. We suggest an Appendix[1] may be a more suitable (read: optional) venue for a literature review (thus, see APPENDIX A: LITERATURE REVIEW). Again, however, there is no method, the choice is yours, and it will vary according to the nature of your problem, proposed solution, and your audience. And, as noted in our introduction, structural requirements from various audiences (journals, academic departments, judges and juries, governments, the SEC, NGO's, etc.) may state explicit structural requirements which are quite independent of the philosophy of science (and also independent of your independent decision to adopt or reject any or all of such so-called 'requirements'). The highly formalized nature and mal-aligned equity stakes of peer-reviewed journals (only a small handful of journals are edited by individuals whom hold equity in the journal), however, is largely counter-productive. Bruno S. Frey[2] surveys this problem in his 2002 *Publishing as Prostitution? Choosing Between One's Own Ideas and Academic Failure:*

> Even among extremely successful economists, crowned by the Nobel Prize, there are some who harshly criticize the existing journal publication system. Examples are Leontief 1971, Coase 1994 or Buchanan 2000; see more generally Leijonhuvfud 1973 and Cassidy 1996.[3]

In fact, the insights, clarity, and unhindered accessibility of Frey's working papers serve as a great testament to his credibility on this issue. And, to this point, he draws our attention to a fortunate reversal in the counter-

1 In the *Principles*, Marshall [1890] confined his use of diagrams and other mathematical notations to footnotes and appendixes so as not to allow his mathematics to detract from his economics. He was interested above all in plain communication—with businessmen as well as with students. Moreover, he was acutely aware that over reliance on mathematics "might lead us astray in pursuit of intellectual toys, imaginary problems not conforming to the conditions of real life: and, further, might distort our sense of proportion by causing us to neglect factors that could not easily be worked up in the mathematic machine" [Pigou, Memorials, p. 84] (Ekelund, p 341).

2 I believe I have some experience and competence in this area. I have published more than 250 papers in over 140 refereed journals during the period 1965–2002. Among them are leading economics journals such as AER, JPE, RES, REcsStats, EJ, JEcLit and JecPersp., but also in political science (e.g. APSR), psychology, law and sociology journals. I have also tried the alternatives to journal publications by writing 16 books and by being a columnist for a leading weekly newspaper. I have served as one of the two (and later three) managing editors of *Kyklos* since 1970, am a member of the board of editors of 23 journals and over the years have served as referee for numerous journals (Frey 2002, p 6).

3 Frey, 2002 p 15. Also see Sokal 1996 a,b,c,d ; Chomsky 1997

productive nature of peer-review journals:

> The advent of wide spread internet publishing reduces the stifling impact of the refereeing process on the papers accepted and submitted to journals. Economics scholars are less bound to devote a large part of their time and effort on formalisms. They have more leeway to concentrate on matters of content. This greater freedom also improves the chances that the advice and suggestions proposed by economic methodologists are put into practice, provided they are of practical use for research. The dominance of orthodoxy is reduced.[1]

This critical point, however, is merely to mark the distinction between scientific method and the structural requirements of various audiences. Even at the PhD dissertation level, however, the sole requirement is the defense of *your contribution to knowledge*. Many formalisms, such as the irrational nature of word and page-count requirements and or restrictions,[2] are counter-productive:

> Most non-economists—as well as an increasing number of economists—would whole-heartedly agree that the economics literature has become arcane and inaccessible, especially so far as the 'serious' (i.e. refereed) and most prestigious journals are concerned. This is only partly due to a specialized language (other social sciences also use jargon). More important is the fact that economists have a high degree of consensus about what constitutes high academic quality. 'Good' economics is considered to be abstract and model oriented. This automatically gives a premium to formal mathematical work. Empirical relevance is of secondary importance….; real-life problems are not the centre of concern of most economists who publish in the leading journals.
>
> One of the unfortunate results of this definition of 'good' economics is that outsiders find it difficult to understand why a particular problem is treated, and if so, why such a high level of formalism is used (Frey & Serna 1995, pp 343-344).

And thus, should we become lured into this brothel of peer-reviewed journals, we ultimately fail to accomplish what we had set out to do: *solve problems*. Instead, *we create more problems*:[3]

> the ordinary citizen is struck dumb with awe when he is told about gold reserves, note issues, inflation, deflation, reflation, and all the rest of the jargon. He feels that anyone who can converse glibly about such matters must be very wise, and he does not dare to question what he is told.[4]

Let's consider John Nash's 27 page PhD dissertation,[5] successfully defended in the department of

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1 Frey 2000 p 9

2 Funk 2007e

3 And, in the process, realize the Kuhnian dream: see APPENDIX A.

4 (a) Russell 1956, p 61
(b) My father, who was an unflagging though friendly critic, once told me that I would never again write so good a book as this my first one because, as I grew older and wiser, I would "know too much" and the books would inevitably be harder to read (Mead 1928, preface). Also:
(c) There are, so Montaigne implied, no legitimate reasons why books in the humanities should be difficult…; wisdom does not require a specialized vocabulary or syntax, nor does an audience benefit from being wearied….Every work presents us with a choice of whether to judge the author inept for not being clear, or ourselves stupid for not grasping what is going on. Montaigne encouraged us to blame the author. (de Botton 2001, p 158).

5 Nash 1950. Refer to Nash 1951 for a more legible reprint of 1950.

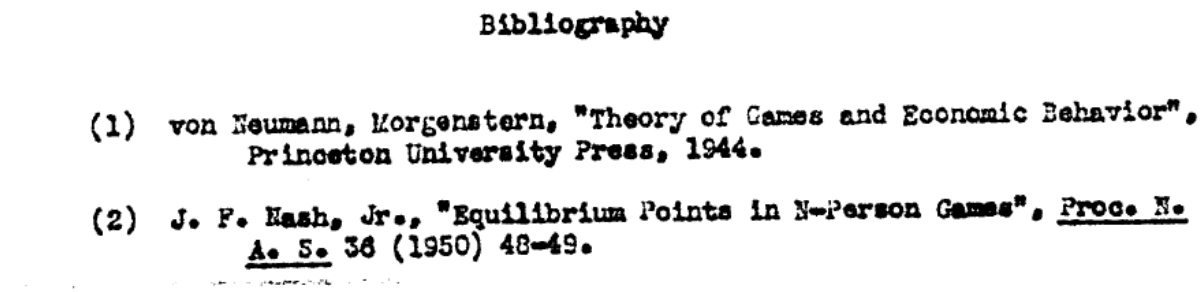
philosophy at Princeton, the dissertation which was attributed as the contribution to economics which merited Nash's 1994 Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel. As previously noted, many will insists research presentations must begin with a review of literature. The full extent of Nash's literature review begins and ends in the first paragraph of page 1:

Introduction

Von Neumann and Morgenstern have developed a very fruitful theory of two-person zero-sum games in their book Theory of Games and Economic Behavior. This book also contains a theory of n-person games of a type which we would call cooperative. This theory is based on an analysis of the interrelationships of the various coalitions which can be formed by the players of the game.

Our theory, in contradistinction, is based on the absence of coalitions in that it is assumed that each participant acts independently, without collaboration or communication with any of the others.

Indeed, Neumann & Morgenstern (1944) was one of the only two references listed in his Bibliography on page 27. The other reference, we note, was to his own prior work:



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(1) von Neumann, Morgenstern, "Theory of Games and Economic Behavior", Princeton University Press, 1944.

(2) J. F. Nash, Jr., "Equilibrium Points in N-Person Games", Proc. N. A. S. 36 (1950) 48-49.

We may note two additional observations: Nash did not suggest future research, and, despite Purdue University Professor Anon's[1] assertion that dissertations may not be written in the 'We'-imperial 'voice' (the stylistic manner in which this paper has been authored, for example), Nash disregarded this common, arbitrary formalism as well.

An argument could also be advanced suggesting that both literature reviews and suggested research may inject bias, but, again, there is no method: if either or both of the aforementioned constitute an aspect of your contribution to knowledge, then so be it.

