What is path dependence and what to do with it?

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Typing, today, is an imporrtyantt buisinserss that almost every one should excel. An issue in the business of typing is that we often mistype words and sentences while writing diplomatic reports, sending emails to friends, or giving directives in the bureaucracy. Typing errors happen millions of times a day. But they sometimes cost just more than a million Euros. In December 2005, a Japanese businessman, Takuo Tsurushima, lost his job, and about 300€ of his asset, because of such a small typing error (BBC News, 13 January 2006). The rumor has it that a diplomatic crisis between the US and Sudan was prevented when it turned out that a report, saying that the US conducted nuclear tests in Sudan in 1960s, was simply mistyped.

The consequences of the business of (mis)typing are important for more than a group of businessmen and diplomats. It is now important, for instance, for the historians and philosophers of science, too. QWERTY-nomics or path dependence, as is better known by

historians, is now a subject that attracts a lot of attention in the academia and elsewhere. The notion has become a well-known metaphor among sociologists, political scientists, historians as well as natural scientists like physicists and biologists.

The idea of path dependence in the historical evolution of social institutions has in fact long been well known by economists. Paul David, an economic historian at Stanford and Oxford, published an article in 1985 – entitled "Clio and the Economics of QWERTY" – which has come to be the first of the sequel of articles on path dependence in economics. The article was a short one, and soon became a "famous fable" in economic science. (For other "famous fables," see Spulber 2001: 90-109.) Following David, economists such as Brian Arthur, from Santa Fe Institute, Paul Krugman, from Princeton, and Douglass North, the Washington University winner of the Nobel Prize in 1983 (with Robert Fogel), among many others, have contributed to the research on path dependence, and the notion has thus turned into a celebrated one in social sciences (Arthur 1994 and 1996; Krugman 1981; and North 1990).

The notion was originally applied to the historical evolution of typing machines. During the times of mechanical typewriters, David argued in the paper, the principal problem was the clashing and jamming of the mechanical parts of typewriters. The solution was shortly found, and the keyboard of the machine was designed in such a way that the machine reduced the speed of the typist so that the amount of clashing and jamming was less. The solution was initially a smart one because it efficiently generated a working solution to a practical problem. It, however, turned out to be "inefficient" when digital keyboards were introduced. For the problem of clashing and jamming in digital keyboards was no more, and yet the keyboard design was the same. The typist, therefore, was now using the keyboard, the fable of the keys goes, at a slower speed than she could although her speed could have been increased if another keyboard had been introduced. The new digital technology didn't allow clashing and jamming but the institution – that is, the keyboard itself – has persisted, in that the problem was passed on to next generations.

"Qwerty-nomics" – as David likes to call it – points at a specific problem in the historical evolution of human institutions: that historical small events can have big consequences in the future. The basic idea behind the story is that the evolution of institutions may be locked in to specific paths in history because of some unforeseen small events, in that humans and societies may have to confront with undesirable – "inefficient," as economists have called it – outcomes in the future as a consequence of individual preferences in the past.

Switching to another path of evolution, under such circumstances, may be difficult or – economically speaking – costly, because it is sometimes impossible or unwise, say, to get rid of old habits or develop new behavioral strategies under the conditions of uncertainty or imperfect information. "Toggling" between paths might also be difficult because, say, old technologies may not allow – as in the case of keyboards – new technologies that would operate more "efficiently" to develop.

The story of path dependence, in Rortyean terms, is "[an attempt] to re-interpret our familiar surroundings in the unfamiliar terms of our new inventions" (Rorty 1980: 260). "The debate about the true nature of path dependence," however, as David writes, "is as likely to be as unproductive in this realm as in others. Path dependence can be given many different interpretations; each will carry its particular logical implications, and suggest its own fields for empirical inquiry" (David 1997). We first have to see that the "path" in the metaphor of path dependence, like many other metaphors, has never been a "reality" – in other words, there has never really been a "path." There has never been any "geography" upon which an economy, society, or intellectualism would practice human abilities such as walking or running. Social scientists have chosen to use the metaphor of path (dependence) in order to express their dissatisfaction with the present state of the evolution of an institution. Path dependence is used in order to communicate a complaint about the historical condition of social and economic institutions. It has become a figure of speech representing an economy – and, too, societies, technologies, sciences, and arts – as if an economy is a mover on a landscape where no destination has been set in advance, or at least, known by the passenger.

Path dependence is only a metaphor, and it could have also been something else – such as a cube or labyrinth. In fact, in the movie CUBE (directed by Vincenzo Natali, Darkyl New Media / Tri-Mark Pictures, 1997) a group of people are trapped in a cube-cell where the only condition of survival is to move continuously to different cube-cells, because there is no final cell where security and stability are ideally sustained. In Alice in Wonderland Alice travels in a world where norms and conventions are radically altered. And further similar metaphors can be developed.

Arjo Klamer, in his recent book, Speaking of Economics (2006), in a similar fashion, but from an opposite perspective, argues that not only getting out but also getting in the course of events (that is, "conversations") can be difficult. According to Klamer, getting into a specific path (or "conversation") can be as tricky, and even impossible. And he is right about that. Develop this…

The metaphor of path dependence, among its alternatives, is only a textured product of imagination aiming at telling the reader the undesirability of the historical condition which leads social institutions to underachieve. Speaking in terms of pathologies, scientists have thought, they would be more able to express their dissatisfaction with the institutions around them. It has become a true figure in the history of successive metaphors because the placeholder "path," not something else, was the winner of the rhetorical battle.

Although it is almost impossible in the philosophical literature to come across any writer using the word "path" (and its derivative "path dependence") in the same way as the social scientists, many thinkers, with or without calling it path dependence, have made the same point. Among those writings, there are many which are entirely in line with the position economists try to take regarding the so-called efficiency of technologies. Exact places where the notion and conception of path (dependence) occur should include John Dewey (1949; 1910a: 50 and 67; 1910b: 118 and 124), William James (1971), Larry Hickman (2004: 95), and Joseph Ratner (1999: 30-31).

We find in Martin Heidegger, for instance, one of the most important and peculiar characteristics of paths in human ideas and thought. Heidegger in his Holzwege talks about paths in woods. One takes such walking paths, he writes, as one meets them. Those paths, however, were built for different purposes. The mover nevertheless does not have any other choice. Heidegger thinks that the paths of thought that the philosophers have been advancing through for ages are like the trodden paths in the woods.

> In the wood there are paths, mostly overgrown, that come to an abrupt stop where the wood is untrodden. They are called Holzwege. Each goes its separate way, through within the same forest. It often appears as if one is identical to another. But it only appears so. Woodcutters and forest keepers know these paths. They know what it means to be on a Holzwege (Heidegger 2002).

Heidegger's message is also present in the following quote by E. B. White in respect to "living language" (E. B. White 1957 "The Living Language" The New Yorker February, quoted by Raghu Garud and Peter Karnoe 2001 Path Dependence and Creation p.28):

> The living language is like a cowpath: it is the creation of the cows themselves, who, having created for it, follow it or depart from it according to their whims or their needs. From daily use, the path undergoes change. A cow is under no obligation to stay in the narrow path she helped make, following the contour of the land, but she often profits by staying with it and she would be handicapped if she didn't know where it was or where it led to.

One can trace the origins of the theory of path dependence in Veblen's works on the analysis of the industrial system. The industrial system, writes Veblen, in his Engineers and Price System (1921, B. N. Huebesch: 52), "is notably different from anything that has gone before. It is eminently a system, self-balanced and comprehensive; and it is a system of interlocking mechanical processes, rather than of skilful manipulation." In his philosophical papers, there is more in depth about his understanding of cumulative causation which he thinks is the primary mechanism that runs the industry. In Veblen's formulation of causation neither industrial development nor social change in general converges toward a predefined point. His philosophical reflections point at a certain feature of social institutions: depiction of the cumulative advancement of humans and societies, which does not necessarily consummate in equilibrium, and where the causal nexus among phenomena is fully specified. Institutional evolution proceeds along different paths in a non-teleological way: cause and effect relationships produce in mutually dependent potencies, which have positive or negative feed-backs between them, and which have no pre-defined final term to which they necessarily converge (See Argyrous 1996). The growth of culture, says Veblen in 1909,

> is a cumulative sequence of habituation, and the ways and means of it are the habitual response of human nature to exigencies that vary incontinently, cumulatively, but with something of a consistent sequence in the cumulative variations that so go forward, – incontinently, because each new move creates a new situation which induces a further new variation in the habitual manner of response; cumulatively, because each new situation is a variation of what has gone before it and embodies as causal factors all that has been effected by what went before; consistently, because the underlying traits of human nature (propensities, aptitudes, and what not) by force of which the response takes place, and on the ground of which the habituation takes effect, remain substantially unchanged.

Early path dependence theory → *Technological Dependence and Monopoly and Growth*

The theory of path dependence – as economists have advanced the theory – provides social sciences with an archetypal perspective over the historical evolution of social institutions – a perspective emphasizing the possible malfunctioning of human institutions through time. Institutions include various technologies such as Britain's coal wagons in the nineteenth century (Puffert 2002, Scott 2001; van Vleck 1997 and 1999), VHS / BETA video systems (Liebowitz and Margolis 1995), and nuclear power reactors (Cowen 1990); legislative rules and regulations such as European corporate laws (Kato 2003; Heine and Kerber 2002; Dimitrakopoulos 2001; Magnusson 2002). The metaphor of path dependence,

and the stories that the metaphor is involved in, has been so attractive and fruitful to scientists that it is widely used in various disciplines from transitional economics (Nee and Cao 1999; McFaul 1999; Chavance and Magnin 2002; Filippov and Shvetsova 1999; Stark 1992; Zukowski 2004; Magnin 2002) to urbanization (Meyer-Stamer 1998; Nitsche 2003; Stern 1993) and economic geography (Krugman 1991; Kenney and von Burg 1999), from environmental economics (Goodstein 1995; Messner 2002) to game theory (Garud and Karnoe 2001; Matsuyama mimeo), organization theory (Stack and Gartland 2003; Gartlan 2005; Eriksson and Majkgard 2000; Egidi and Narduzzo 1997; Antonelli 1997; Mueller 1997), corporate governance (Roe 1996; Bebchuk and Roe 1999; Gilson 1996), and behavioral economics (Altman 2000; Gold and List 2004; Anderlini and Antonella 1996; Barnes et al. 2004). Sociologists, political scientists, and psychologists are attracted by the idea, too (Goldstone 1998; Mahoney (2000, 2001, and 2002); Kiser and Hechter 1998; Hay and Wincott 1998; Griffin 1992; Pierson 2000; Brown et al. 1986; Alexander 2001; Berman 1988; Page 2006 and Page and Bednar 2006).

