Natural sciences and social sciences epistemology

1–<u>What are natural sciences</u>:

In science, natural science is the rational study of the universe via rules or laws of natural order. The term natural science is also used to differentiate those fields using scientific method in the study of nature, in contrast with social sciences which use the scientific method applied to human behavior, and in contrast to formal sciences, which uses different methodology.
Formal sciences are sciences that are predominantly concerned with abstract forms, for instance, logic, mathematics, and the theoretical branches of computer sciences, information theory, and statistics.
In the natural sciences, i.e. according to the American Nobel Prize winning chemist Gilbert Lewis there are three great branches:
Aside from the logical and mathematical sciences, there are three great branches of *natural science* which stand apart by reason of the variety of far reaching deductions drawn from a small number of primary postulates – they are the mechanics, electrodynamics and thermodynamics.
Natural sciences form the basis for the applied sciences. Together, the natural and applied sciences are distinguished from the social sciences on the one hand, and from the humanities, theology and the arts on the other. Mathematics as formal sciences is not natural sciences, but provides many tools and frameworks used within the natural sciences.
Alongside this traditional usage, more recently the words natural sciences are sometimes used in a way more closely matching their everyday meaning, stemming from natural history. In this sense "natural sciences" can be an alternative phrase for biological sciences, involved in biological processes, or perhaps also the earth sciences, as might be distinguished from the physical sciences (more directly involved in the study of physical and chemical laws underlying the universe).

<u>2- What is scientific method</u>?

Scientific method is a body of techniques for investigating *phenomena* and acquiring new knowledge, as well as for correcting and integrating previous knowledge. It is based on observable, empirical, measurable evidence, and subject to *laws of reasoning*.
Although specialized procedures vary from one field of inquiry to another, there are identifiable features that distinguish scientific inquiry from other methods of developing knowledge.
Scientific researchers propose specific <u>hypotheses</u> as explanations of natural phenomena, and design experimental studies that test these predictions for accuracy. These steps are repeated in order to make increasingly dependable predictions of future results. <u>Theories</u> that encompass whole domains of inquiry serve to bind more specific hypotheses together into logically coherent wholes. This in turn aids in the formation of new hypotheses, as well as in placing groups of specific hypotheses into a broader context of understanding.
Among other facets shared by the various fields of inquiry is the conviction that the process must be *objective* so that the scientist does not bias the interpretation of the results or change the results outright. (In science, objectivity is usually considered as the result of the observance of the scientific method by the scientific community, including a contradictory debate on agreements and paradigms, but how we know that the scientific method is objective). Another basic

expectation is that of making complete documentation of data and methodology available for careful scrutiny by other scientists and researchers, thereby allowing other researchers the opportunity to verify results by attempted reproduction of them. This also allows statistical measures of the *reliability* (1) of the results to be established. The scientific method also may involve attempts, if possible and appropriate, to achieve control over the factors involved in the area of inquiry, which may in turn be manipulated to test new hypotheses in order to gain further knowledge.

3 - Elements of scientific method

3-1 General features:

"Science is a way of thinking much more than it is a body of knowledge." (Carl Sagan) ". .
“Science consists in grouping facts so that general laws or conclusions may be drawn from them." (Charles Darwin).
There are multiple ways of outlining the basic method shared by all of the fields of scientific inquiry. The following examples are typical classifications of the most important components of the method on which there is very wide agreement in the scientific community and among philosophers of science, each of which are subject only to marginal disagreements about a few very specific aspects.

The scientific method involves the following basic facets:

- Observation: A constant feature of scientific inquiry.
- Description: Information must be reliable, i.e., replicable (repeatable) as well as valid (relevant to the inquiry).

- Prediction: Information must be valid for observations past, present, and future of given phenomena, i.e., purported "one shot" phenomena do not give rise to the capability to predict, or to the ability to repeat an experiment.
- Control: Actively and fairly sampling the range of possible occurrences, whenever possible and proper, as opposed to the passive acceptance of opportunistic data, is the best way to control or counterbalance the risk of empirical bias.

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1) In statistics, reliability is the consistency of a set of measurements or measuring instrument. Reliability does not imply validity. That is, a reliable measure is measuring something consistently, but not necessarily what it is supposed to be measuring. For example, while there are many reliable tests, not all of them would validly predict job performance.
In experimental sciences, reliability is the extent to which the measurements of a test remain consistent over repeated tests of the same subject under identical conditions. An experiment is reliable if it yields consistent results of the same measure. It is unreliable if repeated measurements give different results.

- Falsifiability: or the elimination of plausible alternatives. This is a gradual process that requires repeated experiments by multiple researchers who must be able to replicate results in order to corroborate them. This requirement, one of the most frequently contended, leads to the following: All hypotheses and theories are in principle subject to disproof. Thus, there is a point at which there might be a consensus about a particular hypothesis or theory, yet it must in principle remain tentative. As a body of knowledge grows and a particular hypothesis or theory repeatedly brings predictable results, confidence in the hypothesis or theory increases.

- Causal explanation: Many scientists and theorists on scientific method argue that concepts of causality are not obligatory to science, but are in fact well-defined only under particular, admittedly widespread conditions.

Under these conditions the following requirements are generally regarded as important to scientific understanding:

a) *Identification of causes*: The identification of the causes of a particular phenomenon to the best achievable extent.

b) *Co variation of events*: The hypothesized causes must correlate with observed effects.

c) *Time-order relationship*: The hypothesized causes must precede the observed effects in time.

These requirements are more specific of the hypothesis/testing method. This general set of elements and organization of procedures will in general tend to be more characteristic of natural sciences and experimental psychology than of disciplines such as sociology and a number of other fields commonly categorized as social sciences. Among the latter, methods of verification and testing of hypotheses may involve less stringent mathematical and statistical interpretations of these elements within the respective disciplines. Nonetheless the cycle of hypothesis, verification and formulation of new hypotheses will tend to resemble the same basic cycle described here.

The essential elements of a scientific method are *iterations, recursions, interleaving* and *orderings* of the following:

- Characterizations : (Quantifications, observations, and measurements)
- Hypotheses (theoretical, hypothetical explanations of observations and measurements)
- Predictions (reasoning including logical deduction from hypotheses and theories)
- Experiments: (tests of all of the above)

The element of observation includes both unconditioned observations (prior to any theory) as well as the observation of the experiment and its results. The element of experimental design must consider the elements of hypothesis development, prediction, and the effects and limits of observation because all of these elements are typically necessary for a valid experiment.
Imre Lakatos and Thomas Kuhn had done extensive work on the "theory laden" character of observation. Kuhn (1961) maintained that the scientist generally has a theory in mind before designing and undertaking experiments so as to make empirical observations, and that the "route from theory to measurement can almost never be traveled backward". This perspective implies that the way in which theory is tested is dictated by the nature of the theory itself which led Kuhn to argue that "once it has been adopted by a profession ... no theory is recognized to be testable by any quantitative tests that it has not already passed".
Each element of scientific method is subject to peer review for possible mistakes. These activities do not describe all that scientists do but apply mostly to experimental sciences (e.g., physics, chemistry). The elements above are often taught in the educational system.

The scientific method is not a recipe: it requires intelligence, imagination, and creativity. Further, it is an ongoing cycle, constantly developing more useful, accurate and comprehensive models and methods. For example, when Einstein developed the Special and General Theories of Relativity, he did not in any way refute or discount Newton's Principia. On the contrary, if one reduces out the astronomically large, the vanishingly small, and the extremely fast from Einstein's theories — all phenomena that Newton could not have observed — one is left with Newton's equations. Einstein's theories are expansions and refinements of Newton's theories, and the observations that increase our confidence in them also increase our confidence in Newton's approximations to them.