This introduction to the problem solving methods has, by design, presented a single-sided (Karl Popper's) introduction, but we will shortly serve due notice to a highly influential approach to the philosophy of science which is antithetical to much of the philosophy and methods presented herewith; it is arguably also more popular. Before doing so, however, we will back-up and address a question readers may be pondering…

Who was Karl Popper?

> Karl Popper is generally regarded as one of the greatest philosophers of science of the 20th century. He was also a social and political philosopher of considerable stature, a self-professed 'critical-rationalist', a dedicated opponent of all forms of scepticism, conventionalism, and relativism in science and in human affairs generally, a committed advocate and staunch defender of the 'Open Society', and an implacable

1 1999, p 7

> critic of totalitarianism in all of its forms. One of the many remarkable features of Popper's thought is the scope of his intellectual influence. In the modern technological and highly-specialized world scientists are rarely aware of the work of philosophers; it is virtually unprecedented to find them queuing up, as they have done in Popper's case, to testify to the enormously practical beneficial impact which that philosophical work has had upon their own.[1]

Perhaps some readers may also inquire, "If Popper was one of the greatest philosophers of science of the 20th century, then why haven't we heard of him or read his work?"

This is an interesting and relatively common question amongst philosophy scholars. Some have suggested it is because he never held a chair at Oxford or Cambridge. Others have noted that

> in intellectual circles Popper was very much admired. But because *The Open Society and Its Enemies* was hostile to so much academic pretension it was treated less than respectfully by those in the various specialties upon whose turf it trod (Jarvie & Pralong 1999, p 6).

Indeed, many very prominent and influential academics, such as Leo Strauss,[2] condemned and actively lobbied against Popper and his philosophy.

However, far more, and arguably far greater intellectuals (at least the kind of intellectuals whom are awarded Nobel prizes)[3] have, as Zalta noted above, lined up to praise and attest to his methods. As F.A. von Hayek remarked near the end of his 1974 Nobel Lecture, *The Pretence of Knowledge*:

> It is often difficult enough for the expert, and certainly in many instances impossible for the layman, to distinguish between legitimate and illegitimate claims advanced in the name of science.... If we are to safeguard the reputation of science, and to prevent the arrogation of knowledge based on a superficial similarity of procedure with that of the physical sciences, much effort will have to be directed toward debunking such arrogations, some of which have by now become the vested interests of established university departments. *We cannot be grateful enough to such modern philosophers of science as Sir Karl Popper for giving us a test by which we can distinguish between what we may accept as scientific and what not - a test which I am sure some doctrines now widely accepted as scientific would not pass.*

1 Zalta 2006, p 1
2 Steinberg 2003 ; Shultz 2007
3 See Popper 1959

For readers with interest in an alternative, yet sound and complimentary 20-page introduction to scientific method, we suggest *The Myth of 'Scientific Method' in Contemporary Educational Research* (Rowbottom & Aiston 2006):

> The Latin word *scientia*, from which our word 'science' comes, originally meant nothing more than 'systematic knowledge of the true causes of particular things' (Smith, 1997, p. 16), as opposed to the revealed knowledge that came from religion. It did not mean what we have come to designate in the 20th century as the 'natural sciences' (ibid.). It was in the 16th and 17th centuries, in what is usually called the Era of Scientific Revolutions, that 'science' began to acquire its modern connotations of empiricism and experimentalism. Thus conceived, 'science' began to seem, because of its spectacular successes, the only game in town, which is why the social sciences came to be so called and why, riding on the prestige of experimental science, some people talk of management science, political science and even the science of literary criticism. They do things differently elsewhere. The German language, for example, does not speak of the social sciences but of the *Geisteswissenschaften*, sometimes translated as the 'humanities' or the 'humanistic study of culture' (literally it means the ways of knowing the human mind or spirit, *Geist*), and distinguishes the *Geisteswissenschaften* from the *Naturwissenschaften* or ways of knowing the natural world. Continental Europe is more hospitable to theory than the Anglophone countries. It is a sobering thought that the influence of the scientific paradigm may be largely an accident of history and of the English language.
>
> Behind the 'what works' dogma there seem to lurk not only the idea that 'science' supplies the model to which all claims to knowledge should aspire, but fantasies and misconceptions concerning science itself. Sarah Aiston and Darrell Rowbottom… [noted above] examine these misconceptions, and analyse the false contrasts often drawn between 'scientific' and 'non-scientific' approaches. They see here the origins of the idea that educational research is centrally a matter of employing particular methods, an idea they find prevalent in standard research methods textbooks.[1]

For those who may hold deeper interests yet, please proceed:

As previously noted, Popper has had many critics, some of which have been the most influential academics of the twentieth century. The most notable (and perhaps most influential) amongst these critics was Leo Strauss:

> In 1950, Popper went to Harvard to deliver the prestigious William James lectures. During his time in the States he appears to have given a talk at the University of Chicago, where Strauss taught. Strauss told Voegelin that the talk "was very bad," "the most washed-out, lifeless positivism" (Emberly and Cooper 1993: 67), and inquired of his opinion of Popper. Voegelin replied with a vicious letter. He reports having reluctantly read Popper because so many people insist his Open Society is a masterpiece. His judgement is that the book is "impudent, dilettantish crap. Every single sentence is a scandal . . ." (ibid.). Noting that Popper takes the concept of open society from Bergson, he comments that Bergson did not develop it "for the sole purpose that the coffeehouse scum might have some-thing to botch." Voegelin believed that Bergson would have thought that "Popper's idea of the open society is ideological rubbish" (ibid.). Voegelin is only just getting started. He accuses Popper of "impertinent disregard for the achievements in this particular problem area [the history of political thought]" (Emberly and Cooper 1993: 68) and of being

1 Bridges & Smith 2006, pp 132-133

> unable to reproduce accurately the ideas of Plato and Hegel. Popper is "a primitive ideological brawler." Voegelin then strings more epithets together, "a failed intellectual," "rascally impertinent, loutish; in terms of technical competence as a piece in the history of thought, it is dilettantish, and as a result is worthless" (Emberley and Cooper 1993: 67). The reader astonished at this undignified diatribe needs to remember that in the book in question Popper is vehement about the duty to think for oneself and not to defer to the authority of experts. Strauss and Voegelin agree on the opposite, and on the duty of the enlightened elite to defend standards. Strauss had said he was willing to keep Voegelin's remarks to himself. Voegelin concludes: "It would not be suitable to show this letter to the unqualified. Where it concerns its factual contents, I would see it as a violation of the vocational duty you identified, to support this scandal through silence" (Emberly and Cooper 1993: 69). Following this invitation, Strauss showed the letter to Kurt Riezler, "who was thereby encouraged to throw his not inconsiderable influence into the balance against Popper's probable appointment here [in the US]. You thereby helped to prevent a scandal." With hindsight one might think that the scandal is that someone who had dared to challenge the traditional Germanic learning, the worship of the great men, the enemies of science and Enlightenment, is not met out in the open with argument, but is disposed of behind the scenes, as quietly as possible, by the self-righteous use of power.
>
> Not all readers, we trust, will value Strauss' position or lend considerable weight to his criticism. Indeed,

some readers, perhaps, may, in light of *Strauss' positions, influences, protoge's*, and *associates*, suspect that Popper's philosophy may indeed hold the *Constitution of Liberty,*[1] and perhaps even a tentative solution to perhaps the greatest and gravest problem facing humankind, the solution to Popper's first manifesto,[2] namely an attack on enemies of the Open Society:

> In a June 17, 1996 article by Richard Lacayo, *Time* magazine named the late University of Chicago philosopher Leo Strauss (1899-1973) as one of the most influential and powerful figures in Washington, D.C.—the man most responsible for the Newt Gingrich "Conservative Revolution" on Capitol Hill, and the intellectual godfather of [Gingrich's] "Contract on America".
>
> If Strauss' influence on politics in the capital of the most powerful nation on Earth was awesome in 1996, it is even more so today. The leading "Straussian" in the Bush Administration is Deputy Defense Secretary Paul Wolfowitz, who was trained by Strauss' alter-ego and fellow University of Chicago professor Allan Bloom. Wolfowitz leads the "war party" within the civilian bureaucracy at the Pentagon, and his own protégé, I. Lewis "Scooter" Libby, is Vice President Dick Cheney's chief of staff and chief national security aide, directing a super-hawkish "shadow national security council" out of the Old Executive Office Building, adjacent to the White House. According to Bloom biographer Saul Bellow, the day that President George H.W. Bush rejected Wolfowitz and Cheney's demand that U.S. troops continue on to Baghdad, during Operation Desert Storm in 1991, Wolfowitz called Bloom on his private phone line to bitterly complain. It seems that "Bush 41" was not enough of a Nietzschean "superman" for Wolfowitz's taste....
>
> On March 3, in a widely circulated radio interview on the Jack Stockwell Show in Salt Lake City (see EIR, March 14), Lyndon LaRouche had singled out Strauss as one of the leading intellectual figures... steering the United States into a disastrous replay of the Peloponnesian War, which led to the collapse of Athens. Within days of the LaRouche interview, Leo Strauss was the subject of a series of public attacks, in the German, French and American media... for his role in producing the current generation of neo-

1 See Hayek 1960

2 1945

conservatives.

> Indeed, author Shadia B. Drury, in her 1997 book, *Leo Strauss and the American Right*, named the following prominent Washington players as among Strauss' protégés: Paul Wolfowitz; Supreme Court Justice Clarence Thomas; Judge Robert Bork; [neo-conservative] propagandist and former Dan Quayle chief of staff, William Kristol; former Secretary of Education William Bennett; the National Review publisher William F. Buckley; former Reagan Administration official Alan Keyes; current White House bio-ethics advisor Francis Fukuyama; Attorney General John Ashcroft; and William Galston, former Clinton Administration domestic policy advisor, and co-author, with Elaine Kamark, of the Joe Lieberman-led Democratic Leadership Council's policy blueprint.
>
> Earlier Strauss allies and protégés in launching the post-World War II neo-conservative movement were Irving Kristol, Norman Podhoretz, Samuel Huntington, Seymour Martin Lipset, Daniel Bell, Jeane Kirkpatrick, and James Q. Wilson....
>
> The hallmark of Strauss' approach to philosophy was his hatred of the modern world, his belief in a totalitarian system, run by "philosophers," who rejected all universal principles of natural law, but saw their mission as absolute rulers, who lied and deceived a foolish "populist" mass, and used both religion and politics as a means of disseminating myths that kept the general population in clueless servitude. For Strauss and all of his protégés (Strauss personally had 100 Ph.D. students, and the "Straussians" now dominate most university political science and philosophy departments), the greatest object of hatred was the United States itself (Steinberg 2003).

Indeed, perhaps future generations may thank Leo Strauss for criticizing Popper in the same way we may thank Aristotle for criticizing those brave, anonomous Greek citizens who had the courage to criticize slavery: If it weren't for Aristitle's criticisms, we would have no account that there were significant objections amongst the citizenry to slavery at all.[1]

The second-most dominant line of criticism direct towards Popper: The most heavily cited reference on the philosophy of science in the twentieth century was not a book by Karl Popper. It was a book written by another philosopher of science: *The Structure of Scientific Revolutions* (1962) by Thomas Kuhn. One very favourable aspect of the philosophy of science is that there are two very clear, well-marked, and heavily travelled contemporary points of departure: Kuhn and Popper:

> (1) The Kuhn-Popper debate, strictly speaking, refers to an encounter that took place at the former Bedford College, University of London on 13 July 1965, as part of the International Colloquium in the Philosophy of Science. It was designed to pit a relatively young theorist of science (Kuhn, aged 43) whose 1962 book, *The Structure of Scientific Revolutions*, was touted as the latest word from the United States, against a relatively old theorist of science (Popper, aged 63) whose seminal book, *The Logic of Scientific Discovery*, had been translated into English on in 1959, a quarter-century after it first appeared in German.[2]

1 Popper 1945
2 Fuller 2003, p10

> (2) Kuhn and Popper tapped into long-simmering, deep-rooted disagreements that went well beyond the pages of their major works on science.... Sometimes behind such scholastic fodder that frames philosophical debate lie opponents who are not so different from each other after all.... But sometimes the stereotype, for all its crudeness, *does* [italics Fuller's] capture differences in sensibility that become deeper the more one looks. This is certainly the case with Popper and Kuhn.[1]
>
> (3) The clash between Popper and Kuhn is not about a mere technical point in epistemology. It concerns our central intellectual values, and has implications not only for theoretical physics but also for the underdeveloped social sciences and even moral and political philosophy.[2]

This author's very brief assessment of the Kuhnian revolution is as follows: Kuhn wrote an encyclopaedia article on the philosophy of science which was ultimately published as Kuhn (1962). In this article, Kuhn detailed the dominant institutional (authoritarian academic and government institutions) phenomena in scientific research: feedback loops and herding behaviour (which he famously termed *paradigm*). This observation was in-part (1) misconstrued as a blueprint for *the* method of science, and (2) adopted as *the* method of science for and by the authoritarian institutions whom benefited most from its adoption: the dominant academic institutions and the dominant cold-war era United States. Indeed, U.S. political and U.S. academic institutional credibility and dominance were near an all-time highs; a very strong argument may, afterall, be tabled that the Manhattan project, borne out of Princeton, had possibly saved the world. The book has indeed been noted as the perennial favourite of politicians: Al Gore has stated that it is his favourite book and George Bush has claimed to have read it as well (though researchers have not found confirmation that Bush has read any books). Indeed, we submit its great appeal to politicians may stem from its position on subjectivism (everything, including truth, is negotiable), relativism, and authoritarianism. Indeed, Popper traces Kuhn's philosophical lineage to Plato:

> The greatest principle of all is that nobody, whether male or female, should be without a leader. Nor should the mind of anybody be habituated to letting him do anything at all on his own initiative ; neither out of zeal, nor even playfully. But in war and in the midst of peace—to his leader he shall direct his eye and follow him faithfully. And even in the smallest matter he should stand under leadership. For example, he should get up, or move, or wash, or take his meals… only if he has been told to do so. In a word, he should teach his soul, by long habit, never to dream of acting independently, and to become utterly incapable of it.[3]

Popper's philosophical lineage, on the other hand, traces back to Plato's teacher, Socrates. Reviewing the

1 Ibid, pp14-15
2 Lakatos 1978, vol 1, p 9
3 Republic, *c.* 360 B.C

literature on this contemporary philosophical debate will invariably lead to philosophers from both schools (Plato left Socrates's school, so to speak, to start a school of his own; Plato's first pupil was Aristotle). These lineages are assembled in Popper (1945).

Although this author is tempted to cite Popper's positions on Kuhn's philosophy, the object of this review is to draw our attention to the fact that an antithetical approach to the method of science exists and that our proposed problem solving technique may be presented in error. Recall that this tenant is central to our method: "We can never excel others in our reasonableness in a way that would establish a claim to authority."[1] You will not discover this acknowledgement of uncertainty in Kuhn (1962). Again, however, we encourage readers to follow their own independent-minded processes of discovery regarding this weighty debate. Fuller (2000) is excellent, but heavily opinionated in Popper's favour. Stanford (2004) provides a more even assessment, and serves as an excellent introduction to Kuhn. Unfortunately, *The Structure of Scientific Revolutions* was Kuhn's only major work, and, not long after the debate cited above, Kuhn stepped out of both the public and academic spotlights and refused to grant interviews. Thus, many open questions pertaining to his philosophy were left to students such as Feyerabend (1975) to answer.

Kuhn's students may or may accurately reflect his philosophy.