Path dependence has also been widely applied in natural sciences as well (F. W. Meyer and H. F. Krause 2005; Gerlagh and Keyzer 2004; Chen and Lu 2004; Schneibel and Munroe 2004; Murken, Höhner and Skrotzki 2003; Vandermeer and Jensen 2001; Hill 2000; van Giessen and Widom 1999).

The vast literature also includes works about the institutional history of thinking systems that have been locked in specific paths since Plato but the so-less number of publications lack a pleasing conclusion about the lessons to be drawn from the general evolution of intellectual institutions such as universities, sciences, and the vocabularies that scientists have so long used to communicate among themselves. It should be emphasized, however, that humans heavily depend on habits and past experiences, in that the history of human ideas and thought, too, is subject to outcomes consequences of which are far from what we had expected or desired. Many conceptual works in the field overlook the issue (see for instance, Cowan and Gunby 1996; Puffert 2003; Rizello 1997; Dutt 1997; Arrow 2000, Balmann 1996), and a general theory of path dependence in human ideas and thought is thus not taken so seriously by intellectual historians.

THE RHETORIC OF THE STORY OF QWERTY

"There is an amazing irony of rhetorical success," David writes, "in the inordinate attention that was captured by one specific illustration of the workings of path dependence, and the consequent significance with which debates over its factual details continues to be endowed … The story of QWERTY provided the simplest heuristic device I could find that might provoke economists to take seriously the ways in which past events have shaped the world around us" (David 1997). The illustrative story of QWERTY is now the emblem of path dependence and the label for the claim that "history matters." The story has been subject to heavy criticism but survived the attacks. Upon the criticisms directed at the story of QWERTY, David writes:

> Indeed, in my view, the obsessive character of QWERTY-skepticism itself threatens to distract attention from the more general class of theoretical questions and empirical phenomena for which QWERTY was intended to be only a readily comprehensible symbol. To be sure, there is (by design) considerable rhetorical force in this illustration. That must bear some of the responsibility for the fact that so many economists continue to be hung up on the question of whether or not QWERTY is the best keyboard available today; and, if it isn't, whether that entails a "big" economic inefficiency, or one the should be dismissed as inconsequentially small. For scholars seriously interested in the historical development of typewriting technology this could be a reasonable obsession. But, to suppose that it is substantively crucial to any of the interesting issues that surround path dependence and its economic policy implications is just plain silly (David 1999).

David presented the article at the 1984 American Economic Association Annual Meetings, and the article – which has been the shortest among his works that David has ever got published – appeared in American Economic Review in 1985. The novelty of the paper, as David reports in his own "story of the story of QWERTY," was not the originality attached to the story but the surprising response of the audience to the paper – the paper had drawn attention and everybody had found it challenging.

The AER, publishing articles and reviews in a wide range of specialized areas in the economic literature, is one of the most famous and influential journals in economics. It is by no means a peculiar expectation that any piece appearing in this journal would be highly recognizable among economists. He has experienced such an advantage and enjoyed the profit of being read by many scholars in economics.

QWERTY is an excellent example to draw the attention of economists to the issue. It is a very easy "word" to write, and it has mattered to almost everybody for more than 20 years now. QWERTY does not make any sense, at least at first glance, for the ones who are not

interested in hardware technologies. But the explanatory power of the "word" owes too much to its meaninglessness. He uses several variants of the "word" in his article – "economics of QWERTY," "QWERTYnomics" and so forth. As Tony Lawson clearly points out,

> Before briefly examining the nature of David's explanation let me recall, in passing, how the example immediately reminds me that all aspects of explanatory endeavors are inherently interest and knowledge conditioned and motivated by conflict, surprise and/or doubt … [I]f the letter arrangement had been ABCDEFGHIJ then many of us would not regard the phenomenon as one that is at all surprising and in particular need of being explained. Of course, even such an unpredictable letter arrangement as QWERTYUIOP is of prima facie explanatory interest to an 'economic historian' such as Paul David. To the unsuspecting mainstream economist a ready explanation is always at hand (Lawson 1997: 249).

The references of the paper deserve attention, too. Here is the very first sentence of his article:

> Cicero demands of historians, first, that we tell true stories. I intend fully to perform my duty on this occasion, by giving you a homely piece of narrative economic history in which "one damn thing follows another." The main point of the story will be plain enough (David 1985).

Could someone argue that he was mistaken in choosing the name Cicero for such a striking introduction? Not likely. Also consider the reference to Tolstoy.

> But while they are, as we now say, perfectly "free to choose," their behavior, nevertheless, is held fast in the grip of events long forgotten and shaped by circumstances in which neither they nor their interests figured. Like the great men of whom Tolstoy wrote in War and Peace, "[e]very action of theirs, that seems to them an act of their own free will, is in an historical sense not free at all, but in bondage to the whole course of previous history (David 1985).

The implied reader of the text is not the group of economists doing their job using traditional or established neo-classical and mathematical tools. Surprisingly, throughout the article, the number of economic concepts he uses are not more than 20; and almost none of them are used for more than four times. (Among them only "market" and "production" are used seven times.) Although the paper is published by a prestigious mainstream economics journal, the paper is organized in a way to which many economists are not accustomed. The article seems to address more to the economists who explain the social phenomena within a historical and social setting.

David sometimes acts as if he is more than a "worldly social scientist." Just have a look at his concluding message:

> III. Message: In place of a moral, I want to leave you with a message of faith and qualified hopes … I believe there are many more QWERTY worlds lying out there in the past, on the very edges of the modern economic analyst's tidy universe; worlds we do not yet fully perceive or understand, but whose influence, like that of dark stars, extends nonetheless to shape the visible orbits of our contemporary economic affairs (David 1985).

David likes to be much more analytic and intense in his prose than other major contributors to the literature on path dependence such as Brian Arthur and Douglass North. Arthur, a trained mathematician, uses rigorous mathematical terms in his works in order to get his message to the reader. And North is more theoretical in expressing his views. But David appears to follow a more analytic scheme when he writes and talks about path dependence. Consider the following passage from a work of David's, in which his "immediate task … is to try to clarify the meaning and amplify the economic significance of path dependence" – a purely analytical task itself:

> Path-independent processes may be said to include those whose dynamics guarantee convergence to a unique, globally stable equilibrium configuration; or, in the case of stochastic systems, those for which there exists an invariant (stationary) asymptotic probability distribution that is continuous over the entire feasible space of outcomes – that is, a limiting distribution that is continuous over all the states that are compatible with the energy of the system" (David 2000).

Such analytic terms as "process," "dynamics," "stochastic", "energy of the system," "ergodic," among many others, abound in many of his works. It seems that his aim, in general, is to "rescue" the idea of path dependence from the hands of "mainstream economic writers" and locate it on some critical foundations. David writes, in almost every single piece of his writings, as if he owns the metaphor of path dependence, and plays the "guard" against his critics, mainly against the conveyors of the "laissez-faire message of neoclassical microeconomics."

Thanks to his "tough-mindedness," David, disguises his point that path dependence implies the possibility of "market failure" and "efficiency." "To be sure," David writes, "there are some underlying connections between the existence of conditions that give rise to path dependence in economic processes, and the possibility that the workings of competitive markets in those circumstances would result in allocations that are inefficient." Nevertheless, he explicitly writes, "[a]nalytically, however, it remains a total non sequitur to assert that the essence of path dependence – a property defined for analyses of dynamical and stochastic processes – consists in asserting propositions regarding the possibility of 'market failure' that were proved first in the context of purely static and deterministic models" (David 2000).

Such lines can be read as corrections to David's previous works on QWERTY, but reading between the lines, the reader gets the impression that even in his replies to his critics he still has in mind that path dependence is a phenomenon that has come to life as a consequence of "big events." In fact, in the following passages of the same work, David writes,

> From this vantage point, Arthur's (1989) phrase 'lock-in by small historical events' is evidently a gloss that should not be read too literally; it is a convenient contraction of the foregoing reference to the way in which trapping regions may be entered – although somewhat unfortunate, in allowing a hasty reader to suppose that the antecedent events somehow have created the local stability, or locked-in state.

SIZE MATTERS

"Big events" cause disappointments. People fail in their lives because they make bad marriages. They sometimes choose wrong schools. Politicians lie. Undergraduate students at economics departments fail their exams because they miscalculate the marginal revenue of economic agents in the proposed question, and so forth. It is not a surprise to know that some societies collapse simply because they cannot prepare for the future. For instance, the German defeated the French in the WWII, Diamond reports, because of the failure of the French military preparations. Diamond tells the story:

> After the horrible bloodbath of WW1, France recognized its vital need to protect itself against the possibility of another German invasion. Unfortunately, the French army staff assumed that a next war would be fought similarly to WW1, in which the Western Front between France and Germany had remained locked in static trench warfare for four years. Defensive infantry forces fortified trenches that had deployed the newly invented tanks only individually and just in support of attacking infantry. Hence France constructed an even more elaborate and expensive system of fortifications, as Maginot Line, to guard its eastern frontier against Germany. But the German army staff having been defeated in WW1, recognized the need for a different strategy. It used tanks rather than infantry to spearhead its attacks, massed the tanks into armored divisions, bypassed the Maginot Line through forested terrain previously considered unsuitable for tanks, and thereby defeated French generals made a common mistake: generals often plan for a coming war as if it will be like the previous war, especially if that previous war was victorious (Diamond 2004: 423).

There is a little problem here, however, which is the following: economists and historians sometimes arrogantly claim that all disappointments today are only because people in the past didn't work things out efficiently. They say economic agents in the past didn't optimize well,

and undesirable consequences have thus occurred. Any disappointment today is because of some big events in the past. We (or they) couldn't eliminate the consequences.

But this is not always the case. As the examples of path dependence suggest, sometimes even when the agents work things out efficiently and optimize the constraints well, they still have undesirable consequences for the future as an outcome. There is a great score of historical cases where efficiency doesn't guide the institutional choice at all. Past generations cannot be accused on the basis that the failure today is only because they couldn't meet the requirements of efficiency and optimality. Arrogant treatments of many economists and historians are undue as they are like accusing women for wearing skirts, or accusing Muslims for going to mosques. The point regarding path dependence is rather that there are many historical small events in the course of institutional evolution, causing failure and thus dissatisfaction in the economy and society. The role of such events has nothing to do with individuals' calculations as to achieve efficiency and optimality.

