

Natural Science and Humanities Concepts in Interdisciplinary Projects: Bridge the Gap between Humanists and Scientists

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All earnest and honest human quests for knowledge are efforts to understand Nature, which includes both human and nonhuman systems, the objects of study in science. Thus, broadly speaking, all these quests are in the science domain. The methods and tools may be different; for example, the literary people use mainly their bodily sensors and their brain as the information processor, while natural scientists may use, in addition, measuring instruments and computers. Yet, all these activities could be viewed in a unified perspective: they are scientific developments at varying stages of maturity and have a lot to learn from each other.

In fact, in the last 400 years or so since Galileo, modern “science”(consisting mainly by nonhuman systems) has progressed rapidly because of three factors: Scientists pick the simple systems to study; they make a lot of simplifications; they use external detectors and information processors (computers). Partly due to the great successes of these studies, these days, the word “science” is inexplicitly identified with the “science of simple systems”, while the “science of complex systems” to which all human-dependent knowledge belongs is often neglected.

However, in the field of human-related disciplines, it is only recently, with the advent of modern science and experiences gathered in the study of statistical physics, complex systems and other disciplines, that we know how these disciplines can be studied scientifically. Science Matters (SciMat) is the new discipline that treats all human-related matters as part of science. SciMat is about all human-dependent knowledge, wherein, humans (the material system of Homo sapiens are studied scientifically from the perspective of complex systems using unifying principles that can be found in different paradigms such as fractals and chaos. SciMat’s definition of science: Science is human’s pursuit of knowledge about all things in Nature, which include all (human and nonhuman) systems, without bringing in God or any supernatural.

There seems to be a consensus on the fact that sciences and humanities are indispensable in generating knowledge about the dynamic changes that transform our societies. They form the basis of the Horizon 2020 Societal Challenges Pillar and their integration with other sciences will broaden our understanding of innovation, driven not only by technological advances,



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but also by societal expectations, values and demands. Now, according to the SciMat Project the aim of SciMat is to bridge this gap by unifying all the fields producing a new landscape of knowledge: the “Knowscape”, which involves a human-dependent part (human matters and artificial systems) plus a human-independent part. SciMat includes: Humanities, Social Sciences, Natural Science and Medical Sciences, all-in-one discipline called SciMat since 2008 according to the principle: “Science is to understand Nature”, humans included because everything is made up of atoms. Science Matters (SciMat) is an attitude (or concept), like the case in any new discipline when it first emerges. The attitude of SciMat is just one sentence: “Science is to understand Nature”. To make this possible knowledge must struggle for a unified perspective.

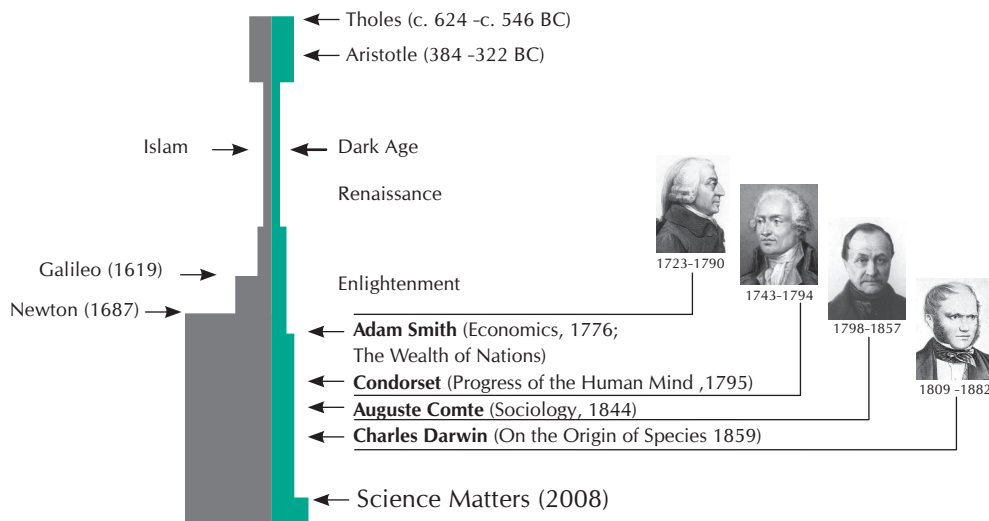
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INTRODUCTION