Popper, on the other hand, was one of the most prolific philosophers of any century, granted a stream of interviews, and is published in over fifty languages. His complete bibliography lists 1292 entries and is 132 pages long (which we will happily forward upon request).

For an alternative, brief introduction to Popper, consider Anderson (2004). We highly suggest, however, a first-hand encounter:

Perhaps the best first-hand introduction to Popper is *In Search of a Better World* (1992), which could be followed up with its sequel, *All Life is Problem Solving* (1999). These two collections represent a distillation of Popper's opus, assembled during the last decades of his life.

1 Ibid, p 227

Alternatively, Popper's first major work, written while in exile in Australia from the Nazi Germany, *The Open Societies and Its Enemies* (1945). Popper mailed the original manuscript (his only copy!) to his fellow Austrian and close friend, F.A. von Hayek, at the London School of economics. Hayek procured a publisher, then later procured Popper's position at LSE. The topical, contemporary aspect of this great work is that, although it was written during the rise of Nazi Germany as cautionary tale regarding the rise of 'Closed' (totalitarian) Societies, it is very difficult to read this text today without drawing uncanny parallels with post-Eisenhower U.S. foreign policy. *The Open Societies and Its Enemies*' central thesis echoes in Hayek (1944).[1]

Researchers in the natural sciences will be well-served by Popper's magnum opus, *The Logic of Scientific Discovery* (1959), but we would encourage any researcher considering the acceptance of inductive logic to review chapters I (which surveys the problem of induction), II (*On the Problem of a Theory of Scientific Method*), III (*Theories*), and VIII (*Probability*). The original manuscript for this great works has been reported to have been anywhere between 2,000 and 5,000 pages (our present edition is 513), but the extensive Appendices were published as individual volumes which may be of interest to researchers in the natural sciences.

Our final recommendation to consider as secondary and tertiary readings to complement those noted above: *Conjectures and Refutations*:

> The essays and lectures of which this book is composed are variations upon one very simple theme--the thesis that we can learn from our mistakes. They develop a theory of knowledge and of its growth. It is a theory of reason that assigns to rational arguments the modest and yet important role of criticizing our often mistaken attempts to solve our problems…Though it stresses our fallibility it does not resign itself to skepticism, for it also stresses the fact that knowledge can grow, and that science can progress - just because we can learn from our mistakes.[2]

Popper was influenced by members of his peer group, the Vienna Circle, his good friend F.A. von Hayek, and especially by the teachings of Socrates,[3] Democritus, Xenophanes Einstein, Wittingstein, Reichenbach,[4] and,

1 Is there a greater tragedy imaginable than that, in our endeavour consciously to shape our future in accordance with high ideals, we should in fact unwittingly produce the very opposite of what we have been striving? (Hayek 1944, p 4).

2 Popper 1962, p xi

3 I am wiser than this man, for neither of us appears to know anything great and good; but he fancies he knows something, although he knows nothing; whereas I, as I do not know anything, so I do not fancy I do. In this trifling particular, then, I appear to be wiser than he, because I do not fancy I know what I do not know (Socrates 399 BC).

4 Reichenbach 1930 ; 1938 ; 1940 ; 1942 ; 1949

perhaps most significantly, the great logician and founder of analytical philosophy, Bertrand Russell:[1]

> A follower of the Enlightenment speaks as simply as possible: we want to be understood. In this respect Bertrand Russell is our great master.[2]

Many of their writings express analogue and complementary philosophies. For an equalled panorama of the western philosophical landscape upon which these philosophies rest, Russell (1945) is simply without equal, thoroughly enjoyable, and thus very highly recommended.

And with Russell in mind, in hindsight, it seems likely we have not stressed the extraordinary, positively essential role sharp criticism plays in the problem solving process, indeed in the process of the growth of all knowledge. We will offer two closing remarks on this point:

> (1) The results of failure in politeness, however bad from the point of view of social occasion, are admirable from the point of view of dispelling myths. There are two ways in which our natural beliefs are corrected: one the contact with fact, as when we mistake a poisonous fungus for a mushroom and suffer pain in consequence; the other, when our beliefs conflict, not directly with objective fact, but with the opposite beliefs of other men.[3]
>
> (2) It is not only the hostility of others that may prevent us from questioning the status quo. Our will to doubt can be just as powerfully zapped by an internal sense that *societal conventions* [italics mine] must have a sound basis, even if we are not sure exactly what this may be, because they have been adhered to by a great many people for a long time. It seems implausible that our society could be gravely mistaken in its beliefs and at the same time that we would be alone in noticing the fact. We stifle our doubts and follow the flock because we cannot conceive of ourselves as pioneers of hitherto unknown, difficult truths.[4]

And finally, after borrowing these three used, tested, very high-mileage ideas, I might also add that, from an economics perspective, the search for truth, the endeavour to test new theories and new ideas is very costly. Thus, it may prove fruitful, as we have done so throughout this paper, to hang your arguments and build upon as many sound, old, tested ideas as possible:

> Most economists enter this market in new ideas, let me emphasize, in order to obtain ideas and methods for the applications they are making of economics to the thousand problems with which they are occupied: these economists are not the suppliers of new ideas but only demanders. Their problem is comparable to

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1 Uncertainty, in the presence of vivid hopes and fears, is painful, but must be endured if we wish to live without the support of comforting fairy tales. It is not good either to forget the questions philosophy asks, or to persuade ourselves we have found indubitable answers to them. To teach how to live without certainty, and yet without being paralysed by hesitation, is perhaps the chief thing that philosophy, in our age, can do for those who study it (Russell 1945). Also see Russell 1908 ; 1915 ; 1922 ; 1928 ; 1940 ; 1948 ; 1953 ; 1956.

2 Popper 1999, p 206

3 Russell 1928, pp 17-18

4 De Botton 2001, p 13

that of the automobile buyer: to find a reliable vehicle. Indeed, they usually end up by buying a used, and therefore tested, idea. *Those economists who seek to engage in research on the new ideas of the science - to refute or confirm or develop or displace them - are in a sense both buyers and sellers of new ideas. They seek to develop new ideas and persuade the science to accept them, but they also are following clues and promises and explorations in the current or preceding ideas of the science. It is very costly to enter this market: it takes a good deal of time and thought to explore a new idea far enough to discover its promise or its lack of promise.* The history of economics, and I assume of every science, is strewn with costly errors: of ideas, so to speak, that wouldn't run far or carry many passengers [italics mine].[1]

1 Stigler 1982, p 57

APPENDIX B: ~~ISLAND BIOECONOMICS~~ PROBLEM SOLVING

For those readers particularly interested in the peculiarities and nuances of various island-based methods, Baldacchino (2007) is also without equal, marks the best entrance to the world of island, and delivers a first-rate bibliographical review of island studies. We will merely note a few exceptional and foundational works: Darwin (1859), Carlquist (1974), and Wallace (1880). Arnason, Felt, Bartmann, & Cairns (1995) and Baldacchino, Greenwood, MacKinnon, & Bartmann (1998), and Baldacchino, Milne, Bartmann, Srebrnik, Paterson, & Jolliffe, (2000) were the three foundational collections of our Institute of Island Studies and offer very insightful island methods and case studies. The best case studies, however, are likely only to be discovered by *living, studying,* and *problem solving* on islands.