The difference that historical small events make in the evolution of human institutions is that there is no single scientific explanation that fits to every single situation when they are in order. As historical small events play significant roles in history, "explanations" about the evolution of economic and social institutions become "historical narratives." And such narratives are complex and specific, in that – such stories tell us the readers – we may have optimized, for instance, our shares in the exchange markets or built the bridges in the most efficient way, but the consequences of our actions in the past can still cause undesirable consequences.

The argument that path dependence generates inefficient and sub-optimal solutions is too far-fetched. Path dependence is not always about inefficiencies. It is not necessarily about "market failures" of capitalist market economies. Where David went wrong was that he saw that history consisted only of inefficient solutions and sub-optimal calculations. His worldview was that disappointments in history were primarily caused by inefficiencies and sub-optimalities that were consequences of "big events" in the past. Capitalist economies, for David, were doomed to "market failures" because, he thought, inefficiency and lack of optimality were embedded into the socio-economic system. That is to say, in one way or another, inefficiencies would pop up in capitalist market economies. There were big forces running human history. Examples of inefficiency and sub-optimality were characteristics of capitalist economies historically.

So, what is it that lies at the heart of the problem, if not inefficiency and sub-optimality?

SIZE DOES NOT NECESSARILY MEAN "BIG"

Historians have pointed out a specific group of events that have dramatically changed the course of history in exceptional manners. Such events hardly fit the general picture drawn by conventional historians, and their consequences accumulate in a noticeably different fashion. They are casual events of history that have causal significance for today; they generate a big difference in an unaccustomed fashion. Following the writings of Arthur on complexity, increasing returns, and path dependence, such events are called "historical small events." According to Arthur, historical small events are

> those events or conditions that are outside the ex-ante knowledge of the observer – beyond the resolving power of his "model" or abstraction of the situation ... [T]he small events ... determines the path of market shares; the process is non-ergodic or path dependent – it is determined by its small-event history.

In order to help us better understand the semantics and dichotomy of "small" and "big," let us study the matrix below.

		EVENTS AS CAUSES	
		SMALL	BIG
EVENTS AS CONSEQUENCES	SMALL	(1)	(2)
	BIG	(4) PATH DEPENDENCE	(3)

The matrix, in the first place, is based on a Humean conception of causation. David Hume argues, in his Treatise on of Human Nature (1739, Book I, Part III, Sections 4-9), that we receive information about natural and social happenings not only through mere reason and understanding but from subjective experience which is characteristically imperfect or incomplete. We collect frequent instances of one species of happenings in our image and

multiply the images of the happenings in our minds until we build a sound resemblance among occurrences. Impressions are not always the same, and need not be. In other words, causes and consequences of every occurrence in every story vary. According to Hume, "one may fix his attention during some time on any one object without looking farther. They are not sole causes. For the thought has evidently a very irregular motion in running along its objects, and may leap from the heavens to the earth, from one end of creation to the other, without any certain method or order" (115). A storyteller should possess a sense of order to develop a causal impression among events. She should explain why event A causes event B causing event C in sequence in such and such a way. A story thus follows a cumulative pattern in the sense that every event is a cause of a phenomenon as well as the consequence of another.

In order for a chain of events to become causes and effects, Hume claims, similar events are placed within similar relations of contiguity and succession. Contiguity and succession are two of the most essential characteristics in a causal relation. A cause, writes Hume, in his Treatise (1739: ??), "is an object precedent and contiguous to another, and where all the objects resembling the former are plac'd in like relations of presidency and contiguity to those objects." It suggests that telling a story of causation is picking up appropriate events and labeling them as causes and consequences. It is being selective about facts, deciding what matters for our purposes (McCloskey If you're so Smart: 34). In other words, judging whether a cause is a cause is a matter of practical purposes. There is no certain direction to the wind of change. It is a matter of attention.

A cause is something that bridges broken or separate or different stories. An event becomes a cause and then a consequence when they are placed in stories and especially when the stories start coming together. What matters in good stories, of course, are not merely causes and consequences. Nobody reads a novel only to learn the end of the story. When people come together they speak to each other and enjoy the durée and different types of conversations. Causation is just one of the types where the speaker and audience care much about the causes and how singular events are connected to each other in specific ways.

Causes and consequences are placeholders in a story communicated to others. The problem of causation is deciding on whether an event is observed to have a consequence on some other events. It is picking up simple facts so as to explain whether an event causes this or that consequence in the course of happenings. The observance of an event causing another

event follows the observance of a gap that is not self-explanatory or at least obvious to the observer. Causation fills in the gap.

That one event comes after another implies continuity in the course of happenings. Once the bridge is built between at least two but usually among a number of events, one accounts for why such an event happened this way but not the other way around. The story should possess an understanding of continuum where singular events or groups of events are indiscrete and unbroken. If the listeners of a story are convinced that a succession of events are not components of a series in the sense that one event they think does not follow the other in any meaningful way, then stories fail to generate a meaning. The story being told does not have any practical consequence.

In successive stages of thinking the antecedents of practical consequences are conceived as causal. There are conclusions and consequences insofar as there are premises or antecedents.

Conclusion and premise are reached by a procedure comparable to the use of boards and nails in making a box; or of paint and canvas in making a picture. If defective materials are employed or if they are put together carelessly and awkwardly, the result is defective. In some cases the result is called unworthy, in others, ugly; in others, inept; in others, wasteful, inefficient, and in still others untrue, false. But in each case, the condemnatory adjective refers to the resulting work judged in the light of its method of production [Dewey, Experience and Nature (Capricorn Books, 1929) p.379].

The matrix is not final and not meant to be complete as it does not provide us with the "objective" criteria to determine causal conjunctions in every possible occasion. As conjunctions between events are not constants, in Humean sense, any event can be a cause of another event. As Dewey once said, "The determination of 'causal' linkage between any two events is not final nor logically complete. It is a means of instituting, in connection with determination of other similar linkages, a single unique continuous history" [Dewey, Logic: The Theory of Inquiry in: Dewey, The Later Works, 1925-1953 (Carbondale and Edwardsville: Southern Illinois University Press, 1986) p.440].

This also means that what determines whether an event is "small" or "big" is the context in which events are said to play roles. Many events can be considered differently within different texts. That is, a small event might be considered as big within another setting. The issue is to connect an event to another and turn it into an integral part of another

story. The semantics of small event-big consequence dichotomy is completely story dependent.

Behind the classification of events according to their size lies a dictum from chaos theory: causes and consequences are not proportional. In chaos theory the sum of the parts of a system is bigger than the whole. In other words, summation of the causes within a system does not exactly gift us the ability to predict the behavior of the system. The reason for this is that output of the system is "fed back" into the system. Interaction between causes amplifies the impact of each cause on each other. A non-linear system responds to a slightest change in a manner that is greater than before.

"The basic difference between the two dynamics, linear and non-linear, is simple," writes Stephen Ziliak in the introduction to a book in which he edited and compiled McCloskey's works, (Stepehen Ziliak (ed.) Measurement and Meaning in Economics: The Essential Deirdre McCloskey Cheltenham: EE, 2001: xviii).

If a "path" of events (such as rocket trajectory or economic growth or women's liberation) is in fact non-linear, then small beginnings can have large effects. And if the true path is linear, then large effects can only stem from large beginnings … [McCloskey] uses small beginnings ("metaphors differ from stories") to make small points ("metaphor and story are linked by a theme") and she uses small beginnings ("metaphors differ from stories") to make big points ("humanists and economists need each other"). In other words, McCloskey uses the means of linear and non-linear dynamics to construct an argument about the narratival ends of linear and non-linear dynamics. The rhetoric of the rhetoric explains itself.

Take prices, for instance. When the amount of demand for a good increases too fast and too high, the prices increase in the short run. But the system, as a whole, may react to this in the long run in the opposite way. Increased prices may decrease the amount of demand and fall in the upcoming periods. For the prices in the previous term loops back into the system in the following periods and prices thus re-adjust.

Or consider population growth. Biologist Robert May argued in 1976 that biological pollution can follow such a growth pattern that every year's population feeds into next year's, causing the total population to increase or decrease in proportion to a changing coefficient. Granted, the population growth rate may be unpredictable after a critical level in that the growth pattern becomes non-linear – that is, the population growth rate oscillates among separate values. Instead of converging to a fixed point, the growth rate fluctuates around a

number of fixed points in a random manner (for the so-called May Equation see Brian Kaye Chaos and Complexity Weinhein: VCH Publishers 1993: 473-477).

Now, according to the matrix above, one could speak of four different possibilities of labeling an event in a course. For simplification, let us use the following terminology in order to remark the combinations of events in a period of time: let "small events" and "big events" mean, respectively, "small events as causes" and "big events as causes." Likewise, let "small consequences" and "big consequences" mean, respectively, "small events as consequences" and "big events as consequences."

The four possibilities mentioned above are the following.

1. Small event-small consequence scheme: In this scheme, the consequences are not really relevant or important for the issue at stake. They are completely ignorable. For an economic historian examining the causes and consequences of the Industrial Revolution, for instance, whether or not the density of sea water in the Northern Sea is higher than that of the Mediterranean is not really an issue. It is completely ignorable. In fact, no one has ever argued this so far. Whether such a fact played a role, if any, is asking the question "how much?" Perhaps, the difference between the densities of the seawater in the Northern Sea and Mediterranean affected in some hitherto unaccounted fashion the way engineers built cargo ships in the eighteenth century, but in order for this to be a scientific fact it is necessary for the scientist to show quantitatively how big the effect was. In other words, size matters.

McCloskey has long debated the issue in a number of different contexts. She coined the term "oomph" to imply the question of "how much?" which she thinks economists have ignored in their works. She argues that there are such phenomena in our economic and social lives that they do not really matter as the magnitude (therefore importance) of their consequences are not so big. Economists have been obsessed with the qualitative correlations among data and completely put aside the true economic question: how big? Such correlations that economists prove by way of using numerous econometric tools do not show whether the tested variables are economically significant. In economic life, some small events cause small consequences although there is a strong correlation between them. However, "what matters is oomph," as writes McCloskey, in her How to be Human, Though an Economist (Michigan University Press 2003: 195), "oomph is what we seek. A variable has oomph when its coefficient is large, its variance high, and its character exogenous. A small coefficient on an endogenous variable that does not move around can be statistically significant, but it is not worth remembering."