Theoretical development is accompanied here by different examples of the scientific method applied to sciences and in particular to Human Genome.

3-2 Characterizations in scientific method:

The scientific method depends upon increasingly more sophisticated characterizations of subjects of the investigation. (The subjects can also be called list of unsolved problems or the unknowns.) For example, Benjamin Franklin correctly characterized St Elmo’s fire as electrical in nature, but it has taken a long series of experiments and theory to establish this.

While seeking the pertinent properties of the subjects, this careful thought may also entail some definitions and observations; the observations often demand careful measurements and/or counting.

The systematic, careful collection of measurements or counts of relevant quantities is often the critical difference between pseudo-sciences, such as alchemy, and a science, such as chemistry. Scientific measurements taken are usually tabulated, graphed, or mapped, and statistical manipulations, such as correlation and regression, performed on them. The measurements might be made in a controlled setting, such as a laboratory, or made on more or less inaccessible or un unmanipulatable objects such as stars or human populations. The measurements often require specialized scientific instruments such as thermometers, spectroscopes, or voltmeters, and the progress of a scientific field is usually intimately tied to their invention and development.

Measurements demand the use of operational definitions of relevant quantities. That is, a scientific quantity is described or defined by how it is measured, as opposed to some more vague, inexact or "idealized" definition. For example, electrical current, measured in amperes, may be operationally defined in terms of the mass of silver deposited in a certain time on an electrode. The operational definition of a thing often relies on comparisons with standards: the operational definition of "mass" ultimately relies on the use of an artifact, such as a certain kilogram of platinum-iridium kept in a laboratory in France.

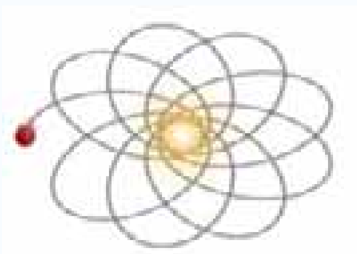
The scientific definition of a term sometimes differs substantially from their natural language usage. For example, mass and weight overlap in meaning in common discourse, but have distinct meanings in physics. Scientific quantities are often characterized by their units of measure which can later be described in terms of conventional physical units when communicating the work.

Measurements in scientific work are also usually accompanied by estimates of their uncertainty. The uncertainty is often estimated by making repeated measurements of the desired quantity. Uncertainties may also be calculated by consideration of the uncertainties of the individual underlying quantities that are used. Counts of things, such as the number of people in a nation at a particular time, may also have an uncertainty due to limitations of the method used. Counts may only represent a sample of desired quantities, with an uncertainty that depends upon the sampling method used and the number of samples taken.

New theories sometimes arise upon realizing that certain terms had not previously been sufficiently clearly defined. For example, Albert Einstein’s first paper on relativity begins by defining simultaneity and the means for determining length. These ideas were skipped over by Isaac Newton with, "I do not define time, space, place and motion, as being well known to all." Einstein's paper then demonstrates that they (viz., absolute time and length independent of motion) were approximations.
Francis Crick cautions us that when characterizing a subject, however, it can be premature to define something when it remains ill-understood. In Crick's study of consciousness, he actually found it easier to study awareness in the visual system, rather than to study Free Will, for example. His cautionary example was the gene; the gene was much more poorly understood before Watson and Crick's pioneering discovery of the structure of DNA; it would have been counterproductive to spend much time on the definition of the gene, before them.

The history of the discovery of the structure of DNA is a classic example of the elements of scientific method: in 1950 it was known that genetic inheritance had a mathematical description, starting with the studies of Gregor Mendel. But the mechanism of the gene was unclear. Researchers at Cambridge University made X-*ray diffraction pictures* of various molecules, starting with crystals of salt, and proceeding to more complicated substances. Using clues which were painstakingly assembled over the course of decades, beginning with its chemical composition, it was determined that it should be possible to characterize the physical structure of DNA, and the X-ray images would be the vehicle.

Precession of Mercury



Precession of the perihelion (very exaggerated)
The characterization element can require extended and extensive study, even centuries. It took thousands of years of measurements, from the Chaldean, Indian, Persian, Greek, Arabic, Chinese and European astronomers, to record the motion of planet Earth. Newton was able to condense these measurements into consequences of his laws of motion. But the perihelion of the planet Mercury’s orbit exhibits a precession which is not fully explained by Newton's laws of motion. The observed difference for Mercury's precession, between Newtonian theory and relativistic theory (approximately 43 arc-seconds per century), was one of the things that occurred to Einstein as a possible early test of his theory of General relativity.

3-3 Hypothesis development in scientific method

A hypothesis is a suggested explanation of a phenomenon, or alternately a reasoned proposal suggesting a possible correlation between or among a set of phenomena.
Normally hypotheses have the form of a mathematical model. Sometimes, but not always, they can also be formulated as existential statements, stating that some particular instance of the phenomenon being studied has some characteristic and causal explanations, which have the

general form of universal statements, stating that every instance of the phenomenon has a particular characteristic.

Scientists are free to use whatever resources they have — their own creativity, ideas from other fields, induction (1, 3), Bayesian inference (3), and so on — to imagine possible explanations for a phenomenon under study. Charles Sanders Peirce, following Aristotle described the incipient stages of inquiry, instigated by the "irritation of doubt" to venture a plausible guess, as abductive reasoning (2). The history of science is filled with stories of scientists claiming a "flash of inspiration", or a hunch, which then motivated them to look for evidence to support or refute their idea. Michael Polyani made such creativity the centerpiece of his discussion of methodology. Karl Popper, following others, notably Charles Peirce, has argued that a hypothesis must be falsifiable, and that a proposition or theory cannot be called scientific if it does not admit the possibility of being shown false. It must at least in principle be possible to make an observation that would show the proposition to be false, even if that observation had not yet been made.

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(1) Induction or inductive reasoning, sometimes called inductive logic, is the process of reasoning in which the premises of an argument is believed to support the conclusion but do not ensure it. It is used to ascribe properties or relations to types based on tokens (i.e., on one or a small number of observations or experiences); or to formulate laws based on limited observations of recurring phenomenal patterns.
Induction is used, for example, in using specific propositions such as:
This ice is cold. A billiard ball moves when struck with a cue.
...to infer general propositions such as:
All ice is cold. For every action, there is an equal and opposite reaction. Anything struck with a cue moves.

(2) Abduction, or abductive reasoning, is the process of reasoning to the best explanations. In other words, it is the reasoning process that starts from a set of facts and derives their most likely explanations. The term abduction is sometimes used to mean just the generation of hypotheses to explain observations or conclusions, but the former definition is more common both in philosophy and computing.
Deduction and abduction differ in the direction in which a rule like "a entails b" is used for inference. Deduction allows deriving b as a consequence of a; in other words, deduction is the process of deriving the consequences of what is known. Abduction allows deriving a as an explanation of b; abduction works in reverse to deduction, by allowing the precondition a of "a entails b" to be derived from the consequence b; in other words, abduction is the process of explaining what is known. In rare occasions, the expression "explanatory conclusions" is used instead of "explanations" to name the result of the abductive process. Applications in artificial intelligence include fault diagnosis, belief revision, and automated planning.
Historically, Aristotle use of the term (apagoge) has referred to a syllogism in which the major premise is known to be true, but the minor premise is only probable.
The philosopher Charles Peirce introduced abduction into modern logic. In his works before 1900, he mostly uses the term to mean the use of a known rule to explain an observation, e.g., "if it rains the grass is wet" is a known rule used to explain that the grass is wet.
He later used the term to mean creating new rules to explain new observations, emphasizing that abduction is the only logical process that actually creates anything new. Namely, he described the process of science as a combination of abduction, deduction and implication, stressing that new knowledge is only created by abduction.
This is contrary to the common use of abduction in the social sciences, where the old meaning is used. Contrary to this use, Peirce stated that the actual process of generating a new rule is not "hampered" by logic rules. Rather, he pointed out that humans have an innate ability to infer correctly; possessing this ability is explained by the evolutionary advantage it gives. Peirce's second use of 'abduction' is most similar to induction.