Although we submit islands offer significant opportunities for problem solving, we trust by now, dear reader, that, since subject matters, including the subject matter of 'scientific method', do not exist, 'Island Bioeconomics' does also not exist. Thus, we notate our recognition of the value of modelling various aspects of relative insularity as ~~*Island Bioeconomics*~~ *Problem Solving*:[1]

Islands serve as lighthouses, as *synecdoches,*[2] socio-economic and ecological models far more representative and far more descriptive than mathematical models.[3] Although our island-based methods do employ mathematics, they do so in the *opposite direction*[4] common to 'continental' economic analysis. These methods have been developed and adopted in light of our recognition of two fundamental economic methodological problems: (1)

1 Funk 2007e

2 Islands are synecdoches: their understanding facilitates a 'coming to grips' with a more complex whole. They also act as advance indicators or extreme reproductions of what is future elsewhere. Crucial, new insights into evolutionary theory, and the realization of so much species differentiation on islands in modern zoogeography, are primarily due to the unwitting and haphazard stumbling of what, at first sight, may have appeared to be inconsequential, island-based, island-specific fieldwork. This includes such investigations as the study of Darwin's finches on the Galapagos Islands (Darwin, 1979; Lack, 1947) or Alfred Wallace's study of birds-of-paradise on the Aru Islands (Wallace, 1975)… The forays of Bronislaw Malinowski amongst the Trobriand (or Kiriwina) Islanders of Papua New Guinea (1922), Margaret Mead to Samoa and the Admiralty Islands (1928; 1934) and Raymond Firth to Tikopia (1936) led to the birth of ethnography (Baldacchino 2007b, p 9).

3 Taleb 2001, p 177 ; Menger & Hayek 1871, p 15 ; Maxwell 1873, p 400 ; Pigou, Memorials, p. 84 ; Hayek 1945, pp 519-530 ; Hayek 1945, pp 519-530 ; Stiglitz 2001, p 475 ; Hayek 1956, pp 519-520.

4 Russell 1919, pp1-2 & pp 194–195

economics is a *derivative science*[1] hereto lacking a tenable theory of value,[2] and (2) that applied mathematical models invariably do not represent truth, because integers do not compete for natural resources and sexual selection.

Darwin's powerful and effective *island-based analysis* enabled us to break through *convenient myths,*[3] *attendant myths,*[4] and grasp global complexity and uncertainty that was beyond our reach; using similar methods *Collapse of Easter Island: Lessons for Sustainability of Small Islands*[5] echoes Von Bertallanfy: "The island microcosm can… help to simplify understanding… related to larger and more complex system dynamics."[6] And "although it is often said that the *Origin of Species* convinced people of evolution because it provided an easily-understood mechanism (natural selection) for evolution, the deluge of articles and books published in 1909, 50 years after the origin, show clearly that it was principally the facts of geographical distribution that had convinced the majority."[7]

In other words, Darwin was able to *describe a very large complex, closed system* (earth) by modeling it with *much smaller,*

1 See Russell 1938

2 See Stigler 1982

3 Modern industrial civilization has developed within a certain system of *convenient myths* [italics mine]. The driving force of modern civilization has been individual material gain which is accepted as legitimate, even praiseworthy, on the grounds that private vices yield public benefits in the classic formulation. Now it's long been understood, very well, that a society that is based on this principle will destroy itself in time. It can only persist with whatever suffering and injustice it entails as long as it's possible to pretend that the destructive forces that humans create are limited, that the world is an infinite resource, and that the world is an infinite garbage can. At this stage of history either one of two things is possible. Either the general population will take control of its own destiny and will concern itself with community interests guided by values of solidarity and sympathy and concern for others. Or alternatively, there will be no destiny for anyone to control. In this possibly terminal phase of human existence, democracy and freedom are more than values to be treasured, they may well be essential to survival (Chomsky 1992, Finale).

4 Human events spring from passions, which generate systems of *attendant myths* [italics mine]. A man who has suffered some humiliation invents a theory that he is King of England, and develops all kinds of ingenious explanations of the fact that he is not treated with that respect which his exalted position demands. In this case, his delusion is one with which his neighbours do not sympathize, so they lock him up. But if, instead of asserting only his own greatness, he asserts the greatness of his nation or his class or his creed, he wins hosts of adherents, and becomes a political or religious leader, even if, to the impartial outsider, his views seem just as absurd as those found in asylums. In this way a collective insanity grows up, which follows laws very similar to those of individual insanity. Every one knows that it is dangerous to depute with a lunatic who thinks he is King of England; but as he is isolated, he can be overpowered. When a whole nation shares a delusion, its anger is of the same kind as that of an individual lunatic if its pretensions are disputed, but nothing short of war can compel it to submit to reason (Russell 1928, pp 6-7).

5 Nagarajan 2006

6 Baldacchino, 2007, p 84.

7 Italics mine, Baldacchino, 2007, p 202.

simplified, semi-closed systems (islands).[1] Island processes are amplified through compression[2] and thus, relative to continents, exhibit explosive rates of evolution.[3] *Therefore islands may enable us to model our Earthly future, to observe socio-economic, political, and ecological conditions on islands (of various degrees of insularity) and to model future global implications: The Problem of Breathing, Eating, & Drinking Poison on Prince Edward Island today is the Problem of Breathing, Eating, & Drinking Poison on Earth tomorrow:*

> All across North America rates of cancer, thyroid dysfunction, learning disabilities, birth defects, environmental sensitivity and other debilitating health conditions are unacceptably high. The costs of these trends are crippling for health care systems, social programs and budgets of all levels of government.[4]

~~*Island Bioeconomics*~~ *Problem Solving* is an island-based methodological approach to economics which rests on a foundation of a theory of value based on relative insularity. Although this methodological approach addresses economic inquiries pertaining to any and *all geographical* locales, we submit you may discover this approach addresses the *false and sandy foundations*[5] of economics which are especially vexing to those who inhabit islands.[6]

But if this method accomplishes nothing else, we hope that it will at least truthfully and irrefutably demonstrate that *we are all islanders!*

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1 Compared with continents… [islands] have a restricted area and definite boundaries, and in most cases their biological and geographical boundaries coincide. The number of species and of genera they contain is always much smaller then in the case of continents, and their peculiar species and groups are usually well defined and strictly limited in range… their relations with other lands are often direct and simple and even when they are more complex are far easier to comprehend than those of continents (Wallace 1880, pp 241-242).

2 It appears almost all ecological and evolutionary processes…are amplified on islands; generally speaking, the smaller the island, the more amplified these processes are. Small size and low diversity seem to be the main factors. With populations existing in miniature, they are prone to stochastic, or random, processes…. Such a mosaic of habitats in a tiny area promotes evolutionary radiation. Conversely, the small size of islands means that they are exquisitely vulnerable to biological invasion and disturbance as there are few distance barriers to dispersal, and few areas are immune to disturbance by inaccessibility. On the plus side, 'amplification by compression' makes islands particularly useful…on islands, process that may be subtle on continents tend to be more clearly exposed (Baldacchino 2007b, p 193).

3 *Rapid evolution of island immigrants is not only possible but frequent. Change after arrival is inevitable.*
"Explosive" evolution is demonstrated by various groups that have had good ecological opportunities [italics Carlquist's 1974, p 20].

4 Novaczek 2007, p2. Also see Barry 2005

5 Keynes 1936

6 My first visits to the developing world in 1967, and a more extensive stay in Kenya in 1969, made an indelible impression on me. Models of perfect markets, as badly flawed as they might seem for Europe or America, seemed truly inappropriate for these countries [and/or SIDS, Stiglitz 2001, p 473).

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(1) One of the most salient features of our culture is that there is so much bullshit. Everyone knows this. Each of us contributes his share. But we tend to take the situation for granted. Most people are rather confident of their ability to recognize bullshit and to avoid being taken in by it. So the phenomenon has not aroused much deliberate concern, nor attracted much sustained inquiry. In consequence, we have no clear understanding of what bullshit is, why there is so much of it, or what functions it serves. And we lack a conscientiously developed appreciation of what it means to us. In other words, we have no theory (Frankfurt 2005, p 1).

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Funk, M. (2007a). On the problem of global warming: A solution for william funk, albert gore and richard branson. *IIS* working paper.