2. Big event-small consequence scheme: The importance of "oomph" reveals itself also when a big event results in a small consequence. Again, in big event-small consequence scheme, the consequence is so small to be relevant. But with a difference from the previous case: in this scheme, consequences are either counterintuitive or disappointing in the sense that the magnitude of the consequence is smaller than expected. In other words, mighty effort is made for a small effect. As the Roman poet Horace (65-8 BC) wrote in his Ars Poetica: "Parturient montes, nascetur ridiculus mus – Mountains will be in labor and the birth will be a funny little mouse" (Brewer's Dictionary of Phrase and Fable London: Cassell 1987: 760). The English idiom "to make a mountain out of a molehill" means unnecessary stress on a small matter (Oxford Dictionary of Phrase and Fable OUP 2000: 711). There is a similar one in Turkish, too: "after a prolonged period the mountain gave birth to a mouse." Nicholas Udall paraphrased Erasmus (1548-1549) in the following lines: "The sophicists of Greece would through their copiousness make an elephant of a fly and a mountain of a molehill" (Concise Dictionary of Phrase and Fable by B. A. Phythian London: Hodder and Stoughton 1993: 213). Such idioms are used exactly to explain the big event-small consequence scheme.

Examples within the big event-small consequence scheme are Y2K and the phenomenon of Postmillennia. Xxx…

3. Big event-big consequence scheme: One of the most important and widely-used schemes among others, which have long been the dominant paradigm in classical physics and "econo-physics," is the big event-big consequence scheme. The general characteristic of big event-big consequence scheme is the reversibility of outcomes and determinism of connections in the course of events. Knowing the circumstances of an object or event at a certain moment, one can identify the consequences that the object or event would lead to. The system is predictable. Phenomena, in this scheme, are those that we explain in deterministic terms. In big event-big consequence scheme, there is no place for randomness and chance events. In the course of events, accidents cancel out each other and historical mistakes are corrected sooner or later. No surprises occur. In this scheme, the events in nature and society are accounted for as if they were components of a well-working clock. The results are universal. Mechanisms identified in such courses of events are generalizeable to other cases without respect to the specificities peculiar to each case. We classify such events as wars, catastrophes, policy reforms under the big event-big consequence scheme.

The Economist (June 9th-15th 2007) reported in a short article entitled "It All Adds Up" that every summer, millions of small engines mow the lawns, whack its weed, and trim its borders in the US. Each engine produces a little smoke but after using a chain-saw for two hours it adds up to an amount of pollution that would be produced after ten cars driven 400 km. The carbon-dioxide emission, escaping fuel vapors, and leaking oil make them dirty machines for their size. Although operated only for short periods, lawn mowing contributes a lot of pollution which the federal government now is planning to take action against.

Big events-big consequences scheme falls into the category that is known as "Laplace's Demon." Ilya Prigogine and Isabelle Stengers, in their Order out of Chaos: Men's New Dialogue with Nature (NY: Bentam Books 1984), argue that Laplace's Demon have held captive the physicist and social scientist up until the invention of the second law of thermodynamics. The central theme of Laplace's Demon, they claim, is not "whether a deterministic prediction of the course of events is actually possible, but whether it is possible in principle, de jure" (Prigogine and Stengers 1984: 75)

> If it were really true that the world is such that a demon … could, starting from the observation of an instantaneous state, calculate its future and past, if nothing qualitatively differentiates the simple systems we can describe from the more complex ones for which a demon is needed, then the world is nothing but an immense tautology. This is the challenge of the science we have inherited from our predecessors, the spell we have to exorcise today (Prigogine and Stengers 1984: 77)

Pierre Simon de Laplace in the eighteenth century claimed that "the present state of the system of nature is evidently a consequence of what it was in the preceding moment, and if we conceive of an intelligence which at a given instant comprehends all the relations of the entity of this universe, it could state the respective positions, motions, and general effects of all these entities at any time in the past or future" (quoted by James P. Crutchfield, J. Doyne Farmer, Norman H. Packard, and Robert S. Shaw "Chaos" in Hao Bai-Lin Chaos II Singapore: World Scientific 1990: 81). In other words, knowing the initial location and momentum of a particle within a system, a physicist can perfectly predict the result by way of, say, applying Newtonian Laws or other deterministic principles that natural scientists apply "under normal conditions." Forces and all other positional possibilities are known to the scientist.

Such systems are also called ergodic. Ergodic systems are those that "come near almost every possible state over time but do so in a regular manner" (Roderick Jansen

"Classical Chaos" in Hao Bai-Lin Chaos II Singapore: World Scientific 1990: 99). Xxx. For a system to be ergodic, it need not be non-linear or non-deterministic. Ergodic systems are also deterministic and give rise to predictable consequences when the initial conditions of similar systems are identical. Mirowski's automate.

Markow chains…

4. Small event-big consequence scheme: Atoms in nature and individuals in society, however, don't quite work that way at all times. Complexity of the system and numerous positive feedbacks can magnify the consequences of "initial events" exponentially. Each time, the amplification of causes evolves the system from a given initial state to "far from equilibrium" attractor. An attractor is a rest point to which a system eventually settles down. Contrary to what Laplace claimed, such a world is full of unpredictable consequences which stem from relatively small causes in earlier stages. Small scale errors and uncertainties, under certain mechanisms, such as positive feedbacks, become larger and larger. There is no short cut to predict the evolutionary future of the system. Henri Poincaré argued in 1903,

A very small cause which escapes out notice determines a considerable effect that we cannot fail to see, and then we say that the effect is due to chance … It may happen that small differences in the initial conditions produce an enormous error in the latter. Prediction becomes impossible, and we have the fortuitous phenomena (quoted by James P. Crutchfield, J. Doyne Farmer, Norman H. Packard, and Robert S. Shaw "Chaos" in Hao Bai-Lin Chaos II Singapore: World Scientific 1990: 81).

We can resemble the accumulation of the consequences of some small events to the way the probability of drawing the same colored balls in the so-called Polya-urn processes increases. The process runs as follows: suppose there are initially equal numbers of red and black balls in an urn. We randomly draw a ball. Then we return the ball to the urn, with another ball of the same color. That is, if the ball that we draw is red we return the red ball with another red one. If there were initially one red and one black ball in the urn, there would now be three red balls in the urn – two reds and one black. We draw another ball. We repeat the game. The consequence of the process is that, as we make further draws, the probability of drawing the same colored ball increases. The process, in other words, is reinforced by the small event of initially drawing a red ball from the urn (For "Polya-urn processes" in economics, see Arthur, Ermoliev, and Kaniowsku 1987).

Historical small events are those the effects of which multiply in an unforeseen and unexpected manner – especially when neglected or overlooked in scientific experiments. Such events are sometimes the errors that researchers overlook. Von Neumann, for instance, who built the first computer with the intention of predicting weather, Gleick reports, "had overlooked the possibility of chaos, with instability at every point … [B]eyond two or three days the world's best forecasts were [thus] speculative, and beyond six or seven they were worthless … [because] the errors will have multiplied to the ten-foot scale, and so on up to the size of the globe" (Gleick 1987: 19).

Robert White, a fellow meteorologist at MIT, gave the answer to von Neumann's problem later on. His idea was that "small modifications, well within human capability, could cause desired large-scale changes" (Gleick 1987: 22).

In effect, the consequences of such events are usually against intuition. They surprise the researcher as multiplication of the consequences of neglected events is never expected. Small events can create a similar effect to the crises that cause "paradigm shifts" in the Kuhnian sense. James Gleick, once again, writes,

> In science as in life, it is well known that a chain of events can have a point of crisis that could magnify small changes. But chaos meant that such points were everywhere. They were pervasive. In systems like the weather, sensitive dependence on initial conditions was an inescapable consequence of the way small scales intertwined with large (Gleick 1987: 23).

Friction, for instance, is a factor the effect of which is often neglected in physics – as well as in economics, for that matter, in the form of transaction costs where transaction costs are seen as market friction or "frictional costs" (see, for instance, Jacobides and Winter 2003). But friction is something that depends on speed – and vice versa – and with friction and speed things can get complicated. Neglecting one small factor – that is, friction – an equation or a system can generate unforeseen or unexpected consequences.

The reason for such a result is that certain mechanisms become effective randomly in the routine course of events. We call such mechanisms "positive feedbacks." A difference between linear and non-linear systems is the following: linear systems feature negative feedbacks which regulate the system and move it to equilibrium, whereas non-linear systems feature positive feedbacks which amplify the magnitude of certain causes and push the system far from equilibrium. When there are positive feedbacks within an equation, the terms of the equation generate disproportional impacts on other terms; terms are repeatedly multiplied by themselves (Briggs and Peat 1984: 24). When a microphone is located in front of a

loudspeaker, for instance, the output from the microphone is fed back into the system as the microphone picks up the signal and sends it back to the loudspeaker.

John Briggs and F. David Peat report, in their Turbulent Mirror (NY: Harper & Row 1989: 158-160), that positive feedbacks occasionally prevent competition among species in nature and promote cooperation. Instead of struggling against each other, they argue, some species can generate such methods of benefiting from each other that there is no competition or conflict for the same end at all. Under such conditions, not only the fittest survive. Relatively weak ones also survive in the long run by way of adapting themselves to the environment in such a way that they do not take part in the race for survival. Weak species simply don't compete with others. They take the advantage of being a part of the collective which self-organizes itself by mutual dependence.

The so-called agglomeration effect is an example to such positive feedbacks in the economy. Agglomeration in geographical economics implies, Caterina Marchionni writes in her Unity, Plurality, and Explanation: The Case of Geographical Economics and its Neighbors PhD Dissertation Erasmus University Rotterdam 2005: 132), that

> The more firms and workers there in a locality, the more the locality becomes attractive as a location for further firms and workers. This creates a cumulative process whose end result might be that all economic activity turns out to be concentrated in one locality … The cumulative nature of the process of agglomeration is such that a small advantage of one location due to locational chance events in the past can have snowball effects which turn that location into the centre of economic activity, even though this outcome might not be the optimal one.

The infrastructure of an industry such as transportation possibilities and geographical endowments is obviously important for starting a business. Non-structural factors, however, such as the location preferences of other firms, are sometimes equally important, too. In that, location preferences of other firms may dominate other factors such as transportation possibilities and geographical endowments. Early places attract others-to-come who are to pick up a place to locate the industry. The early firms might have given their decision accidentally long before there were any infrastructural reasons available for them to consider. As more firms start doing business in a region, others are more likely to follow. The advantages of doing business in the location could overwhelm the ("real") advantages of the infrastructure at another location. The industry is located in the early chosen places. The outcome is not unique: another set of accidental small events could have caused the industry to settle in another location.