All earnest and honest human quests for knowledge are efforts to understand Nature, which includes both human and nonhuman systems, the objects of study in science. Thus, broadly speaking, all these quests are in the science domain. The methods and tools may be different; for example, the literary people use mainly their bodily sensors and their brain as the information processor, while natural scientists may use, in addition,

measuring instruments and computers. Yet, all these activities could be viewed in a unified perspective: they are scientific developments at varying stages of maturity and have a lot to learn from each other. In fact, in the last 400 years or so since Galileo, modern “science” (Fig. 1) (consisting mainly by nonhuman systems) has progressed rapidly because of three factors: Scientists pick the simple systems to study; they make a lot of simplifications; they use external

Fig. 1. A brief history of science in the last 2600 years since Thales. The left (right) column corresponds to simple (complex) systems; the column width represents roughly how much the development activity was during different time periods.



detectors and information processors (computers). Partly due to the great successes of these studies, these days, the word “science” is inexplicitly identified with the “science of simple systems”, while the “science of complex systems” to which all human-dependent knowledge belongs is often neglected.

“Science” with the so-called scientific method dated only from 1867 and emerged as a separated field of knowledge from humanities. Therefore, the aim of SciMat is to bridge this gap by unifying all the fields producing a new landscape of knowledge: the “Knowscape” (Fig. 2), which involves a human-dependent part (involves the study of humanities, social sciences and medical sciences mainly neurosciences and genetics) plus a human-independent part (involves the study of non-human biologic and inanimate systems – usually called as “natural sciences”). SciMat includes: Humanities, Social Sciences and Natural Science all-in-one discipline called SciMat since 2008 according to the principle: “Science

is to understand Nature”, humans included because everything is made up of atoms. Science Matters (SciMat) is an attitude (or concept), like the case in any new discipline when it first emerges.

In the field of human-related disciplines, it is only recently, with the advent of modern science and experiences gathered in the study of statistical physics, complex systems and other disciplines, that we know how these disciplines can be studied scientifically. To bridge the gap, Science Matters (SciMat) is the new discipline that treats all human-related matters as part of science. Science Matters links up humanities and “science” completely while active walk, fractal and chaos, respectively, does that partially. Humanities and “science” share the same root, growing up like two branches of the same plant (Fig. 3).

SciMat is about all human-dependent knowledge, wherein, humans (the material system of Homo sapiens are studied scientifically from the perspective of complex systems

Fig. 2. Knowscape.

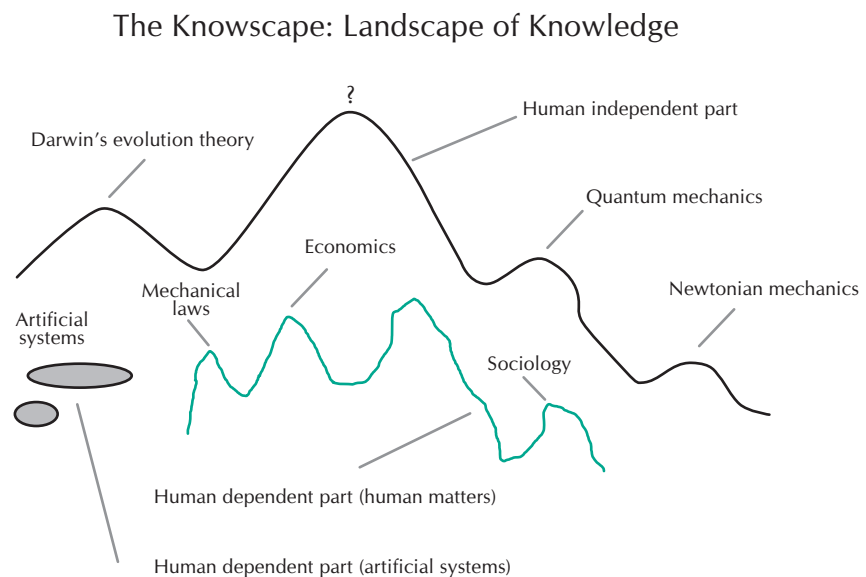
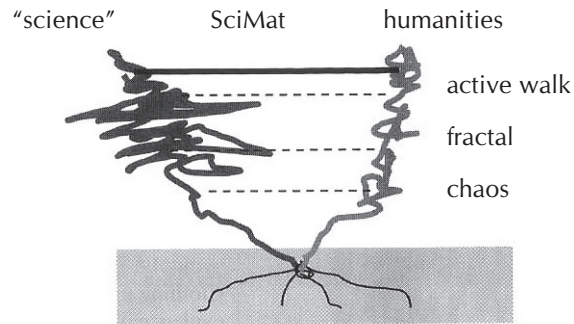


Fig. 3.