Abstract: This paper forwards the conjecture that, contrary to consensus, "*The Problem of Global Warming*," is *not* the anthropogenic superheating of the Earth—because this is clearly not the problem—it is merely a single symptom of far more significant problems, which stem from the *Problem of Induction*. In short, *The Problem of Induction* has generated convenient myths which encourage men to act irrationally. Irrationality spawns and

maintains irrational institutions which manufacture consent, drive irrational conspicuous consumption, and, moreover, foster hyperirrational resource consumption—which is *not* limited to the consumption of superheating fossil fuels. This paper proposes a variety of counter-intuitive, viable solutions, but concludes the problem may be insoluble, as the philosophical and methodological foundations which render dominant irrational agents and institutions unable to recognize the true nature of the problem and/or unwilling to act upon otherwise viable solutions.

Funk, M. (2007b). On the problem of global warming II: a brief history of a new & unpopular theory in an open letter to john gillis & ragnar arnason. *IIS* working paper.

Abstract**:** This paper traces the history, evolution, and development of this new and unpopular theory.

Funk, M. (2007c). On the problem of dependent people: natural resource valuation errors in atlantic canadian Island Jurisdictions. *IIS* working paper.

Abstract: Prince Edward Island's Economics, Statistics and Federal Fiscal Relations Division's *33rd Annual Statistical Review* theorized (reported) the total value of 2006 fish landings was CAD 166.6 MM. This paper refutes this conjecture: The total value of fish landings for 2006 was approximately CAD 416.5 MM. Furthermore, this paper submits this error has been consistently generated for all 33 years that the *Annual Statistical Review* has been published. Moreover, this entrenched, systemic error has promoted far more significant problems: a ripple-effect of bias throughout all relative natural resource valuations and destructive land-use policies. These *significant problems* include (1) *The Problem of Continental Economics* and (2) *The Problem of Dependent People*. ~~*Island Bioeconomic*~~ *Problem Solving* comparitive models propose tentative solutions by contrasting fishery management methodology and practice amongst dependent Canadian islanders with the fishery management methodology and practices amongst independent Icelandic islanders. In conclusion, the possibilities that independent people enjoy higher levels of rationality, efficiency, happiness, economic sustainability, general well-being, and are thus, ceteris paribus, less likely to commit errors associated with *The Problem of Induction* are discussed. Likewise, this paper suggests dependent people are more likely to exhibit irrational behaviour, develop deeper dependencies, and to contribute to a wide-array of systemic errors, such as those which exacerbate *The Problem of Global Warming*.

Funk, M. (2007d). On the problem of hollywood economics: de vany's error—george lucas knows something. *IIS* working paper.

Abstract: Hayek (1991) lamented the difficulty in distinguishing between economics and excrement, and Hemingway (1958) noted "The most essential gift for a good writer is a built-in, shock-proof, bullshit detector." In this spirit and within the context of Frankfurt's (2004) *Theory of Bullshit*, this paper constructs a bullshit detector for economics. This apparatus is carefully calibrated to detect the Seven Deadly Sins of 'Hollywood Economics': Hubris, Intellectual Dishonesty, Greed, Mathematical Mania, Physics Fetishes, Conditions of Emptiness, and Sunspots. We trace the philosophical and methodological origin of these traits to its source, *The Problem of Induction*, then illustrate with examples from Plato to the present, including detailed analysis from the illuminating cases of Long Term Capital Management and William Stanley Jevons' sunspot theory. Furthermore, we demonstrate the contemporary effectiveness of this apparatus by detecting hereto undetected economic bullshit, namely Arthur de Vany's (2004) *Hollywood Economics: How Extreme Uncertainty Shapes the Film Industry*. In the process, we falsify de Vany's '*Nobody knows anything*' theory and advance our replacement theory: *George Lucas knows something*.

Funk, M. (2007e). On the problem of sustainable economic development: introducing ~~*island bioeconomics*~~ *problem solving* & an economic theory of value. *IIS* working paper.

Abstract: This paper presents a solution to an open problem in economics: Stigler's 1982 *Problem of Value*. This

universal solution is based upon relative geographical insularity. Ever since Menger's 1883 *Problems of Economics and Sociology*, conscientious economists have understood the implications of Stigler's *Problem of Value*; ever since the *Silent Spring* of 1962, conscientious people everywhere have intuitively understood Stigler's *Problem of Value*. Unfortunately, this near-universal understanding has culminated in a thoroughly misguided quest for *Sustainable Economic Development*. Over the past century, a landfill of literature dedicated to this topic has revealed a significant and near-universal error: Those most able to navigate the perilous seas of economics, astutely demonstrate that neoclassical economic theory fails to pass the test of the second law of thermodynamics, then proceed to report this finding as if at long last Stigler's *Problem of Value* had been solved. Text books, refereed journals, and working papers (especially those denoting "Ecological Economics" as key words) alike conclude that, based upon this *revolutionary new perspective,* we are now positioned to *reshape economic theory and policy.* The primary problem, which appears to elude them all is this: economics is a *derivative* science, not a *primary* science. This paper employs ~~*Island Bioeconomics*~~ *Problem Solving*—an island-based economic modelling technique—in order to demonstrate this fundamental error, and the irrational economic errors and ecological degradation it is generating. Lessons are drawn from Iceland, Prince Edward Island, and beyond. Our *Economic Theory of Value* based on relative insularity axiomates an inverse relationship between relative insularity and economic development. This theory produces a robust, innovative and counterintuitive solution for *Sustainable Economic* Development, and, perhaps a tenable solution to *The Problem of Global Warming*.

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Hayek, F. A. (1960). *The constitution of liberty* (1978 ed.). London: Routledge.

LIBERTY AND EQUALITY: He who confuses political liberty with freedom and political equality with similarity has never thought for five minutes about either. Nothing can be unconditional: consequently nothing can be free. Liberty means responsibility. That is why most men dread it. The duke inquires contemptuously whether his gamekeeper is the equal of the Astronomer Royal; but he insists that they shall both be hanged equally if they murder him. The notion that the colonel need be a better man than the private is as confused as the notion that the keystone need be stronger than the coping stone. Where equality is undisputed, so also is subordination. Equality is fundamental in every department of social organization. The relation of superior to inferior excludes good manners (Shaw 1903, lns 23-30).

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Hume, D. (1739). *A treatise of human nature: Being an attempt to introduce the experimental method of reasoning into moral subjects.*

(1) Our foregoing method of reasoning will easily convince us, that *there can be no demonstrative arguments to prove,*

that those instances, of which we have had no experience, resemble those, of which we have had experience (Hume 1739, Book I, Vol I, p 137).

(2) To falsify a knowledge-claim is to provide evidence that it is false. Since the time of David Hume, empiricist philosophy of science has struggled with the problem of induction: namely, how is it possible to justify inference, from a finite set of instances, to the truth of a universal law whose scope is potentially infinite? In the absence of a convincing answer to this question, our everyday and scientific belief in a regular, ordered, and predictable universe must seem to be a physiologically indispensable, but still irrational, habit of mind.

The original approach to this problem pioneered by Karl Popper involved a reasoned rejection of the question itself. Popper accepted that the problem of induction was insoluble, but it did not follow that science was irrational, or that it could not progress. Instead of seeing discovery of the truth as the aim of science, we should, rather, see scientific activity as a systematic attempt to 'falsify'—or refute—bold and imaginative conjectures about the nature of the world. Popper's formulation of this principle is widely acknowledged as one of the most original contributions to the modern philosophy of science1.

(3) It took a remarkably long time before the novelty of the intellectual situation was grasped. Few realized what had happened. David Hume…saw that a great step forward had been taken, but he did not understand just how great and how radical this advance in human knowledge really was. *I am afraid that even today many people still do not fully understand this* [italics mine] (Popper 1992, p 36).

(4) *The classical notion of science as true, secure and sufficiently justified knowledge still flourishes even today* [italics mine]. But it was overtaken sixty years ago by the Einsteinian Revolution; by Einstein's gravitational theory.

The outcome of this revolution is that Einstein's theory, whether true or false, demonstrates that knowledge in the classical sense, secure knowledge, certainly is impossible. *Kant was right: our theories are free creations of our intellect, which we try to impose upon nature. But we are only rarely successful in guessing the truth; and we can never be certain whether we have succeeded. We must make do with conjectural knowledge* [italics mine] (Popper 1992, p 37).