Indeed, this is what has happened in Santa Clara Country in California → Arthur, Brian. 1994e. "Industry Location Patterns and the Importance of History" Increasing Returns and Path Dependence in the Economy (Michigan: University of Michigan Press) + Kenney, Martin and von Burg, Urs. 1999. "Technology, Entrepreneurship, and Path Dependence: Industrial Clustering in Silicon Valley and Route 128" Industrial and Corporate Change 8(1).

Another perspective on the way in which positive feedback loops generate turbulence at macro levels is developed by Prigogine and Stengers (1984). According to Prigogine and Stengers, every system involves sub-systems that work independently from a regular principle. Occasionally, such sub-systems can be affected by a number of positive feedbacks which result in the destruction of the past states of the system. Prigogine and Stengers call the phenomenon "bifurcation." After bifurcation takes place, it is not certain which direction the system will move toward. Microscopic changes under the influence of numerous positive feedbacks revolutionize the system at macro levels. The system stabilizes itself by virtue of exchanging energy with other factors in the environment. The entropy consumes the energy of the system and minimizes the differences among the systems in the environment. They call the new stabilized systems "dissipative structures." Although randomness, with the help of certain positive feedback mechanisms, causes such systems, dissipative structures, once occurred, are ruled by deterministic rules. The course of events after bifurcation evolves following some predictable rules; however, it is not possible to predict when the next bifurcation will occur. In the foreword Alvin Toffler wrote to their book,

> Thus, according to the theory of change implied in the idea of dissipative structures, when fluctuations force an existing system into a far-from equilibrium condition and threaten its structure, it approaches a critical moment or bifurcation point. At this point, according to the authors, it is inherently impossible to determine in advance the next state of the system. Chance nudges what remains of the system down a new a path of development. And once that path is chosen (from among many), determinism takes over again until the next bifurcation point is reached (Prigogine and Stengers 1984: xxiii)

A puzzling issue here is whether the presence of small events precludes the role of deterministic structures in the course of events. Neither thermodynamics nor the occurrence of dissipative structures, as is illustrated by Prigogine and Stengers as well as many others, is a story of random occurrences alone. Random events play an important role when positive feedbacks destabilize the macrostates of a system by way of causing determinate consequences at micro levels to move in the same direction as their causes. Determinist structures fail to function in the predicted way at the very moment of the bifurcation giving

rise to unaccountable changes. This causes fluctuations in the system but it eventually results in the dissipative structures where the occurrence of indeterminate small events is less probable and the determinate relations prevails.

After every bifurcation, the world is divided into numerous "parallel universes," so to speak. In every universe, events take place either according to deterministic laws or according to random occurrences and mechanisms. Which game is selected, we never know unless we stop thinking and take one of the thinkable paths. In other words, exact prediction on the future values of the terms of a system is theoretically and practically impossible. Contrary to what Albert Einstein claimed in 1920s, God plays dice.

In fact, the real question is not whether God does play dice. As Ian Stewart once put it, it is how she plays it (Stewart God Plays the Dice Basic Blackwell 1989: 1-3). Erwin Schrödinger illustrated the case with a thought experiment in a paper published in Die Naturwissenschaften in 1935. He wanted us to think of a cat imprisoned in a steel chamber along with a tube full of hydrocyanic acid and a device which was programmed to detect the existence of radioactive substances in the chamber. Radioactive substances were released when atoms decayed and this did not follow a deterministic pattern. If the device detected the atoms decayed, it would trigger a hammer which would break the tube of hydrocyanic acid and kill the cat inside the chamber. The issue here is that one could not know whether an atom decayed prior to observation and certainly have claimed that the probability of the cat in the chamber to be alive was just 50%. Schrödinger's example demonstrates, however, that one cannot be sure of the outcome unless the observer opens the box and observes the case. The result cannot be predicted beyond statistical measures. The experiment tells us that macroscopic states of objects, such as a cat in a chamber, cannot have unique deterministic descriptions. Every system becomes either this or that only at the very moment that one observes the system. There is no truth about possible states of a system unless observation takes place. "It is typical of these cases," wrote Schrödinger, "that an indeterminacy originally restricted to the atomic domain becomes transformed into macroscopic indeterminacy, which can then be resolved by direct observation. That prevents us from so naively accepting as valid a 'blurred model' for representing reality. In itself it would not embody anything unclear or contradictory. There is a difference between a shaky or out-of-focus photograph and a snapshot of clouds and fog banks" (Erwin Schrödinger "The Present Situation in Quantum Mechanics: A Translation of Schrödinger's 'Cat Paradox' Paper" Proceedings of the American Philosophical Society 124 1980 http://www.tu-

harburg.de/rzt/rzt/it/QM/cat.html and John Gribbin In Pursuit of Schrödinger's Cat: Quantum Physics and Reality (Bantam Books 1984: 1-6 and 235-254).

The lesson to be drawn from Schrödinger's thought experiment is that the outcome doesn't exist without measurement. Put it differently, equations and coefficients hanging on the blackboard hardly ever tell us the actual result that would necessarily come out unless one takes the trouble of measuring off the blackboard how big their effect is. It does not really make any sense (at least scientifically) to prove any theorem on the blackboard without observing or testing it in the "real" world. A possibility could be claimed to be "true," such as the claim that the cat in the chamber is 50% alive and 50% dead. But the claim is practically insignificant. We are not at all times able to predict the direction that the terms of an equation or the components of a system will move before we run the equation or put the system in motion. The relations among terms and components are not always deterministic. Several mechanisms are able to track off the course of events at any time. In that, small perturbations may result in large occurrences. What matters is the measurement of possible states of the system. We must observe how big the effect of each term on others is.

The issue here is that we do not know ex ante whether and when an event becomes dependent on a feedback mechanism which amplifies the magnitude of the effect of a small event. To put it differently, knowing the initial conditions of a system, we may not be able to predict the result. It is probable that a random event might dominate the entire course of events. This does not rule out the deterministic relations after such an event occurs. Whether the system will lead to this (deterministic) or that (random) result is only a matter of probability.

NATURA FACIT SALTUM

So, indeed, as Edward Lorenz in his The Essence of Chaos (Seattle: University of Washington Press 1993: 3-6) says, "it only looks random." Perhaps, but it's not, only. It is also deterministic. And it may also only look quantum mechanics. Yes, but it is not, only; it is also Newtonian dynamics. And finally, it may only look a small event. Yes, but it is not, only; it is also big.

Stephan Jay Gould, in his Panda's Thumb (NY: W. W. Norton & Co. 1982: 49) claims that Einstein contended with saying openly that "all is relative." Jacques Delperrié de Bayac reports in his La Vie de Karl Marx (Paris: JCLattés 1979: 373) that Marx wrote in a letter to

his son-in-law Paul Lafargue in 1883 that, if anything was certain, Marx was not a Marxist himself; Marx didn't believe that every social dynamic could be explained in some obscure notion of dialectical materialism. Every idea, such examples show, can be trivialized and misrepresented in scholarly life in the sense that the implications and applications of any theory may be used in absolute and exclusive terms. The ideas of chaos, indeterminacy, and substantial consequences caused by small events are no exceptions.

The same concern applies to Darwin's "natural selection" as well, Richard Dawkins argues in his Climbing Mount Improbable (W. W. Norton Company, 1996). No organism or structure in nature, Dawkins claims, has been created by a finger click or by chance alone. There are such phenomena in nature that although they look too statistically improbable, they are selected by virtue of a number of deterministic mechanisms. Natural selection, according to Dawkins, breaks down the problem of improbability into small pieces each of which is slightly improbable. As Richard Dawkins writes, xxx

Gould reports that lying on a sunny bank in Australia in 1936, Darwin was puzzled with an idea: why would there be so many diverse creatures in similar climates and geographies? The answer would be either, Darwin thought, that there were two creators at work or that species evolved separately tracking down different pathways at different times. In either case, there would have been no inherent direction or tendency of internal perfecting. According to Gould, the existence of imperfections and oddities among species proved Darwin that there were pathways in nature in which we could trace the particular causes that leaded life's history to follow this or that route (Gould 1982: 28). One couldn't demonstrate evolution with perfection, Gould claims, because perfection didn't need to have a history. If there were, any organism in nature would have been created for the purpose that it perfectly pertained. To put it differently, there was evolution, according to Gould, because the root of an organism didn't always coincide with the "modern form" of the organism. If these two were equal, then there was no indication of evolutionary history. "Oddities in current terms are the signs of history," writes Gould (Gould 1982: 29). Now let us elaborate on that.

Natural selection is a mechanism that causes "better adapted" species to win. A species' better adaptation does not necessarily mean the species' transforming into a superior creature in some anatomical sense. Natural selection involves mechanisms of positive feedbacks in which the consequences of historical contingencies are sometimes reinforced in such a way that some birds without aerodynamic design of feather or some insects by way of mimicry that gift them the ability to look like a leaf or a stick survive. Optimal adaptation

does not always occur in life's history. "Darwin recognized," writes Gould, "that perfection cannot provide evidence for evolution … that the primary evidence for evolution must be sought in quirks, oddities, and imperfections that lay bare the pathways of history" (Gould Wonderful Life: The Burgess Shale and the Nature of History London: Penguin Books 1991: 300).

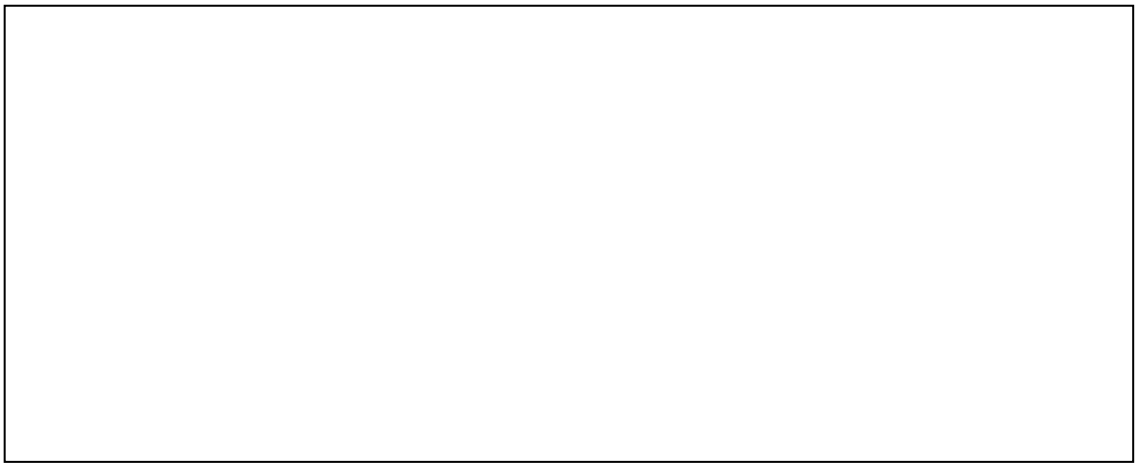
Darwin saw the large in small. But he didn't argue, Gould claims, that the large would emerge out of the small by basically adding up of time into the process. Natural (and social) patterns are not at all times the outcome of uninterrupted proliferation and betterment. Patience has never been the sole point of history. Imperfections in nature occasionally prevailed and occasionally did the job better than the perfect. Pandas didn't have perfect "thumbs." They had five digits and the "thumb" evolved separately. Pandas used it like a sixth finger to run, stab, and strip off the bamboo leaves. Panda's thumb was remodeled for a new purpose which helped them survive by virtue of a different diet than that of ordinary bears and raccoons (Gould 1982: 19-26). Dinosaurs were superior to many other species in their local environment and they didn't survive. Interestingly, however, some other small animals survived the conditions which caused mass extinction of dinosaurs not because the small animal the small animals featured some anatomic superiority. Their smallness was a negativity in "normal" times; they didn't predict that their size would win them an advantage in future. They remained small for some other reasons which helped them survive the catastrophe (Gould 1991: 307).