Linus Pauling proposed that DNA was a triple helix. Crick and Watson learned of Pauling's hypothesis, understood from existing data that Pauling was wrong and realized that Pauling would soon realize his mistake. So the race was on to figure out the correct structure. Except that Pauling did not realize at the time that he was in a race!
Any useful hypothesis will enable predictions, by reasoning including deductive reasoning. It might predict the outcome of an experiment in a laboratory setting or the observation of a phenomenon in nature. The prediction can also be statistical and only talk about probabilities.
It is essential that the outcome be currently unknown. Only in this case does the eventuation increase the probability that the hypothesis be true. If the outcome is already known, it's called a consequence and should have already been considered while formulating the hypothesis.
If the predictions are not accessible by observation or experience, the hypothesis is not yet useful for the method, and must wait for others who might come afterward, and perhaps rekindle its line of reasoning. For example, a new technology or theory might make the necessary experiments feasible.

3-4 Predictions in scientific method

When Crick and Watson hypothesized that DNA was a double helix, Crick predicted that an X-ray diffraction image of DNA would show an X-shape. Also in their first paper they predicted that the double-helix structure that they discovered would prove important in biology writing "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material".

Einstein's theory of General relativity makes several specific predictions about the observable structure of space-time; such as a prediction that light bends in a gravitational field and that the amount of bending depends in a precise way on the strength of that gravitational field. Arthur Eddington's observations made during a 1919 solar eclipse supported General Relativity rather than Newtonian gravitation.

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(3) The nature of induction consists in inducing the universal from the particular. However, the conclusion is not certain. All observed crows are black. Therefore, all crows are black. Unless we are certain that we have seen every crow – something that is impossible – there may be one of a different color. (In fact albino birds are far from impossible.) (Being black may be added to the definition of a crow; but if two crow-like birds were to be identical except for their color, one would become an instance of a black crow and the other a (rare) instance of, say, a blue crow – but both would still be regarded as crows.) Some inductions are weaker than others: I always hang pictures on nails. Therefore, all pictures hang from nails. The link between the premise and the inductive conclusion is weak. No reason exists to believe that just because one person hangs pictures on nails that there are no other ways for pictures to be, or that other people cannot do other things with pictures. Indeed, not all pictures are hung from nails; moreover, not all pictures are hung.
A generalization (more accurately, an inductive generalization) proceeds from a premise about a sample to a conclusion about the population.
A statistical syllogism is also inductive proceeds from a generalization to a conclusion about an individual: A proportion Q of population P has attribute A. An individual I is a member of P. Therefore, there is a probability which corresponds to Q that I has A.
An (inductive) analogy proceeds from known similarities between two things to a conclusion about an additional attribute common to both things: P is similar to Q. P has attribute A therefore Q has A.
Of the candidate systems for an inductive logic, the most influential is Bayesanism. This uses probability theory as the framework for induction. Given new evidence, Bayes' theorem is used to evaluate how much the strength of a belief in a hypothesis should change.

3-5 Experiments and scientific method:

Once predictions are made, they can be tested by experiments. If test results contradict predictions, then the hypotheses are called into question and explanations may be sought. Sometimes experiments are conducted incorrectly and are at fault. If the results confirm the predictions, then the hypotheses are considered likely to be correct but might still be wrong and are subject to further testing.
Depending on the predictions, the experiments can have different shapes. It could be a classical experiment in a laboratory setting, a double-blind study or an archeological excavation. Even taking a plane from Delhi to Paris is an experiment which tests the aerodynamical hypotheses used for constructing the plane.
Scientists assume an attitude of openness and accountability on the part of those conducting an experiment. Detailed recordkeeping is essential, to aid in recording and reporting on the experimental results, and providing evidence of the effectiveness and integrity of the procedure. They will also assist in reproducing the experimental results. This tradition can be seen in the work of Hipparchus (190 BCE-120 BCE), when determining a value for the precession of the Earth over 2100 years ago, and 1000 years before Al-Batani.
The X-shape in X-ray images helped Watson and Crick to confirm the double - helical structure of DNA.

3-6 Evaluation and iteration; Testing and improvement

The scientific process is iterative. At any stage it is possible that some consideration will lead the scientist to repeat an earlier part of the process. Failure to develop an interesting hypothesis may lead a scientist to re-define the subject they are considering. Failure of a hypothesis to produce interesting and testable predictions may lead to reconsideration of the hypothesis or of the definition of the subject. Failure of the experiment to produce interesting results may lead the scientist to reconsidering the experimental method, the hypothesis or the definition of the subject. Other scientists may start their own research and enter the process at any stage. They might adopt the characterization and formulate their own hypothesis, or they might adopt the hypothesis and deduce their own predictions. Often the experiment is not done by the person who made the prediction and the characterization is based on experiments done by someone else. Published results of experiments can also serve as a hypothesis predicting their own reproducibility.
After considerable fruitless experimentation, Watson and Crick were able to infer the essential structure of DNA by concrete modeling of the physical shapes of the nucleotides which comprise it. They were guided by the bond lengths which had been deduced by Pauling and the X-ray diffraction images of Franklin.

3-7 Confirmation:

Science is a social enterprise, and scientific work tends to be accepted by the community when it has been confirmed. Crucially, experimental and theoretical results must be reproduced by others within the science community. Researchers have given their lives for this vision. Georg Wilhelm Franklin was killed by lightning (1753) attempting to replicate the kite experiment of Benjamin Franklin.

4- Brief Timeline of the history of scientific method:

The development of the scientific method is inseparable from the history of science itself. Ancient Egyptian documents, such as early papyri, describe methods of medical diagnosis. In ancient Greek culture, the first elements of the inductive scientific method clearly become well established. Significant progress in methodology was made in early Muslim philosophy, in particular using experiments to distinguish between competing scientific theories set within a generally empirical orientation. The fundamental tenets of the basic scientific method crystallized no later than the rise of the modern physical sciences, in the 17^{th} and 18^{th} centuries. In his work Novum Organum (1620) — a reference to Aristotle's Organon — Francis Bacon outlined a new system of logic to improve upon the old philosophical process of syllogism. Then, in 1637, Rene Descartes established the framework for a scientific method's guiding principles in his treatise, Discourse on method. These writings are considered critical in the historical development of the scientific method.