(5) Hume has permanently influenced the development of the best of philosophers who came after him. *Man has an intense desire for assured knowledge. That is why Hume's clear message seemed crushing* [italics mine] (Einstein 1956 p 21-22).

(6) There is a problem in inference well-known as the problem of induction. It is a problem that has been haunting science for a long time, but hard science has not been as harmed by it as the social sciences, particularly economics, even more the branch of financial economics (Taleb 2001, p 117).

(7) The assumption that *economists* (italics Hayek's) can find predictable solutions to economic problems is undoubtedly the most inhibiting force in… economics. It has led to the increasing isolation of theoretical economists from the day-to-day practitioners of the subject—the actual participants in an economy, the consumers and the producers (Hayek 1991, p 9).

(8) Kant, in his *Critique of Pure Reason*, asserted under the influence of Hume that pure speculation or reason, whenever it ventures into a field in which it cannot possibly be checked by experience, is liable to get involved in contradictions or 'anti-anomies' and to produce what he unambiguously described as 'mere fancies' ; 'nonsense' ; 'illusions' ; 'a sterile dogmatism' ; and 'a superficial pretension to the knowledge of everything' (Popper, 1945, vII, p38).

(9) Reared on Merton's and Scholes teachings of efficient markets, the professors [Nobel Laureates Robert S. Merton and Myron Scholes] actually believed that prices would go and go directly where the models said they should. The professors' conceit was to think that models could forecast limits of behavior. In fact, the models could tell them what was reasonable or what was predicable based on the past" (Lowenstein 2000, p. 234).

(10) Belief that tomorrow's risks can be inferred by from yesterday's prices and volatilities prevails at virtually every investment bank and trading desk." (Ibid, p. 235).

IU. (2008). *Thesis Statements.* Retrieved 1/21/2008, 2008, from http://www.indiana.edu/~wts/pamphlets/thesis_statement.shtml

Jarecki, E., Shipman, S., McCain, J., Vidal, G., Eisenhower, J. S. D., et al. (2006). *Why we fight*. Culver City, CA: Sony Pictures Home Entertainment.

Jarvie, I. C., & Pralong, S. (1999). Popper's Open society after fifty years. London ; New York: Routledge. http://rlproxy.upei.ca/login?url=http://site.ebrary.com.rlproxy.upei.ca/lib/upei/Doc?id=10017068

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Mead, M. (1928). *Coming of age in samoa : A psychological study of primitive youth for western civilization* (1964 ed.). New York, N.Y.: William Morrow.

Menger, C. (1883). *Problems of economics and sociology (untersuchungen über die methode der socialwissenschaften und der politischen oekonomie insbesondere)*. 1963 edition. Urbana: University of Illinois Press.

McMahon, Timothy F. (1998). *Carcinogenicity of chlorothalonil: data in support of a non-linear mechanism for carcinogenicity*. The United States of America Environmental Protection Agengy Scientific Advisory Panel (SAP) Risk Assessment and Science Support Branch, Antimicrobials Division Senior Toxicologist Report, Session 4: July 1998 Meeting: http://www.epa.gov/scipoly/sap/meetings/1998/july/session4.pdf

Abstract: The Office of Pesticide Programs, U.S. Environmental Protection Agency (U.S. EPA), has recently characterized the fungicide Chlorothalonil as "likely" to be a human carcinogen" by all routes of exposure (Memorandum dated October 20, 1997 from Timothy F. McMahon to Walter Waldrop/Andrew Ertman). This decision is based on: 1) evidence of increased incidence of renal adenoma, carcinoma, and adenoma/carcinoma combined in Fischer 344 rats following chronic administration of chlorothalonil at doses of 15 and 175 mg/kg/day; 2) papilloma and/or papilloma/carcinoma of the forestomach combined in Fischer 344 rats at 175 mg/kg/day, and 3) increased incidence of forestomach carcinoma in CD-1 mice at 214 mg/kg/day. Based on the evidence characterizing the mode of action for production of renal and forestmach tumors, the Office of Pesticide Programs (OPP) concluded that Chlorothalonil met the cancer risk assessment guideline criteria for non-linearity of the dose response and that the Margin-of-Exposure approach be used for purposes of cancer risk assessment for chlorothalonil. Following is background material leading to this determination.

Mittelstaedt, M. (2006, 06/12/2006). PEI'S killing fields: 'Pesticides are what is killing our kids'. *Globe & Mail*.

Abstract: PEI would be a good place to shed more light on the health effects of agricultural chemicals because areas such as Kensington have some of the highest airborne concentrations of pesticides around farm fields in the world, and a sizeable rural population literally living on the doorstep of the spraying (p 1).

Nasar, S. (1998). *A beautiful mind : a biography of John Forbes Nash, Jr., winner of the Nobel Prize in economics, 1994*. New York: Simon & Schuster.

Nash, J. F. (1950). *Non-cooperative games* from http://www.princeton.edu/mudd/news/faq/topics/Non-Cooperative_Games_Nash.pdf

Nash, J. (1951). Non-Cooperative Games. *The Annals of Mathematics, 54*(2), 286-295. http://links.jstor.org.rlproxy.upei.ca/sici?sici=0003-486X%28195109%292%3A54%3A2%3C286%3ANG%3E2.0.CO%3B2-G

Novaczek, I. (2007). *Submission to the standing committee for agriculture, forestry and environment*. Submitted by Dr Irene Novaczek, Director IIS, UPEI at Charlottetown, PEI, Tuesday 11 December 2007.

Pesticides are designed to kill, and scientific evidence increasingly supports the public's perception that exposure to even small amounts - whether in the air we breathe, the water we drink or the food we eat - is likely to increase our risks of contracting cancer or suffering other impacts such as thyroid dysfunction and nervous system impairment. Of particular concern are impacts on children which can include increased risk of ADD/ADHD and violent personality disorders; impacts on pregnant women and both men and women of childbearing age, in the form of increased rates of birth defects; and impacts on people whose health is already poor, such as the elderly infirm and people with highly sensitive or compromised immune systems.

We know from the 1999 provincial water quality report, and from the federal government's air quality research, that mixtures of pesticides at parts per billion concentrations can be found in domestic wells close to potato and blueberry fields; that an even greater array of toxins are detectable in PEI streams and rivers; and that airborne pesticides, especially the fungicide chlorothalonil, are in every breath we take over the summer and autumn agricultural season. This is not just a human health issue but one that affects the whole food chain. Recent laboratory studies performed by Dr Wayne Fairchild of DFO indicate that such low concentrations (ppb) of certain commonly used insecticides are lethal or damaging to larval lobsters. Clams in estuaries such as the Mill River already exhibit a haemolytic disease that in other jurisdictions has been linked to toxins in the environment. And fish kills continue to plague our rivers despite efforts to control runoff of pesticides and fertilizers from agricultural land….

All across North America rates of cancer, thyroid dysfunction, learning disabilities, birth defects, environmental sensitivity and other debilitating health conditions are unacceptably high. The costs of these trends are crippling for health care systems, social programs and budgets of all levels of government. Demographic research reveals that on PEI, despite the absence of heavy industry, the bucolic landscape and appearance of pristine environments that attract tourists, we suffer from higher than average rates of cancer compared to other provinces, even after controlling for our ageing population. Thyroid problems, ADD in children, asthma and environmental diseases are also serious concerns….

On PEI, we have a population of 138,000 on a total land base of 566,000 hectares. Just under half of the land is used for agriculture; between 6 and 9% is under municipal governance - around 40,000 hectares. PEI's annual pesticide sales amount to over 1.1 million kg of active toxic ingredients/yr: that's 8 kg/yr for every man, woman and child living on the island – far in excess of the North American average (1.5 kg/person/yr).