Losers do not only disappear by inferiority in competition (Gould 1991: 302). The pathway from small to large involves short-cuts generating mechanisms. There is no single pattern in which to decide who get through and who doesn't. There is no unique ket to unlock the secret doors of history. Most of the species survive through special reasons because they take the advantage of pathways in which causation running accumulatively enhance the impact of certain events immeasurably. This wouldn't happen for a second time. As a consequence, imperfections and oddities are not singled out automatically. On the contrary, they prevail in such a way that down the pathway evolution does have no direction. Evolution does not lead to higher and superior species. It is not always progressive.

Insert some stuff about progress…

Progress is not necessarily a single line of advance. It is rather a combination of a number of evolutionary lineages. Gould argues that life is often demonstrated in life sciences like a growing bush and there is almost always more than one only surviving twig. Every

pathway is only one among thousands of others on a complex bush. Progress, according to Gould, illustrates the increasing amount of a branching bush and is by no means like the infamous iconography of the march of progress which linearize the evolution of "human advance" from antiquity until today.



Adapted from Gould (1991: 40) picture 1.16. According to the common demonstration, all species of earlier times are considered not as ancestors but

This is not a correct demonstration, Gould argues. Conventional iconography, writes he, "has fastened upon a primary model, the 'cone of increasing diversity,' an upside-down Christmas three. Life begins with the restricted and simple, and progresses ever upward to more and more, by implication, better and better" (Gould 1991: 38). Such threes grow upwards and widens outwards, expanding the "cone of diversity." "In" on the three means old and "down" simple. They also imply ranking among ancestors and cousins. Upward and outward species take the advantages of complexity which grow out of the consequences of success of species at each successive stage of evolution.

The problem is that this is not necessarily so. If evolutionary progress meant success, the pathway from antiquity until today would be linear and directed toward inevitability and superiority. But success is not always nature's theme, as Gould argues. Some species are unfit and they survive while others are perfectly fit and they extinct. Nevertheless, evolution of species is illustrated by the "ladder of life," Gould claims because "they nurture our hopes for a universe of intrinsic meaning defined in our terms … our continued allegiance to the

manifestly false iconographies of ladder and cone [points at] cosmically justified hope and arrogance" (Gould 1991: 43 and 45).

In other words, sometimes, diversity and complexity are not the point of biological evolution. After a level of diversity in history, evolution may proceed by elimination instead of further expansion. Evolution may hit such a pathway that "life settles down to generating endless variants upon a few surviving models" (Gould 1991: 47). The system may lock itself into specific evolutionary lineages in and out of which an overwhelming majority of species is destroyed and only a few survived. No diverse pathways exist. The number of anatomical designs is reduced. Evolutionary history in the iconography now demonstrates both simplicity and complexity as well as both "old" and "new." In other words, species that survived may have prevailed not for a cause on the Darwinian basis of success in normal times. "Perhaps, the actual reasons for survival do not support conventional ideas of cause as complexity, improvement, or anything moving at all humanward" (Gould !991: 48). Perhaps an earthquake hit the region. Or an unpredictable environmental catastrophe provoked mass extinction. Evolution may have become dependent upon improbable chains of events which are sensible in retrospect and unpredictable and unrepeatable in prospect. Gould calls this thought experiment "replaying life's tape."

> You press the rewind button and making sure you thoroughly erase everything that actually happened, go back to any time and place in the past – say, to the seas of the Burgess Shale. Then let the tape run again and see if the repetition looks at all like the original. If each replay strongly resembles life's actual pathway, then we must conclude that what really happened pretty much had to occur. But suppose that the experimental versions all yield sensible results strikingly different from the actual history of life. What could we then say about the predictability of self-conscious intelligence or of mammals or vertebrates or of life on land or simply of multicellular persistence for 600 million difficult years? (Gould 1991 49-50)

This does not mean that evolution after a chance or contingent event is senseless. It only means that strict determinism of perfection may not apply. Each stage gives a way to a next one for a cause but no final term can be specified, knowing the initial step of a process. Moreover, no term would occur again if we had run the system for a second time. No matter how small in size, replace any event or insert another event that seems improbable or without apparent importance, and evolution would lead to a completely different pathway (Gould 1991: 51).

Insert punctuated equilibrium…

Punctuated equilibrium (such as Gould). See for instance: Eldredge and Gould, "Punctuated Equilibria: the Tempo and mode of evolution reconsidered" Paleobiology 3, 1997 + Steven J. Brams, "Response to Randall Stone: Heresy or Scientific Progress?" Journal of Conflict Resolution, Vol. 45, No. 2, 245-254 (2001) 2001.

The difficulty here is the observation of "repeated perfection" in natural history. Repeated perfection indicates that some organisms converge upon the same solutions again and again. In the evolutionary history of a number of species oddities never occur. Some kind of an "ordering force" interlocks evolution to certain directions.

Gould argues that Darwinian notion that evolution is unplanned and undirected does not cancel out the fact that "natural selection build good design by rejecting most variants while accepting and accumulating the few that improve adaptation to local environments" (Gould 1982: 40). Optimal solutions are prevalent in natural history and it is repeated more than twice in different lineages. In disparate groups, abstract forms of ideal world exist. Final adaptation is so complex and peculiar that in some cases physical forces override natural selection in such a way that species obtain an optimal form by virtue of physical forces acting upon them. Complex forms are shaped by simpler mechanisms in a variety of unsuspected ways. A number of natural states, Gould claims, such as hexagonal creature or spiral leaves, are created as a consequence of only a small perturbation and modification in the form of the species.

XXX

The past does have examples where chance and contingency play a modest or no role. You study the whole week for the final examination of the History of Economic Thought class. You take the exam and pass it with grade A. There is no chance element here playing any role. You don't take precautions for the coming winter storm, and your car doesn't work in the morning as the water in the carburetor is frozen. There is no chance element here, either, playing any role.

Some events in history, however, are unique. They need a special treatment. When such events are present, artificial repetition of the same sequence within a model or a laboratory is not always possible. The do not violate the principles of causation – one can explain why and how such and such consequences occur out of such and such causes. After they take place, the complexity of the chain of events are not always reducible to a number of

law-like statement, gifting the scientist the ability to quantify, experiment, and predict future occurrences. As Gould writes,

> The resolution of history must be rooted in the reconstruction of past events themselves – in their own terms – based on narrative evidence of their own unique phenomena. No law guaranteed the demise of Wiwaxia, but some complex set of events conspired to assure this result – and we may be able to recover the causes if, by good fortune, sufficient evidence lies recorded in our spotty geological record (Gould 1991: 278).

Explanation of contingent patterns in history takes the form of narrative. If only one singular event had not occurred in the chain of events, the results would be radically different. Or had there been slightest unpredictable change – such as injection of an extra factor seemingly without any causal significance – the same consequences wouldn't follow. Every (final) term is dependent upon antecedent states consequence of which are uneliminatable and never un-happen again. Each event in every course, no matter how small, has the power of transforming the impacts of events after it.

Examples of contingency→

Roland Rabartin and Phillipe Rocker Les Volcanos, le climat et la Revolutions Francaise → see sonsuzlugun kiyilari pp.79-82

Voltaire and Lisbon earthquake → Evil in Modern Thought

Geography as a small event: Kenneth Arrow, in a similar fashion, reports, relying on the Dutch historian Pieter Geyl's The Netherlands in the Seventeenth Century (1961-1964), that beyond the motivations that caused the separation of the Netherlands from Belgium was the contingent and accidental set of events that had given great advantages the Protestants in the North of Low Countries against the sovereignty of the Spanish rule because "the convoluted sea coasts in the North provided great refuge for the rebels."

As the Spanish regain control in the South, Protestant refugees fled to North, changing the religious balance. It was therefore because of geography that the North became the successful point of resistance and also the center of Protestantism, to the point that when independence was ceded to the North, the two areas became increasing divergent in religion and other social attitudes. Two hundred years later, the unity of the Netherlands was reestablished by the decision of the victors over Napoleon but could not be maintained with such divergence of religion and of national sentiment (Arrow 2000).

Irreducible complexity in here…

An important question is the following: does evolution increase complexity? The answer, Darwin's answer, argues Richard Dawkins in his The Blind Watchmaker (1986: 43) is "yes." Living things came into existence, Dawkins writes,

> by gradual, step-by-step transformations from simple beginnings, from primordial entities sufficiently simple to have come into existence by chance. Each successive change in the gradual evolutionary process was simple enough, relative to its predecessor, to have arisen by chance. But the whole sequence of cumulative steps constitutes anything but a chance process, when you consider the complexity of the final end-product relative to the original starting point.

According to Dawkins the idea of tiny changes cumulated of many steps is a very powerful idea (p.90). The "cumulative selection" brings a number of random mutations together in a sequence at the end of which the product seems to be "too improbable to have come about by chance alone" (p.140). He argues that in order to get away from miracles and major improbabilities in scientific prose, we should break down large chance events into a cumulative series of smaller events. The "process" is highly complex in the sense that once cumulative selection starts it advances to a point where many have only speculative thoughts about its origins. Spontaneous arising of DNA or RNA would seem them to be only a miracle; the origin of life no more than a myth. "Given infinite time, or infinite opportunities," claims Dawkins, "anything is possible" (p.130). Small events, under Darwinan rules, often have substantial effects. Events of small probability occasionally give rise to consecutive changes components of which are mutually dependent on each other. The course of events under such conditions "self-organizes" itself, increasing the complexity of the system. Blind chance, or small events, with natural selection is thus able to replace miracles and myths about such organisms as dinosaurs and humans.