In the late 19th century, Charles Sanders Pierce proposed a schema that would turn out to have considerable influence in the development of current scientific method generally. Peirce accelerated the progress on several fronts. Firstly, speaking in broader context in "How to Make Our Ideas Clear", Peirce outlined an objectively verifiable method to test the truth of putative knowledge on a way that goes beyond mere foundational alternatives, focusing upon both deduction and induction. He thus placed induction and deduction in a complementary rather than competitive context (the latter of which had been the primary trend at least since David Hume, who wrote in the mid-to-late 18th century). Secondly, and of more direct importance to modern method, Peirce put forth the basic schema for hypothesis/testing that continues to prevail today. Extracting the theory of inquiry from its raw materials in classical logic, he refined it in parallel with the early development of symbolic logic to address the then-current problems in scientific reasoning. Peirce examined and articulated the three fundamental modes of reasoning that, as discussed above in this lecture, play a role in inquiry today, the processes that are currently known as abductive, deductive, and inductive inference. Thirdly, he played a major role in the progress of symbolic logic itself — indeed this was his primary specialty.

Karl Popper r (1902-1994), beginning in the 1930s and with increased vigor after World War II, argued that a hypothesis must be falsifiable, that science would best progress using deductive reasoning as its primary emphasis, known as critical rationalism.

In science and the philosophy of science, falsifiability, contingency, and defeasibility are roughly equivalent terms referring to the property of empirical statements that they must admit of logical counterexamples. This stands in contradiction to formal and mathematical statements that may be tautologies, that is, universally true by definitions, axioms, and proofs. Karl Popper has asserted that no empirical hypothesis, proposition, or theory can be considered scientific if it does not admit the possibility of a contrary case.

Falsifiable does not mean false. For a proposition to be falsifiable, it must be possible, at least in principle, to make an observation that would show the proposition to fall short of being a tautology, even if that observation is not actually made. The logical precondition of being able to observe something of a given description is that something of that description exists.

For example, the proposition "all swans are white" would be falsified by observing a black swan, which would in turn depend on there being a black swan somewhere in existence. A falsifiable proposition or theory must define in some way what is, or will be, forbidden by that proposition or theory. For example, in this case the existence of a black swan is forbidden by the proposition in question. The possibility in principle of observing a black swan as a counterexample to the general proposition is sufficient to qualify the proposition as falsifiable.

The property of being contingent, defeasible, or falsifiable is a logical property.

Testability, a property applying to an empirical hypothesis, involves two components:

(1) the logical property that is variously described as contingency, defeasibility, or falsifiability , which means that counterexamples to the hypothesis are not logically impossible,
(2) the practical feasibility of observing a reproducible series of such counterexamples if they do exist. In short, a hypothesis is testable if there is some real hope of deciding whether it is true or false of real experience. Upon this property of its constituent hypotheses rests the ability to decide whether a theory can be confirmed or falsified by the data of actual experience.

5-Major controversies in the epistemology of social sciences:

An historical link, particular and complex, bounds epistemology and social sciences. You will relate on the introduction given in the next lecture performed by Professor Jodhka to have more advanced knowledge on some aspects of history of sociology in Europe as in India as well. However as an introduction to these controversies and to the state of the art, we need to anticipate this lecture and have a rapid glance to the objects and genesis of sociology.

5- 1- Object of sociology:

Sociology is the study of society and human social action. It generally concerns itself with the social rules and processes that bind and separate people not only as individuals, but as members of associations, groups, and institutions, and includes the examination of the organization and development of human social life. The sociological field of interest ranges from the analysis of short contacts between anonymous individuals on the street to the study of global social processes. Most sociologists work in one or more specialties or subfields.

Sociology is a social science involving the study of the social life of people, groups, and societies, sometimes defined as the study of social interactions.

Because sociology is such a broad discipline, it can be difficult to define, even for professional sociologists. One useful way to describe the discipline is as a cluster of sub-fields that examine different dimensions of society. For example, social stratification inequality and class structure; demography studies changes in a population size or type; criminology examines criminal behavior and deviance; political sociology studies government and laws; and the sociology of race and sociology of gender examine society's racial and gender cleavages.

Sociology is methodologically diverse using case studies, survey research, statistical analysis, different methods of observation such as participant observation, and model building, among other approaches.

New sociological sub-fields continue to appear - such as economic sociology, community studies computational sociology, network analysis, actor-network theory, and a growing list, many of which are cross-disciplinary in nature.

Since the late 1970s, many sociologists have tried to make the discipline useful for non-academic purposes. The results of sociological research aid educators, lawmakers, administrators, developers, and others interested in resolving social problems and formulating public policy, through sub disciplinary areas such as survey and evaluation research, methodological assessment, and public sociology .

Sociological methods, theories, and concepts compel the sociologist to explore the origins of commonly accepted rules governing human behavior. This specific approach to reality is known as the sociological perspective.

5-2 Genesis of Sociology:

Sociology is a relatively new academic discipline among other social sciences including economics, political science, anthropology, and psychology. The ideas behind it, however, have a long history and can trace their origins to a mixture of common human knowledge, works of art and philosophy. “When and where was born sociology?” seems to be an inappropriate question! Men and women living in society had the need of rules and institutions in order to maintain harmony among them and ensure their own survival. Social knowledge as other knowledge has a practical goal whose purpose is ethical. Men are gregarious and live in societies. Obviously, men had to solve the problems linked to their social condition and establish rules and norms for ensuring collective life. This form of social knowledge had existed before the advent of sociology as a science.

Therefore Sociological reasoning as such is much older than sociology; it can be traced back to Ancient Greece (Socrates, Plato, Aristotle). Ibn Khaldun with his theory of the four stages of Bedouin societies in Middle East might be considered as one of the most ancient sociologist (fourteenth century).

Sociology as a scientific discipline emerged only in the early 19th century as an academic response to the challenge of modernity: as the world is becoming smaller and more integrated, people's experience of the world is increasingly atomized and dispersed. Sociologists hoped not only to understand what held social groups together, but also to develop an "antidote" to social disintegration.

In the eighteen century in Europe, the development of industrial capitalism induces the growing of ideas such as rationalization and individuation. Rationalization was the principle which was applied in business and work .It has allowed the advance of industrial capitalism; even it was the byproduct of the techniques of the bankers and merchants of the commercial capitalism during the feudal period. As capitalism advanced, the bourgeoisie became the dominant and ruling class in a world where economic exchanges and relations have increased dramatically. Out of his natural community, the bourgeois claims his individuality. He was a man attached to his personal promotion rather than the well being of his group and detached from God and other mystical ideas. These two tendencies: rationalization and individuation generated the emergence of rationalism in European philosophy. The development of the scientific thought is highly correlated to the emergence of rationalist philosophy. Rationalism succeeds during the industrial revolution to unify all studies of humankind--including history, psychology and economics. Rationalist thinkers believe on Reason. Rationalists disenchant the world and believe on Reason, because only reason can explain the truth which command any phenomenon and allow humans to control the universe. Rationalism was not only a method for knowledge acquisition, but also a method for action.

The term sociology was coined by Auguste Comte in 1838 from Latin socius (companion, associate) and Greek logia (study of, speech): the study of men associations. The first books with the term 'sociology' in their title were written in mid-19th century by the English philosopher Herbert Spencer. In the United States, Lester Frank Ward, sometimes called 'the father of American sociology', published Dynamic Sociology in 1883 and the discipline was taught by its name for the first time at the University of Kansas, in 1890 under the course title Elements of Sociology .The first full fledged university department of sociology in the United States was established in 1892 at the University of Chicago. The first European department of Sociology was founded in 1895 at the University of Bordeaux by Émile Durkheim, founder of L'Année Sociologique (1896). In 1919 a sociology department was established in Germany at the

University of Munich by Weber .The first sociology departments in the United Kingdom were founded only after the Second World War.