Estimates from other jurisdictions suggest that 90% of all pesticides sold are applied for agricultural purposes, with about 10% being used at the household level. Urban use of pesticides, although less than agricultural use in terms of total annual weight, is of concern because these applications are made intensively, in environments where humans are most concentrated. Also, urban pesticide users apply a relatively greater amount of highly toxic insecticides, whereas agricultural chemicals used on PEI are predominantly (by weight) fungicides and herbicides.

Typically, application rates for agricultural pesticides are in the range of 0.8-1 kg of active ingredients per hectare. On PEI we may have an anomalous situation, judging from Environment Canada research that shows that potato fields may receive more than 6 kg ai/hectare over the growing season. In general, urban garden applications of pesticides in Canada are similarly intense, averaging 3-4 kg ai/hectare. Much of this intensive pesticide application–probably in excess of 100,000 kg ai/yr–is being applied in our top 10 most populous municipalities where over 70% of Islanders live and many more work–most notably in Charlottetown and Summerside (pp 1-3).

Von Neumann, J., & Morgenstern, O. (2004). *Theory of games and economic behavior* (60th anniversary ed.). Princeton, N.J. ; Woodstock: Princeton University Press.

North, D. C. *Corporate Leadership in an Uncertain World*. Retrieved 10/22/2007, 2007, from http://www.conference-board.org/publications/annualEssay.cfm

Popper, K. R. (1945). *The open society and its enemies*. London: G. Routledge & Sons, Ltd.

Popper, K. R. (1956). ON THE NON-EXISTENCE OF SCIENTIFIC METHOD. (preface from 1956 edition, Vol. I of the Postscript to 1983 edition of The Logic of Scientific Discovery edited by W.W. Bartley III ed.,). London: Routledge.

Popper, K. R. (1959). *The logic of scientific discovery* [Logik der Forschung, 1935, Vienna, Austria] . London ; New York: Routledge.

Abstract: This is the book where Popper first introduced his famous "solution" to the problem of induction. Originally publish in German in 1934, this version is Popper's own English translation undertaken in the 1950s. It should go without saying that the book is a classic in philosophic epistemology--perhaps the most important such work to appear since Hume's "*An Enquiry Concerning Human Understanding.*" Popper argues that scientific theories can never be proven, merely tested and corroborated. Scientific inquiry is distinguished from all other types of investigation by its testability, or, as Popper put, by the falsifiability of its theories. Unfalsifiable theories are unscientific precisely because they cannot be tested (Nyquist, 2001).

(1) Emile Zola described a work of art as a corner of nature seen through a temperament. The philosopher Karl Popper, the economist F.A. Hayek, and the art historian K. H. Gombrich have shown that the creative process in science and art consists of two main activities: an imaginative jumping forward to a new abstraction or simplified representation, followed by a critical looking back to see how nature appears in the light of the new vision (Peter Mitchell, *Nobel Banquet Speech*, 1978).

(2) My characteristics as a scientist stem from a non-conformist upbringing, a sense of being something of an outsider, and looking for different perceptions in everything from novels, to art to experimental results. I like complexity, and am delighted by the unexpected. Ideas interest me. I was influened early on by reading Arthur Koestler and Edward de Bono, and more recently by the writings of Karl Popper… (Peter C. Doherty, *Nobel Lecture*, 1996).

(3) Popper believed the "discovery was not a matter of logic" but rather the application of methodology, which fits the discovery of cointegration. This insight intrigues me. (Clive Granger, *Nobel Lecture*, 2003).

Popper, K. R. (1962). *Conjectures and refutations : The growth of scientific knowledge* (First Edition Preface from the 1963 Routledge edition ed.)

Popper, K. R. (1963). *Conjectures and refutations : The growth of scientific knowledge* (Originally published: 5th ed., rev. London ; New York : 2002. ed.). London ; New York: Routledge Classics.

Popper, K. R. (1992). *In search of a better world* [Auf der Suche nach einer besseren Welt.] (Laura J. Bennett, with additional material by Melitta Mew Trans.). London ; New York: Routledge.

All the great scientists realized that every solution to a scientific problem raises many new and unsolved problems. Our knowledge of our ignorance, becomes increasingly conscious, detailed and precise, the more we learn about the world. Scientific research is the best method we have for obtaining information about ourselves and about our ignorance. It leads us to the important insight that there may be great differences between us with regard to minor details of what wed may perhaps know, yet we are all equal in our infinite ignorance (, p 40).

Popper, K. R. (1999). *All life is problem solving* [Alles Leben ist Problemlösen.] . London ; New York: Routledge.

Popper, K. R., & Bartley, W. W. (1956). *Realism and the aim of science* (1983, including Popper's introduction from the 1982 edition and Popper's preface from 1956 edition ed.). London: Routledge.

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Reichenbach, H. (1938). *On probability and induction*, Philosophy of Science, 5, 21–45.

Reichenbach, H. (1940). *On the justification of induction*, The Journal of Philosophy, 37, 97–103.

Reichenbach, H. (1942). From copernicus to einstein. New York: Alliance Book Corp.

Reichenbach, H. (1949). *The theory of probability*, University of California Press.

Reichenbach, Hans. (1951). University of California Press (full, searchable online version at Google Books: http://books.google.com/books?vid=ISBN9780520010550.

Abstract: This book represents a new approach to philosophy. It treats philosophy as not a collection of systems, but as a study of problems.

Rowbottom, D.P., Aiston, S.J. (2006). The Myth of 'Scientific Method' in Contemporary Educational Research. *Journal of Philosophy of Education, 40*(2), 137-156.

Russell, B. (1908). Mathematical Logic as Based on the Theory of Types. *American Journal of Mathematics, 30*(3), 222-262. http://links.jstor.org.rlproxy.upei.ca/sici?sici=0002-9327%28190807%2930%3A3%3C222%3AMLABOT%3E2.0.CO%3B2-G

Russell, B. (1915). *War, the offspring of fear*. London: Union of Democratic Control.

Russell, B. (1919). *Introduction to mathematical philosophy* (1950th ed.). London: G. Allen and Unwin.

Russell, B. (1922). *Free thought and official propaganda*. London: Watts & co., etc.

Russell, B. (1928). *Sceptical essays*. London: G. Allen & Unwin.

(1) The search for happiness based upon untrue beliefs is neither very noble nor very glorious. There is a stark joy in the unflinching perception of our true place in the world, and a more vivid drama than any that is possible to those who hide behind the enclosing walls of myth (p 21).

Russell, B. (1938). *Power*. London: Routledge Classics 2004 edition, preface by Samuel Brittan, introduction by Kirk Willis.

Economic power, unlike military power, is not primary, but derivative. Within one State, it depends on law; in international dealings it is only on minor issues that it depends on law, but *when large issues are involved it depends upon war or the threat of war.* It has been customary to accept economic power without analysis, and this has led, in modern times, to an undue emphasis upon economics, as opposed to war and propaganda, in the causal interpretation of history.

Apart from the economic power of labour, all other economic power, in its ultimate analysis, consists in being able to decide, by the use of armed force if necessary, who shall be allowed to stand upon a given piece of land and to put things into it and take things from it [all italics mine, p 95].

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Abstract: The lecture focuses on the reasons that new ideas are accepted or rejected by a science. A distinction is drawn between pre-scientific and scientific stages of a discipline. The diverse fates of new ideas are illustrated by a variety of episodes in the history of economics, including the economics of information and the theory of economic regulation.

(1) In economics the most fundamental of these central problems is the theory of value. The theory of value must explain how the comparative values of different goods and services are established. Until that problem is solved, it is not possible to analyse for scientific purposes what will be produced and in what quantities, how the resources will be employed in producing the menu of outputs, and how the resources will be valued. Without a theory of value the economist can have no theory of international trade nor possibly a theory of money. This

central problem of value does not change in its essential content if one seeks to explain values in rural or urban societies, or in agricultural or industrial societies. Indeed, if the problem of value were so chameleon like as to alter its nature whenever the economic or political system altered, each epoch in economic life would require its own theory, and short epochs would get short-lived theories (p 61).

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