SMALL EVENTS IN OPERATION: THE COASE THEOREM

George Stigler invited Ronald Coase to Chicago in 1959 to give a speech at a workshop. Coase accepted the offer. After the workshop Coase asked the learned audience of Chicago to organize a special meeting to discuss about his approach to the "rationale of property rights" which the Chicagoans thought was an error and Coase should delete it from his 1959 article on "Federal Communications Commission." The meeting was arranged. The big shots of Chicago gathered at the residence of Aaron Director, the founder of the Journal of Economics and Law. Milton Friedman, Arnold Harberger, and John McGee were at the meeting. "How could such a fine economist like Coase think," his fellows at Chicago thought, "that there

were costs involved in the operation of price mechanism in the market?" The discussion took about two hours. It was this meeting that Coase could convince his Chicago colleagues about his argument. And so was it possible for us the next generation of economists to know "probably the most widely cited article in the whole of the modern economic literature." "I persuaded these economists that I was right," reported Coase in his autobiography in 1991, "and I was asked to write up my argument for publication in the Journal of Law and Economics … Had it not been for the fact that these economists at the University of Chicago thought that I had made an error in my article on 'The Federal Communications Commission,' it is probable that 'The Problem of Social Cost [1960]' would never have been written." (From Les Prix Nobel. The Nobel Prizes 1991, Editor Tore Frängsmyr, [Nobel Foundation], Stockholm, 1992)

The "Coase Theorem" was introduced by Stigler in 1966 and has since become an important topic to investigate for economists. Coase's 1960 article, as Stigler has shown, has raised important issues about the efficiency of markets, government intervention, and property rights. An interesting issue about the theorem, however, has been a common misunderstanding that has only come out at Coase's Lobel Prize Lecture in 1991.

In the "Problem of Social Cost," Coase argued that carrying out market transactions (such as conducting negotiations with parties, drawing up a contract, reaching an agreement about the terms of the contract, and so on) were costly – "sufficiently costly at any rate," wrote Coase, "to prevent many transactions that would be carried out in a world in which the pricing system worked without cost" (Coase 1960). Established economic theory, however, assumed costless market transactions. That is, the discussion of the problems that even well operating price mechanisms were not easily able to solve – such as harmful effects of individual actions on others or "negative externalities" – was inadequate. Economists, since Arthur Cecil Pigou, have believed that the government should restrain those responsible for the "harmful effects" of individual action in the market. Although this was not unwise, Coase argued, such a solution would depend on whether the "gain from preventing the harm is greater than the loss which would be suffered elsewhere as a result of stopping the action which produces the harm" (Coase 1960). There was no single solution to every problem in the market, in other words, and economists should be more concerned with the consequences that happen in actual cases – not merely with the consequences that would happen on the blackboard only.

The problem in the case of the "Coase Theorem" was that Stigler, in the third addition of his The Theory of Price (1966), formulated Coase's contribution in peculiar way. He wrote that "[t]he Coase theorem thus asserts that under perfect competition private and social costs will be equal. It is a more remarkable proposition to us older economists who have believed the opposite for a generation, than it will appear to the young reader who was never wrong, here" (Stigler 1966: 113). Since Stigler, this definition has been established in the conventional economic theory as the "Coase Theorem."

A common confusion about Coase's contribution is that the "Coase Theorem" is elaborated as if Coase himself argued that there were no transaction costs in the market. But he didn't. He argued that since there are transaction costs in the market, externalities might cause an inefficient allocation of resources and the government intervention may be needed. Transaction costs are not always negligible, Coase claimed, and this is the reason why resources may not move to their most highly valued and consumers may not be able to direct the resources to where these resources yield the highest value.

In a number of important articles and books, however, that of Stigler being the first, the "Coase Theorem" has been analyzed incorrectly. Even 70 years after Coase first published his "The Nature of Firm" and introduced his conception of "transaction costs," consequences of the initial conditions under which Coase's contribution was first formulated – that is, Stigler's ideological manipulation of Coase's approach – couldn't be eliminated. Richard Allan Posner, senior lecturer at the University of Chicago Law School, in his Economic Analysis of Law (1986: 7) wrote thus: "if transactions are costless, the initial assignment of a property right will not determine the ultimate use of the property." To which Coase responded: "after having read Posner's paper I felt I could not remain silent (…) The trouble with Posner (…) is not with what he doesn't know but with what he knows things that 'ain't so'" (Coase 1993 Coase Ronald (1993a) "Coase on Posner on Coase and Concluding Comment", 149 Zeitschrift für die Gesamte Staatswissenschaft (Journal of Institutional and Theoretical Economics) 96, 360 (1992), quote by Antonio Nicita and Ugo Panago Manuscript "Law and Economics in Retrospect). Hal R. Varian, too, argued that "the result that under certain circumstances the efficient amount of the good involved in the externality is independent of the distribution of property rights is sometimes known as the Coase Theorem" (Hal R. Varian Intermediate Microeconomics NY: W. W. Norton: pp.542-543). The point hasn't been correctly elaborated by the following generation of textbooks on economics and law (See also: Jeffrey L. Harrison (1995: 56-60) and Robert Cooter and Thomas Ulen (1995:

79-84)). Not even at the web site of University of Chicago Law School: http://www.law.uchicago.edu/socrates/coase.html

An interesting case to investigate closely is by Gary North, a Christian Reconstructivism activist and president of the Institute for Christian Economics. North, in his The Coase Theorem: A Study in Economic Epistemology (Institute for Christian Economics, 1992), argues that the "Coase Theorem" raises a number of moral issues: the "Coase Theorem," North argues, "assigns zero economic value – and therefore zero relevance – to the sense of moral and legal right associated with a willful violation of private ownership. The theorem ignores the economic relevance of the public's sense of moral outrage when there is no enforcement by the civil government of owners' legal immunities from invasion, even if this invasion is done in the name of some 'more efficient' social good or social goal" (p. 27). The victims of, say, pollution, claims North, in other words, wouldn't sue the polluter in civil courts. Or, restrictions on kidnappers would be impossible. North thus considers the "Coase Theorem" "one of the most morally insidious pieces of academic nonsense ever to hit the economics profession" (p. 27). In the hands of North the epistemological problem of social costs becomes an ethical one; and economics happen to be "wicked." He poses an important question:

> Who should make the initial distribution of an ownership right to whomever "values it the most"? How does this sovereign agent know scientifically which potential owners "are likely to value them [ownership rights] the most"? In short: By what standard of value does he make the initial distribution? (p.30).

North falls in the trap of Stigler, too: Coase didn't say this. He didn't assume individuals having no commitment to any sense of justice. He pointed out "the impossibility of a world without transaction costs." If Coase were asked the questions in the above quote, he would argue the judges should certainly intervene the disputes to settle a solution. He would argue that there are reasons for governments to enter markets to protect the rights of different parties. Some economists – certainly, the followers of Stigler – can be considered as "wicked." Economics, however, cannot be. Coase doesn't assume that economists should be value-free and morally neutral. Many economists, like Coase himself, and unlike Stigler and his followers, care about justice, equity etc. The problem of social cost means also the problem of ethics and justice; it is the problem of caring about the social consequences of individual doings. Externalities can be morally significant, too, especially when one's action harms the utility of another and violate the others' rights (Jonathan Anomaly "The Moral Cost

of the Coase Theorem" Unpublished Manuscript December 2006 http://www.mises.org/journals/scholar/anomaly.pdf) North accepts it too that "the issue of economic efficiency therefore cannot be separated from the issue of judicial equity" (p. 45). But he, just like the followers of Stigler, fails to see that Coase has never meant the "Coase Theorem." Coase argued in his 1960 essay that

> There is no reason why, on occasion, ... governmental administrative regulation should not lead to an improvement in economic efficiency. This would seem particularly likely when, as is normally the case with the smoke nuisance, a large number of people is involved and when therefore the costs of handling the problem through the market or the firm may be high (Coase 1960).

The above interpretations of Coase's 1960 article look bizarre as the "Coase Theorem" does not belong to the works of Coase, but of Adam Smith. In other words, one would never need the "Coase Theorem," as Coase himself reports, to say that "people will use resources in the way that produces the most value" (Thomas Hazlett "Looking for Results?: Nobel Laureate Ronald Coase on Right, Resources, and Regulation" Reasononline January 1997: http://www.reason.com/news/show/30115.html). This would mean a world without transaction costs, but Coase has never assumed that transaction costs are negligible. On the contrary, Coase believed, we have lived in a world of positive transaction costs. And a world with positive transaction costs meant to be the opposite of what he calls "blackboard economics." The naming of the "Coase Theorem" was basically wrong because the theorem meant the opposite of what he wrote in his works. In fact, Coase raised the issue in his The Firm, the Market, and the Law (1988: 15). He said:

> What my argument does suggest is the need to introduce positive transaction costs explicitly into economic analysis so that we can study the world that exists. This has not been the effect of my article. The extensive discussion in the journals has concentrated almost entirely on the "Coase Theorem," a proposition about the world of zero transaction costs. This response, although disappointing, is undesirable.

McCloskey considers Stigler as one of the worst historians of economic thought. Stigler "used the history as an ideological tool," says McCloskey, "and was ruthless in doing so. He read a lot but was defective in paying attention. Thus the Coase Theorem" (Other Things Equal: the so-called Coase Theorem Eastern Economic Journal Summer 1998). McCloskey… Zerbe and Medema Coasean Economics

> The "Coase" theorem as advertised by George Stigler or sneered at by Paul Samuelson is actually Adam Smith's theorem (1776). It is wholly explicit in F. Y. Edgeworth (1881, 30ff, 114); and with all the bells and whistles in Arrow and Debreu (1954). Smith, Edgeworth, Arrow, Debreu,

> with many others, noted that an item gravitates by exchange into the hands of the person who values it the most, if transactions costs (such as the cost of transportation) are not too high. Why a student of economic thought like Stigler would call this oldest idea in economics "remarkable" I do not know, though as I say it is not the only strange reading that Stigler gave. Applying it to pollution rights is unremarkable. Where's the theorem? (McCloskey Other Things Equal: the so-called Coase Theorem Eastern Economic Journal Summer1998)

The case of the "Coase Theorem" is an example to intellectual paths in the history of economic thought in which a small event – that is Stigler's misreading of the writings of Coase – has generated a different path in the evolution of economic thought – a path dissimilar to Coase's argument in 1930s, 1960s, and onwards. Stigler's "Coase Theorem" was not in Coase's "The Nature of the Firm" (1937). Neither was it in "The Problem of Social Cost" (1960). A chance element – namely, Stigler – that didn't belong to the intellectual capacity of Coase influenced the way his contribution is construed by economists today.