using unifying principles that can be found in different paradigms such as fractals, chaos and “active walk”. A fractal is a self-similar object, possessing quite often a fractional dimension; fractals are everywhere, ranging from the morphology of three leaves, rock formations and human blood vessels to the stock market indices and the structure of galaxies [Warnecken, 1993; Barrow, 1995; Lam, 2004]. Chaos is the phenomenon observed in some nonlinear systems and as examples there are, human heartbeats and planetary motion in the solar system. The concept is also found applicable in psychology, life sciences and literature [Robertson & Combs, 1995]. A review of chaos for general readers is available [Yorke & Grebogi, 1996]. Active Walk (AW) is a major principle that Nature uses in self-organization; it is a generic origin of complexity in the real world [Zhou et al., 2008]. Active Walk is a paradigm introduced by [Lam, 2006] in 1992, to handle complex systems; in a AW, a particle (the walker) changes a deformable potential – the landscape – as it walks: its next step is influenced by the changed landscape. Active walk has been applied successfully to a number of complex systems coming from natural and social sciences. Examples include pattern formation in physical, chemical and biological systems such as surface-

reaction induced filaments and retinal neurons, formation of fractal surfaces and human history [Lam, 2002; 2006; 2008]. All three principles are now an integral part of complex-system science, which is becoming important in the understanding of business, governments and the media, among other things. In any scientific study there are three approaches or levels: empirical, phenomenological and bottom-up – that one can adopt to go further [Lam, 2002]. These three approaches in the cases of physics and arts are sketched in Fig. 4. Empirical studies always happen first. Phenomenological studies are done without knowing the mechanism underlying a phenomenon; they are very powerful and sometimes undervalued. Fundamental understanding of a phenomenon is reached through the bottom-up studies in which the mechanism will reveal itself and become understood.

SciMat’s definition of science: Science is human’s pursuit of knowledge about all things in Nature, including all (human and nonhuman) systems, without bringing in God or any supernatural (Fig. 5).

So we can design a “Science Room” where we can see the difference between the conventional view of science and SciMat view (Fig. 6).

By grouping humanities and social science together under one umbrella, human-related science, one can

Fig. 4.

Three Levels of Study in Humanities

In any scientific study, after

- observing and collecting data and,
- analyzing data

In arts, done mostly by artists, writers, musicians, movie directors and actors, ...

See, e.g., J. Lehrer Froust was a neuroscientist (2007)

There are three approaches to go further:

| Approach | Gas | Arts |
|------------------|--|---|
| Empirical | gas law | done by some artists, art critics and historians; physicist-fractals |
| Phenomenological | Navier-Stokes equation | done by some historians / philosophers; evolution theory (Darwin's time) |
| Bottom-up | molecular picture (called "microscopic" method in physics) | biology-evolution theory (genes), cognitive science (neuro) physics - statistical analysis, ... |

Jonh Barrow, *The Artful Universe (1995): Physics Meets Art and Literature*. Dec. 2002

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Fig. 5.

God in the Philosophy Box

- Science defined as humans' research on understand Nature (human and non-human systems) without appealing to God / superstition
- God could be brought in

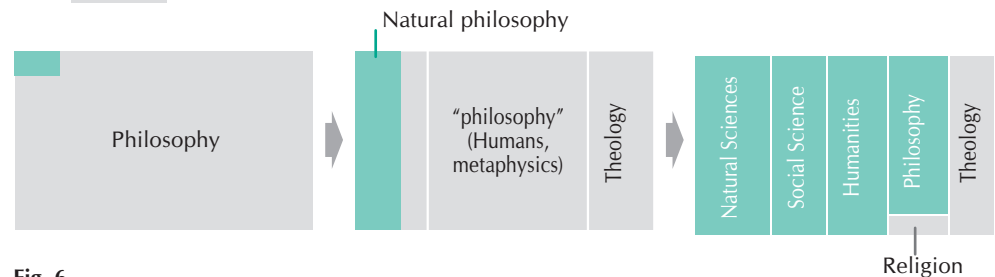
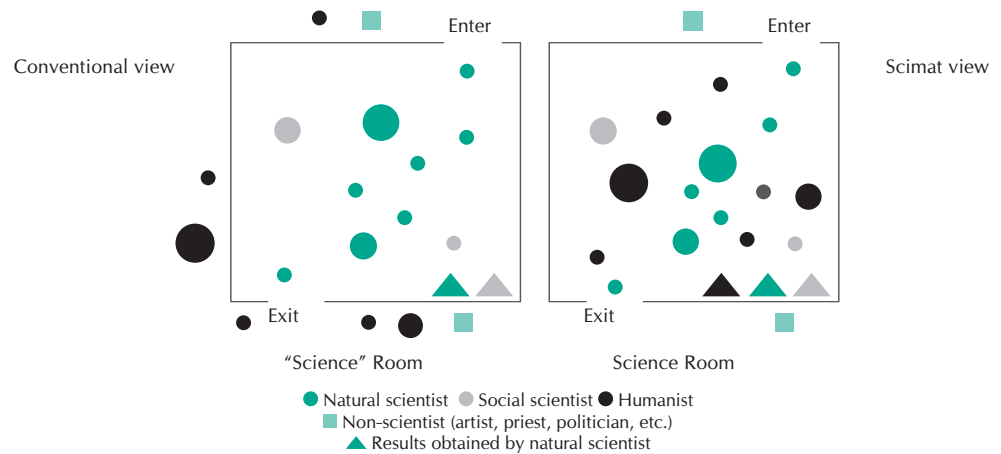


Fig. 6.