Classical" theorists of sociology from the late 19th and early 20th centuries include Karl Marx, Ferdinand Tönnies, Émile Durkheim, Vilfredo Pareto, and Max Weber. In a manner similar to Comte, none thought of themselves as purely "sociologists". In particular, their works address religion, education, economics, psychology, ethics, philosophy, and theology. With the exception of Marx, their most enduring influence has been on sociology, and it is in this field that their theories are still considered most valuable.

5-3 Explanation and comprehension in social sciences:

Early sociologists have considered their discipline to be similar to natural sciences like physics or biology. Therefore many researchers argued that methods and methodology used in those sciences are perfectly suited to be used in the study of sociology without any changes. The positive effects of this attitude, like the use of scientific method and stress on empiricism, allowed sociology to be distinguished from theology and metaphysics and be recognized as a true Science.
The concept of explanation social sciences refers and is strictly conformed to the kind of reasoning operations used in natural sciences that we have presented in the first part of our lecture. It is reflected in Hempel model of epistemology. Hempel proposes a model in which one wants to explain a fact has to show how that fact can be subsumed under a law or several laws together with various antecedent conditions. This approach to explanation is called the covering-law. The most popular version of the Hempel model of explanation is called the deductive-nomological model of explanation.

However, a question arises from this type of explanation: Is it an adequate procedure in social sciences? Positivists have assumed that it was possible:

Those early views, in the 19th century, supported by August Comte, led to the methodologies known as positivism and based on the view of sociological naturalism. Comte’s Positivism would establish science as a superior form of knowledge, in which causality has to be replaced by laws of nature, and that science has to be contained in few disciplines. Biology must lay on physics, sociology on biology, and so forth.

Emile Durkheim, one of the most pro eminent French sociologists was deeply influenced by the teaching of Auguste Comte at “Ecole Normale Superieure”. He sought to define social sciences as those that attend to special sorts of facts, which he called social facts. In his book, the *Rules of Sociological Method,* he said that a social fact can be recognized by "the power of external coercion which it exercises or is capable of exercising over individuals, and the presence of this power may be recognized in its turn either by the existence of some specific sanction or by the resistance offered against every individual effort to violate it.”
What Durkheim meant to highlight, though, were the formal sanctions such as law, the informal sanctions such as shunning, and the norms of society that both sorts of sanction enforce. Within the philosophy of social science, of course, that definition or any other is up for debate. Methodologically, social facts have to be treated as things. Causes of a particular social fact have to be explained by another social fact. Social facts have rarely a psychological origin (as he developed in his thesis on Suicide). Social facts, according to Durkheim, are numerous and diverse: structures, institutions, opinions and ideologies. They have to be described, classified, compared and explained positively and it is the task of a sociologist.

However, positivism and naturalism have been questioned by scientists like Wilhelm Dilthey, who argued that the world of nature is not the same as the worlds of society, as human society have unique aspects like meanings, symbols, rules, norms, values - all that can be described as the culture. Dilthey opposed natural sciences and sciences of thought and mind. Social and cultural phenomena request an interpretative procedure, quite similar to the approaches developed for the interpretation of literature and symbolism (hermeneutics).

This view was further developed by Max Weber, in a more rationalistic manner. He was too very critical with positivism. He developed the idea that social sciences have to face the question of the sense that human individuals give subjectively to their actions. As sciences of collective action, sociology, economy cannot avoid the necessity to look for the causality of social phenomena and the conditions of these causalities.

Weber developed a humanistic and comprehensive sociology, which have a great influence on modern sociology and anthropology. According to this view, sociology research must concentrate on humans, their cultural values and actions. Action, Weber says, is the human behavior to which the acting individual attaches a subjective meaning. Action is social when the acting individual takes account of the behavior of others. In *Economy and Society* Max Weber proposed that social action is the fundamental building block of social phenomena or, as Durkheim would say, social facts.

Weber emphasizes the understandability and comprehension of social phenomena when they are considered at the level of the individual human beings involved.
Weber argues and postulates that:

a) Meaningful action to which no subjective value is attached cannot be drawn empirically.

Per example, many mystical experiences which cannot be adequately communicated in words are, for a person who is unfamiliar to such experiences, not fully understandable. On the other hand, the ability to perform the same kind of action is not a necessary prerequisite for understanding; "one need not to be Caesar in order to understand Caesar". The full imaginary experience of the same kind of action is helpful for the clarity of understanding, but not a necessary condition for meaningful interpretation.

b) All interpretation of meaning, like all scientific works, strives for clarity.
The clarity can be of either rational (logical, mathematical) or empathic (emotionally or artistically appreciative) character. Rational clarity is classical. Empathic clarity is attained by empathic participation to imaginary experience of emotional-context of action. Interpretation of rationally end-oriented action has, for the understanding of the selected means, the highest degree of clarity. With a lower degree of clarity, which is a current matter in social situations, we are only able to understand errors, confusion of problems of the sort that we ourselves are liable to, or the origin of which we can detect by empathic participation.

c) Many ultimate ends or values toward which human action may be oriented often cannot be understood completely.
In this case, depending upon the circumstances, even we must be content with a purely interpretation of such values, or when even that fails, sometimes we must simply accept them as given facts.

d) Given these difficulties, Weber built up pure rational ideal –types and has argued that these models should be convenient to treat all irrational, affectually influenced elements of action

e) In definitive, what is understandable and grasped by social sciences is the relation of human action to its means and ends.

f) But no matter how clear an interpretation of meaning as such appears to be, it cannot on this account alone claim to be the causally valid interpretation, even sociologists have to look for correct and adequate causal explanations. Correct causal explanations of a concrete course of actions occur only when the action and the motives (the context of meaning) have both been correctly apprehended and at the same time their relation meaning fully comprehended (verstehen in German language).

Debate and controversies between explanation and comprehension have continued all along the twentieth century. In particular, the most relevant issue was on the question of how one can draw the line between subjective and objective research. This debate had philosophical consequences and violent exchanges have opposed not only Weber and Husserl to the positivists, but latter Adorno to Karl Popper. We can consider that even today there is a profound disagreement between the pros and cons of a causal reduction of action and the pros and cons of the intentionality of action

5-4 Modeling and narratives

This opposition is often mixed with the former. However we have to distinguish it, because it less relevant epistemological and the debate is more methodological. This debate doesn't concern the social sciences statute and the kind of explanation required in social sciences, but rather the legitimacy of theories and the organization of field data, even these questions are linked. In science, a set of objects can be treated from a nomothetic point of view or idiographic.
The first point of view reveals regularities and expresses them in a restrictive set of general propositions whose allow the deduction of particular propositions tested by experimentation. The prerequisites for such a model are identical, in terms of formal validity, for natural sciences or social sciences: they consist of an abstract model, able to represent and to perform scenarios dealing the concrete reality. Economy, in social sciences, is the elective domain of modeling.
However, it is possible to focus on the multitude of the determinations and aspects constitutive of a singular phenomenon. This particular phenomenon, if it is not independent of general laws of nature, requires special attention and changing perspective. Per example, a theory of urban development does not exhaust the complexity and specificity of cities as Delhi, Paris or Berlin or a theory of the "rites de passage" the diversity of the ritual practices of the Australian aborigines. The form of restitution of data and observations suited to this point of view seemed to be not the formalization but rather the idiographic descriptions and narratives. History and ethnology have used it extensively.
This dual situation has allowed in social sciences the emergence of two antithetic paradigms: one which is inspired by literature, perspectivist and relativist, the second which is scientist and logistician.