Some ideas in history are in such institutional environments that we cannot easily eliminate their consequences: consequences linger and they give rise to further ideas. The chain of happenings feeds itself endlessly in such a way that early events in the course generate intellectual paths that last into the future. Had such ideas not been invented or argued for initially, the entire history of ideas would have been completely different.

James Wible, in his The Economics of Science: Methodology and Epistemology as if Economics Really Mattered (London: Routledge, 1998: pp.43-61), argues that consequences of small events in such chains of happenings can even result in "fraud." "Fraud in this context," writes Wible, "is the deliberate violation of scientific principle for personal material gain and professional advancement" (Wible 1998: 44). Whether the case of "Coase Theorem" could be called a "fraud" in the above sense is a different matter. What is certain in the case, however, is that a small event – Stigler's misnaming of Coase's contribution – was an error that lasted until today without being corrected and has generated an intellectual path in history. The problem of the social cost of Stigler's misunderstanding of Coase's writings to the community of intellectuals has been the failure to correct an error that has lasted for decades.

For an error to be counted as important, the error should be reinforced. It should persist in the face of correction. The market for ideas is full of such errors which put our world away from an intellectual optimum – that is, the state of a market of ideas in which past errors are not easily corrected. As Dewey once argued "'truths' in philosophy are in fact only

systematized mistakes and prejudices of our ancestors. Many of them originated in accident; many in class interest and bias, perpetuated by authority for this very reason" (Dewey 1950: 50). Rorty makes the point in a similar fashion. He thinks that many philosophical problems are products of the unconscious adoption of assumptions built into the vocabulary in which the problems were stated. We inherit philosophical problems, in other words, without questioning the assumptions that caused the problems. These assumptions, Rorty writes, are mainly due to the unfortunate mistakes and confusions that we are jammed into after the writings of Descartes, Locke, and Kant. Just as the patient needs to relive his past to answer her question, Rorty argues, philosophy needs to relive its past in order to resolve those obsessions.

Our present notions of what it is to be a philosopher are so tied up with the Kantian attempt to render all knowledge-claims commensurable that it is difficult to imagine what philosophy without epistemology could be. More generally, it is difficult to imagine that any activity would be entitled to bear the name "philosophy" if it had nothing to do with knowledge – if it were not in some sense a theory of knowledge, or a method for getting knowledge, or at least a hint as to where some supremely important kind of knowledge might be found. The difficulty stems from a notion shared by Platonists, Kantians, and positivists: that man has an essence – namely, to discover essences. The notion that our chief task is to mirror accurately, in our own Glassy Essence, the universe around us is the complement of the notion, common to Democritus and Descartes, that the universe is made up of every simple, clearly and distinctly knowable things, knowledge of whose essences provides the master-vocabulary which permits commensuration of all discourses (Rorty 1979: 357).

Many errors in the history of human ideas are usually trivial, because they are often corrected. In other words, "errors" do not always cause intellectual paths and give rise to undesirable consequences for the future. Stanley Jevons thought there was a connection between sunspots and business cycles. But it was soon corrected. "The Earth [was] at rest," Ptolemy thought, "[that] it [was] in the centre of the Universe, and that fixed stars move[d] together as a sphere" (Field 1981: 349). His astronomy nevertheless worked well, and it helped navigators produce land and sea maps using measurement and observatory techniques. Sungook Hong reports that Guglielmo Marconi's invention of the transmission of wireless signals across Atlantic was based upon a big mistake:

A number of notable scientists and engineers joined Marconi in believing it possible for electromagnetic waves to travel over a wall of ocean, based on the current theories of the

electron and ether, in which the electron was regarded as a "knot" of the electric strain in the ether. In this theoretical framework, the earth itself functioned as a sort of huge waveguide. However, it was not long before Marconi's idea of surface transmission was shown to be in error, for the electron was soon identified with real particles, and it was also shown that the earth could not guide waves as Marconi believed. We now know the electromagnetic waves that Marconi received in St. John's in 1901 did not get there by traveling along the surface of the earth, but by reflecting off the upper ionosphere (now known as the Heaviside-Kennelly layer). Marconi's achievement, based on the science of his time, was based upon a "big mistake (Hong 2005).

While some errors in history are harmless or even fruitful on occasion, some others generate long lasting paths of evolution. For some of the past errors are left uncorrected in time. We keep repeating the same errors through time. And uncorrected errors of the past sometimes generate disappointments about concrete situations in the future.

Ziliak and McCloskey report that of the 182 papers published in American Economic Review during 1980s 70% did not distinguish statistical significance from economic significance and 96% misused statistical significance tests (Ziliak and McCloskey 1996). They have conducted the same survey for the empirical papers of the next decade, and concluded that the case hasn't been getting better. Economists have since 1980s not ceased to make the same error. "Of the 137 relevant papers in the 1990s," write Ziliak and McCloskey (2004), "82% mistook statistically significant coefficients for economically significant coefficients (as against 70% in the earlier decade). In the 1980s 53% had relied exclusively on statistical significance as a criterion of importance at its first use; in the 1990s 64% did." Ziliak and McCloskey comment on the problem on their recent book, too, Size Matters (2007, forthcoming).

The sociological question is how such an error can persist. Or, rather, the economic question is why, because sociologists have less trouble than economists do – another trained incapacity – in supposing that people can persist in stupidity year after year. Economists on the contrary like to wonder why some smart person doesn't pick up the largely denominated bill, start a new intellectual firm, and reap the profits. If null hypothesis significance testing is as idiotic as we and its other critics believe, how has it survived?

Such errors have survived because historians of economics didn't notice a common feature about human thinking. The social element – that is, the set of undesirable consequences of the imperfect character of human doings – has usually been left out as

irrelevant in history books. Oddities and wrong-headedness have never been at the forefronts of human notice. They are seen only as peculiarities to be corrected sooner or later. There is not much a place left for insanity and madness in human history.

Charles Mackay in his Extraordinary Popular Delusions and the Madness of Crowds (1852) focuses on manias, follies, and delusions in human history. He covers such issues as "The South-Sea Bubble," "The Witch Mania," and "The Slow Poisoners," about which he wrote in 1852: "We find that whole communities suddenly fix their minds upon one object, and go mad in its pursuit; that millions of people become simultaneously impressed with one delusion, and run after it, till their attention is caught by some new folly more captivating than the first" (Mackay 1852: xv). Many haven't noticed the stories of madness in the past, but we live by the consequences of idiocy, insanity, and irony such as those that Mackay mentions in his book.

Matthias van Boxsel in his Encyclopedia of Stupidity (Reaktion Books, 2004) gives numerous examples to ironies in history. He argues that stupidity is the foundation of our civilization. This is how: the best way to get rid of the terrible feeling after a stupid act, according to Boxsel, is to repeat it. This turns stupidity into a joke and makes it funny. Thus stupidity turns into a conscious act. It is institutionalized and has become a condition for intelligence.

Is there any place in the history of economic ideas for the imperfect character of human doings that is repeated until we stop to think of it as an error? In the conventional histories of economics there is almost none. The importance of the phenomenon, however, is immense. There are such events in history and they generate paths upon which the entire literature is often held dependent. The "Coase Theorem" and statistical significance tests are only two of the examples to important intellectual paths in our scholarly life in which to set a new path in motion has long been impossible. As Morris Altman, the editor of The Journal of Socio-Economics, argues:

The current practice statistical significance represents a market failure in the sense that the market for published and refereed articles has failed to drive out a substandard product: the use of tests statistical significance for wrong (unscientific) reasons. Moreover, the persistence of this sub-optimal practice is path dependent, a product of the type of market which exists for journal articles and the economic and psychological costs of producing the product. The current structure of incentives is such that one cannot expect that the current wrong practices will be easily abandoned or significantly modified. We are locked in to a

path of empirical practice which yields unscientific results with regards to analytical significance (Altman 2004).

Jevons once made an identical point. He argued that "that able but wrong-headed man, David Ricardo, shunted the car of Economic science on to a wrong line, a line, however, on which it was further urged towards confusion by his equally able and wrong-headed admirer, John Stuart Mill" (Jevons 1871: 45). Jevons thought that Malthus and Senior had a better understanding of "true doctrines." But the influence of Ricardo and Mill was big. "It will be a work of labor," Jevons claimed, "to pick up the fragments of a shattered science and to start anew." But it is a hard task, he argued, though a must for those who'd like to see the advance of economic science.

As William Coleman correctly points at, "instead of moving further away ('ahead') from the past, economic thought has sometimes moved 'forward into the past' as old problems recur, and older theories live again. Thus in the 1970s slow growth of the UK economy promoted Roger Bacon and Walter Eltis to advance classical growth like diagnoses of this sluggishness: too few producers. Similarly, the war between post-Keynesians and Monetarists in the same period was reminiscent of the 1840s controversy between the Banking School and the Currency School" (Coleman 2005). And likewise, the South Sea Bubble was repeated when the Wall Street crashed in 1929. Families were torn apart at the time. People turned beggars (Mackay 1995: 46-88; Colbert 2001: 13-14). Alchemists and fortunetellers are still alive at the present. They keep occupied the minds of many people who read astrology magazines. We have so long forgotten the business of witchcraft, but witchcraft remains (at least) conceptually in our daily lives.

An important issues here is nevertheless that although such errors are abound in intellectual history, there is a great many important achievements in the past. It is not wise today, for instance, to look up Smith to read the best theory of division of labor. Sophisticated versions of the theories of the eighteenth and nineteenth centuries are printed in many contemporary economics textbooks. The idea of government today is much sophisticated that it was when Plato first wrote about it. In other words, there's been considerable progress in sciences, philosophy, and arts. Boulding's question, in this sense, is very intriguing: after Paul Samuelson who needs Adam Smith? (Boulding 1971).

It is a vice, however, to ignore the historical past of economic science as if there were a single path of institutional evolution headed at perfection. Economists have incorrectly assumed that whatever knowledge that economics departments produce would immediately

add to the body of economic science. Some texts, which were not considered as important at the time they were first published, could come to the forefronts of the economic theory only years after their publication. Cournot's model of competition and Wicksell's theory of inflation are among the examples showing us that good ideas are sometimes completely ignored or stood out of economists' sight (Coleman 2005).

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