The Science Room



understand a new and more logically the connection between the constituent disciplines (Table 1.1). For the sake of convenience and with full respect for life an interesting phenomenon in Nature with yet an unknown origin, let us call a human being a “body” (there are several basic facts about such a body [Lam, 2002]().

Keeping these facts and table 1.1 in mind is important and advantageous when a human-related study is being undertaken. It allows you to pick up the right tools and the right approximations (that is, simplifying the problem by ignoring some irrelevant factors) to do the research. And it allows you to borrow or to be inspired by some successful experience from other areas of study such as physics or chemistry (wherein, same classification like that in Table 1.1 is used).

There seems to be a consensus on the fact that sciences and humanities are indispensable in generating knowledge about the dynamic

changes that transform our societies. They form the basis of the Horizon 2020 Societal Challenges Pillar and their integration with other sciences will broaden our understanding of innovation, driven not only by technological advances, but also by societal expectations, values and demands. Now, according to the SciMat Project there is a six steps Science Matters Program being the first three already performed. The Science Matters Program, started by Maria Burguete and Lui Lam in 2007, is the latest international effort to revive the Aristotle tradition of a unified knowledge, and is the “only game in town”:

1. Established the biennial international SciMat conference series
2. Establish an International Science Matters Committee with 17 prestigious members from all around the world, Robin Warren, Nobel of Medicine 2005 included
3. Establish a new book series, Science Matters Series Books published by World Scientific

Table 1. Classification of the human system in a focused study according to the number of bodies involved, with examples and major relevant disciplines.

| | One-body | Few-body | Many-body |
|------------|--|---|---|
| Example | a Greek male, a Tang Dynasty female, Einstein, Barbara Streisand, Hark Tsui, you, me | Romeo and Juliet, husband and wife, husband and wife living with mother-in-law? A person with two loves, small-size family, the Beatles | Large physics class, tribe, city, country, Roman Empire, society, stock market, IBM |
| Discipline | Art, music, performing arts, language, literature, psychology, history (biography), neuroscience, genetics, medicinal science, law | Psychology, literature, performing arts, history, (family) law | Anthropology, (mass) psychology, philosophy, literature, culture, religion, history, business management, economics, education, environmental science, law, social welfare, sociology, women’s study, law |

¹ Each body is macroscopic from 40–200 cm long; it is a classical particle, so quantum mechanics is irrelevant to those bodies; each body in their daily life moves very slowly compared to light, so no need for Einstein’s special relativity theory; the mass of each body is so small (compared with that of the Planet, say), that Einstein’s general theory of relativity can be forgotten too; each body consists of layers and layers of structures (molecules, cells, organs, etc); and many internal states (memory, thought, mood, etc); all bodies derived from the same ancestor, say African Eve, around ten thousand years ago and according to Darwin’s evolution theory, human body and human nature, take a long time to evolve and thus are practically unchanged over the last 6000 years or so – the period in which human history is recorded; each body is an open system, so the second law of thermodynamics does not apply here since the law is for closed systems and equilibrium states only; each body is under the influence of external fields, the most important of which is the society to which the body happens to belong.

Publisher until 2017 assuring the first five volumes of the collection 4. Establish SciMat centers worldwide 5. Set up an International SciMat Society 6. Publish an International SciMat Journal.

To make this possible knowledge must struggle for a unified perspective. To make the world better it is important to raise the scientific level of the humanities. We believe that Enlightenment (1688-1789) fails to establish humanities as a science because: human matters are complex systems and also not deterministic systems like in Newtonian mechanics and the tool of probabilistic science

was not yet there. To ensure this happen, the two crucial steps are:

- 1) The establishment of a large number of SciMat Centers around the world.

- 2) To write up of a SciMat general-education textbook for university students of all majors.

To finish, I would like to say a word in terminology: In SciMat, the word Science is used to mean all kinds of scholarly enquiry, including those from Sociology, Art Studies as well as Physical Sciences, while Science in the narrow sense adopted by others is written with quotes, "Science".

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