5-5- Methodological individualism and Methodological holism:

A central issue in epistemology of social science involves the relation between social regularities and facts about individuals.

5-5-1 Methodological individualism:

It is the position that asserts the primacy of facts about individuals over facts about social entities. Social phenomena are the aggregate result of several understandable and comprehensible actions. Social systems are composed of individuals who are acting. Actions are comprehensible, as Weber formulated. In the more restrictive interpretation, economic rationality is one example of methodological individualism. It can be enlarged to altruistic ends. Actions have cumulative effects. Per example, L. White (1962) demonstrated how the new iron plough linked to new methods of horse harnessing in medieval period has produced a cascade of social events and economic transformations.

Epistemologically, methodological individualism as a doctrine takes three forms:
a claim about social entities, a claim about social concepts, and a claim about social regularities.

- The first version of the doctrine maintains that social entities must be reducible to ensembles of individuals-- as an insurance company might be reduced to the ensemble of employees, supervisors, managers, and owners whose actions constitute the company.
- Likewise, it is sometimes held that social concepts must be reducible to concepts involving only individuals--for example, the concept of a social class might be defined in terms of concepts pertaining only to individuals and their behavior. (the second version)
- Finally, it is sometimes held that social regularities must be derivable from regularities of individual behavior.

There are many critics to methodological individualism. Indeed, the macro sociological consequences of individual actions can be contradictory to the expectations of the individuals. In poor countries, birth rate is often very high; the parents are looking for their security during their old days when they conceive children. However, the consequent increase in the rate of the population growth increases actually the global poverty of the nations. Moreover, methodological individualism is difficult to implement as a practical strategy of research , either the individual process of decision making are not precisely known, or aggregative process are so complex that they are not comprehensible.

5-5-2 Methodological holism:

At the extreme, it is the attitude opposed to methodological individualism.
Holism is the doctrine that holds that social entities and facts are autonomous and irreducible. In its pristine version, holism excluded action as a causal source of social phenomena and was drawn from positivism. Holism was initially developed by Durkheim School. Durkheim explained that society as whole is more than the sum of its components. There are two paradigms which are attached to methodological holism: causal analysis and structural-functionalism. Causal analysis is well illustrated by Durkheim analysis of the causes of suicide. Rates of suicide accordingly come from the level of integration to different social groups: too low or too strong. In the structural-functionalism, all social treats are considered as elements of a system which interact like organs in body. Social institutions fulfill functions from the point of view of the society and are complementary from a structural point of view. This paradigm took initial development in anthropology. As an example, Radcliffe-Brown explains the institution of the cult of ancestors in traditional societies by a function: the enhancement and/or the reinforcement of organic solidarity. By this way, each individual could understand that he may be supported by the magical action of his lineage, if he respects the authority of different traditional rules.

This approach puts on the front stage the conformist attitudes of individuals and their dependence to codified and normative rules.

5-5-3 Remark:

There is a position intermediate between these two that holds that every social explanation requires micro foundations: i.e. an account of the circumstances at the individual level that lead individuals to behave in such ways as to bring about the observed social regularities.
If we observe, per example, that a factory's strike is successful over an extended period of time, it is not sufficient to explain this circumstance by referring to the common interest that members of the trade-union have in winning their demands. Rather, we need to have information about the circumstances of the individual union member that induces him or her to contribute to this public good. This position does not require, however, that social explanations be couched in non-social concepts; instead, the circumstances of individual agents may be characterized in social terms.

6- The Point of view of professional philosophy on the logic and methods of the social sciences:

6-1 Introduction:

Social sciences are different, we said, but what are the criteria of a good social explanation? How (if at all) are the social sciences distinct from the natural sciences? Is there a distinctive method for social research? Through what sorts of empirical procedures are social science assertions to be evaluated? Are there irreducible social laws? Are there causal relations among social phenomena? Do social facts and regularities require some form of reduction to facts and regularities involving only the properties and actions of individuals?
The philosophy of social science aims to provide an interpretation of the social sciences that permits answers to these questions. The philosophy of social science, like the philosophy of natural sciences, has both a descriptive and a prescriptive side.

On the one hand, the field is about the social sciences: the explanations, methods, empirical arguments, theories, hypotheses, that actually occur in the social science literature, past and present. This means that the philosopher needs to have extensive knowledge of several areas of social science research, in order to be able to formulate an analysis of the social sciences that corresponds appropriately to scientists' practice.
On the other hand, the field is epistemic: it is concerned with the idea that scientific theories and hypotheses are put forward as true or probable, and are justified on rational grounds (empirical and theoretical). The philosopher therefore wants to be able to provide a critical evaluation of existing social science methods insofar as these methods are found to be less truth-enhancing than they might be. These two aspects of the philosophical enterprise suggest that philosophy of social science should be construed as a rational reconstruction of existing social science practice—a reconstruction that is guided by existing practice but that goes beyond that practice by identifying faulty assumptions, forms of reasoning, or explanatory frameworks.

Philosophers have disagreed over the relation between the social and natural sciences. One early position, we told, was positivism and naturalism, according to which the methods of the social sciences should correspond closely to those of the natural sciences, where that all higher-level phenomena and regularities--including social phenomena--must be ultimately reducible to physical entities and the laws which govern them.
On the other side is the view that the social sciences are inherently distinct from the natural sciences. This perspective holds that social phenomena are distinguishable from natural

phenomena because they are intentional: they depend on the meaningful actions of individuals. On this view, natural phenomena admit of causal explanation, whereas social phenomena require intentional explanation. The anti-naturalist position also maintains that there is a corresponding difference between the methods appropriate to natural and social science. The best way to take in account this perspective is the development of a comprehensive method of inquiry. This method of “intuitive interpretation of human action” is obviously radically distinct from methods of inquiry in the natural sciences.

Interpretive sociology maintains that the goal of social inquiry is to provide interpretations of human conduct within the context of culturally specific meaningful arrangements and follows the tradition of Weber. Max Weber's treatment of the relation between capitalism and the Protestant ethic, where he attempts to identify the elements of western European culture that shaped human action in this environment in such a way as to produce capitalism, has a profound impact on interpretative anthropology. On this account, both Calvinism and capitalism are historically specific complexes of values and meanings, and we can better understand the emergence of the latter by seeing how it corresponds to the meaningful structures of the former.
Interpretive sociologists often take the meaningfulness of social phenomena to imply that social phenomena do not admit of causal explanation. However, it is possible to accept the idea that social phenomena derive from the purposive actions of individuals, without relinquishing the goal of providing causal explanations of social phenomena, as Weber suggested.
For it is necessary to distinguish between the general idea of a causal relation between two circumstances and the more specific idea of "causal determination through strict laws of nature." It is certainly true that social phenomena rarely derive from strict laws of nature; wars do not result from antecedent political tensions in the way that earthquakes result from antecedent conditions in plate tectonics.
However, when we admit the possibility of non deterministic causal relations deriving from the choices of individual persons, it is evident that social phenomena admit of causal explanation, and in fact much social explanation depends on asserting causal relations between social events and processes. An important variety of causal explanation in social science is materialist explanation. This type of explanation attempts to explain a social feature in terms of properties of the material environment in the context of which the social phenomenon occurs. Thus Karl Marx holds that it is the development of the "productive forces" (technology) that drives the development of property relations and political systems.

6-2 Evaluation of the Theories of Explanation in social sciences:

Central to most theories of explanation in hard sciences is the idea that explanation depends on general laws governing the phenomena in question. Thus the discovery of the laws of electrodynamics permitted the explanation of a variety of electromagnetic phenomena.
But social phenomena derive from the actions of purposive men and women; so what kinds of regularities are available on the basis of which to provide social explanations?
We have already the difficulties of methodological individualism as a general research framework in the social sciences. If it gives rise to a set of regularities about individual behavior that may be used as a ground for social explanation, we may explain some complex social phenomenon as the aggregate result of the actions of a large number of individual agents with a hypothesized set of goals within a structured environment of choice, which represent a major difficulty.

We have quoted above some weaknesses of methodological holism. Social scientists have often been inclined to offer functional explanations of social phenomena. Generally, a functional explanation of a social feature is one that explains the presence and persistence of a social feature in terms of the beneficial consequences the feature has for the ongoing working of the social system as a whole.

This type of explanation is based on an analogy between biology and sociology, as Durkheim used to argue. Biologists explain features in terms of their contribution to reproductive fitness, and sociologists sometimes explain social features in terms of their contribution to "social" fitness or efficiency. However, the analogy is a misleading one, because there is a general mechanism establishing functionality in the biological realm that is not present in the social realm. This is the mechanism of natural selection, through which a species arrives at a set of traits that are locally optimal. There is no analogous process at work in the social realm, however; so it is groundless to suppose that social traits exist because of their beneficial consequences for the good of society as a whole (or important sub-systems within society). So functional explanations of social phenomena must be buttressed by specific accounts of the causal processes that underlay the postulated functional relationships.

Although some of the topics and issues generated by social science methodology and reflected in the philosophy of social science are as old as philosophy itself (for example, the contrast between nature and convention and the idea of rationality are dealt with by Aristotle), the explicit emergence of a sub-discipline of philosophy with this name is a very recent phenomenon, which in turn may itself have stimulated greater philosophical activity in the area. Clearly, this emergence is tied to the development and growth of the social sciences themselves.

6-3 Understanding the position of the philosophy of social sciences:

There are, perhaps, four distinct ways in which to gain an understanding of the philosophy of social science. These ways are, of course, complementary.

First, just as with most other areas of philosophy, one might approach the philosophy of the social sciences historically, by studying major schools or philosophers of an earlier period. We will develop here very brief aspects as a conclusion to this introductory lecture. There is much to recommend this approach. There are a number of classical texts (by Weber and Durkheim, for example, notes added to this course are provided) of which any interested student of the philosophy of the social sciences should be aware, much as there is in epistemology or ethics. This provides an interesting contrast with the philosophy of the natural sciences; far less could be said in favor of gaining an understanding of the latter in this way.

Compared with other areas of philosophy, the history of the philosophy of the social sciences is somewhat truncated, since it can only begin properly with the earliest attempts at social science, in the late eighteenth and early nineteenth centuries, first in the Enlightenment in France, England, Scotland and subsequently in Germany. Prior to this period, there had been speculation about the nature of society, some of it quite rich and rewarding (Rousseau, Hobbes), but it is only in the period of the Enlightenment and after that writers begin to reflect the first systematic attempts to study and understand society.

6-3-1 Some classical epistemological issues in philosophy of social science:

A second way in which to gain an understanding of the philosophy of social science is through the study of the issues and problems that social scientists writers address. Many of these problems arise in ordinary as well as in more scientific discussions of and thought about the social realm. It is not only social scientists who think about the social world; all of us do a great deal of the time. Even in those cases in which the social scientist introduces neologisms, for example, ‘demand curves’ or ‘anomie’, they seem closely connected to, and sometimes only a refinement of, concepts already grasped by the lay person. However, this nonscientific reflection arises quite apart from any specialized scientific work.

Most of the things that social science is about, social structures (like families or society itself), norms and rules of behavior, conventions, specific sorts of human action, and so on, are items that find a place in the discourse of the ordinary lay person who has as good a grasp of common talk about social class and purchase, voting and banking, as does the social scientist.
This raises, in a direct way, questions about the nature of these things. Are these social structures anything more than just individuals and their interrelations? Many thinkers have been struck by the reality and integrity of the social world, and how it seems to impress itself on the individual willy-nilly. From this perspective, social structures cannot be denied.

What is an action, and how does it differ from the mere movement of one's body? It seems hard to say in what this difference consists in a way that remains plausible and true to what action is like. Whatever an action is, what makes some actions social actions? One might think that an action is social in virtue of its causal consequences on others. Another line of thought holds that an action is social in virtue of its intrinsic character, quite apart from the question of its effects. Much of the philosophical discussion of action arose in the philosophy of history, over the explanation of historically important action, but has now been absorbed into a separate area of philosophy, the theory of action. The alleged contrast between nature and convention occurs to those who think about humankind and its development, whether they are scientists and philosophers or not.

Is cultural relativism dealing with rationality a sustainable philosophical posture? Anyone who has traveled widely and noticed the social differences between peoples and cultures may have wondered whether all social practice was rational in its own terms, wherever found and no matter how apparently peculiar by our home-grown lights. Or perhaps, on the other hand, there are some universal standards of rationality, in the light of which evaluation of social practices and criticism of some of them can be mounted.

The relationship between scientific theory and ordinary modes of thought is, of course, interactive, since many of the concepts or issues that have become part of ordinary lore have their roots in earlier scientific theory (our modern, and by most accounts, confused, concept of race might be an example of this).

Another set of problems arise in thinking through the nature of the social scientific enterprise itself. What standards must full explanation in social science meet?
Causal explanation is a mode of explanation in natural science that is, relatively speaking, well understood. Explanations of a ritual or practice in society do not appear to be causal explanations, nor do explanations of human action. The first are often functional explanations (for example, a certain ritual exists because it produces such-and-such) and this appears to be an explanation of something by its effects rather than by its causes. Explanations of human action are intentional explanations, whereby an action is explained by the goal or end at which it is directed. This also appears not to be causal. But perhaps appearances are deceptive, and these can be recast as causal explanations after all.

Natural scientists believe that their work is ethically neutral. To be sure, their work can be put to good and bad uses, but this presumably reflects on the users rather than on the content of the science itself. The relationship between social science and the values of the social scientist seems far more immediate and direct than this, and this alleged contrast has been the subject for continuing discussion and debate.

Many philosophers, in the grip of the ideal of the unity of science, have held out the prospect that social science can be derived from, and is therefore reducible to, biology and psychology (the latter eventually being reducible to chemistry and physics). For such thinkers, the world is ultimately a simple place, with only many different ways in which to speak about it.

In the developed natural sciences, there are controlled experiments and predictions. Neither seem available to the social scientist. Natural scientists attempt to formulate the laws that govern the phenomena they study. Is this a reasonable goal for the social scientist? Certainly, there are not many candidate laws for the social sciences one can think of. Does the social scientist use statistical evidence in the same way as the natural scientist?
Finally, in natural science, we distinguish between theory and observation in a relatively sharp way, and we believe that a rational person should accept that theory which is best confirmed by observations. It is neither clear that we can make the same distinction in the social sciences, nor that theory is supported by observation in just the same way. Our observations of the social world seem even more colored by the theory we employ than is the case in the natural sciences.

6-3-2 Contemporary movements

A third way in which to approach the subject is through the study of either contemporary movements and schools of philosophy, or specific philosophers, who bring a specific slant to the sub-discipline. Controversy marks the natural as well as the social sciences, but observers have noted that there seems to be even less consensus, even less of an agreed paradigm at any particular time, in the latter than in the former.
Critical reflection on society, or on social science, or both, is very different in France and Germany from the way it is in the English-speaking world. The problems are the same, but the traditions and the manner in which the discussions proceed are markedly distinctive. The hope is that each tradition may learn something from the other.

6-3-3 Specific social sciences

Fourth and finally, one might approach the philosophy of the social sciences by studying the philosophical problems that arise specifically within each of the social sciences. Some, although not all, of the social sciences have thrown up philosophical industries all their own. Economics is the most salient example. In many ways, it is the most developed of all the social sciences, and this may be the reason why some of the best-defined controversies in the philosophy of social science arise from within it. Questions about the philosophical foundations of economics touch on the philosophically central issues of rationality, choice and the nature of wants or desires and their connection with action. But other social sciences have also given rise to specific problems, including history; psychology, sociology, and anthropology. (see introduction to social anthropology notes and history of anthropology).

7- Historical Conclusion to the lecture:

In ancient philosophy, there was no difference between the liberal arts of mathematics and the study of history, poetry or politics—only with the development of mathematical proof did there gradually arise a perceived difference between "scientific" disciplines and others, the "humanities" or "liberal arts". Thus, Aristotle studies planetary motion and poetry with the same methods, and Plato mixes geometrical proofs with his demonstration on the state of intrinsic knowledge.

This unity of science as descriptive remains, for example, in the time of Thomas Hobbes who argued that deductive reasoning from axioms created a scientific framework, and hence his *Leviathan* was a scientific description of a political commonwealth. What would happen within decades of his work was a revolution in what constituted "science", particularly the work of Isaac Newton in physics. Newton, by revolutionizing what was then called "natural philosophy", changed the basic framework by which individuals understood what was "scientific".

While he was merely the archetype of an accelerating trend, the important distinction is that for Newton, the mathematical flowed from a presumed reality independent of the observer, and working by its own rules. For philosophers of the same period, mathematical expression of philosophical ideals was taken to be symbolic of natural human relationships as well: the same laws moved physical and spiritual reality. Pascal, Leibniz and Kepler, each of whom took mathematical examples as models for human behavior directly. In Pascal's case, it is the famous wager; for Leibniz, the invention of binary computation; and for Kepler, the intervention of angels to guide the planets.

In the realm of other disciplines, this created a pressure to express ideas in the form of mathematical relationships. Such relationships, called "Laws" after the usage of the time became the model which other disciplines would emulate.

Comte argued that ideas pass through three rising stages, Theological, Philosophical and Scientific. He defined the difference as the first being rooted in assumption, the second in critical thinking, and the third in positive observation. This framework, still rejected by many, encapsulated the thinking which was to push economic study from being a descriptive to a mathematically based discipline. Karl Marx was one of the first writers to claim that his methods of research represented a scientific view of history in this model.

With the late 19th century, attempts to apply equations to statements about human behavior became increasingly common. It was with the work of Darwin that the descriptive version of social theory received another shock. Biology had, seemingly, resisted mathematical study, and yet the Theory of Natural Selection and the implied idea of Genetic inheritance - later found to have been enunciated by Gregor Mendel, seemed to point in the direction of a scientific biology based, like physics and chemistry, on mathematical relationships.

In the first half of the twentieth century, statistics became a free-standing discipline of applied mathematics. Statistical methods were used confidently, for example in an increasingly statistical view of biology.

The first thinkers to attempt to combine inquiry of the type they saw in Darwin with exploration of human relationships, which, evolutionary theory implied, would be based on selective forces, were Freud in Austria and William James in the United States. Freud's theory of the functioning of the mind, and James' work on experimental psychology would have enormous impact on those that followed. Freud, in particular, created a framework which would appeal not only to those studying psychology, but artists and writers as well.

One of the most persuasive advocates for the view of scientific treatment of philosophy would be John Dewey (1859-1952). He began, as Marx did, in an attempt to weld Hegelian idealism and logic to experimental science, for example in his "Psychology" of 1887. However, it is when he abandoned Hegelian constructs, and joined the movement in America called Pragmatism possibly under the influence of James "Principles of Psychology" that he began to formulate his basic doctrine, enunciated in essays such as "The Influence of Darwin on Philosophy" (1910). This idea, based on his theory of how organisms respond, states that there are three phases to the process of inquiry: Problematic Situation, where the typical response is inadequate. Isolation of Data or subject matter. Reflective, which is tested empirically.

With the rise of the idea of quantitative measurement in the physical sciences, for example Rutherford‘s famous maxim that any knowledge that one cannot measure numerically "is a poor sort of knowledge", the stage was set for the conception of the humanities as being precursors to "social science." This change was not, and is not, without its detractors, both inside of academia and outside. The range of critiques begin from those who believe that the physical sciences are qualitatively different from social sciences, through those who do not believe in statistical science of any kind, through those who disagree with the methodology and kinds of conclusion of social science, to those who believe the entire framework of scientificizing these disciplines is solely, or mostly, from a desire for prestige and to alienate the public.

Theodore Porter argued in "The Rise of Statistical Thinking" that the effort to provide a synthetic social science is a matter of both administration and discovery combined, and that the rise of social science was, therefore, marked by both pragmatic needs as much as by theoretical purity. An example of this is the rise of the concept of Intelligence Quotient, or IQ, a test which produces a number which it is not clear what, precisely, is being measured, except that it has pragmatic utility in predicting success in certain tasks.

The rise of industrialism had created a series of social, economic, and political problems, particularly in managing supply and demand in their political economy, the management of resources for military and developmental use, the creation of mass education systems to train individuals in symbolic reasoning and problems in managing the effects of industrialization itself. The perceived senselessness of the "Great War" as it was then called, of 1914-1918, based in what were perceived to be "emotional" and "irrational" decisions, provided an immediate impetus for a form of decision making that was more "scientific" and easier to manage. Simply put, to manage the new multi-national enterprises, private and governmental, required more data. More data required a means of reducing it to information upon which to make decisions. Numbers and charts could be interpreted more quickly and moved more efficiently than long texts.

In the 1930s this new model of managing decision making became cemented with the New Deal in the US, and in Europe with the increasing need to manage industrial production and governmental affairs. Departments of "social research" at prestigious universities were meant to fill the growing demand for individuals who could quantify human interactions and produce models for decision making on this basis.

Coupled with this pragmatic need was the belief that the clarity and simplicity of mathematical expression avoided systematic errors of holistic thinking and logic rooted in traditional argument. This trend, part of the larger movement known as Modernism provided the rhetorical edge for the expansion of social sciences.

There continues to be little movement toward consensus on what methodology might have the power and refinement to connect a proposed "grand theory" with the various midrange theories which, with considerable success, continue to provide usable frameworks for massive, growing data banks.

The social sciences are sometimes criticized as being less scientific than the natural sciences, in that they are seen as being less rigorous or empirical in their methods. This claim is most commonly made when comparing social sciences to fields such as physics, chemistry or biology in which direct experimentation and falsification of results is generally carried out in a more direct fashion. Social scientists however, argue against such claims by pointing to the use of a rich variety of scientific processes, mathematical proofs, and other methods in their professional literature. Others however argue that the social world is much too complex to be studied as one would study static molecules. The actions or reactions of a molecule or chemical substance are always the same when placed in certain situations. Humans, on the other hand, are much too complex for these traditional scientific methodologies. Humans and society do not have certain rules that always have the same outcome and they cannot guarantee to react the same way to certain situations.

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