

Research: Facts, Science, and Theory

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The paper explains the concepts and nature of theory, science, facts and types of facts. Features of different types of facts and their importance are described briefly in order to elaborately explain their role and functions in scientific research. The paper highlights the process of transformation of common into scientific facts. Theory is postulated to furnish the framework of scientific research. Research by its very nature focuses on relating one fact with one or more facts in a causal relationship. This necessitates accession and exploration of facts which are the subject matter of study. The forging of causal relations between facts involves examination and analysis to focus on the detection of systematic patterns of changes in values and their relationship. The results of analysis need explanation of inter-relations between facts. Scientific theory emerges from the pivotal relations between facts, which are bound together in a causal relation. This paper extends this paradigm of research in natural and physical sciences to encompass social science research in its domain; it postulates that social sciences also endeavor to forge causal relations between social facts through research. Therefore, theories of social sciences also involve the formulation of concepts/constructs, and the adoption of specific assumptions which underlie these theories. The formulation of hypotheses, their testing, verification and validation are postulated as the basic functions of scientific social science research.

INTRODUCTION

The paper answers the following basic questions of research: What is the meaning of facts and how many are types of facts? What are the roles and functions of facts in scientific research? Answer to the above question involves the following questions: What is the concept and nature of Science? What is the concept and nature of scientific facts and scientific theory? What is the relation between facts and scientific theory? Are social facts of social sciences and scientific facts of natural sciences similar? Does the formulation of hypotheses and their testing in social science research capture the essence of the statement,

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“Hypotheses are the nets; only he who casts it will catch” (quotes of Novalis). Above research questions define the objectives of this paper.

Human beings have probably always been curious to know not only about the world they live in, but also the world beyond them from the very inception of human life on earth. Incidentally, the knowledge of evolution of ‘knowledge’ is probably coterminous with the evolution of civilization. The evolution of knowledge comprised and still comprises the twin processes of ‘Generation of New Knowledge’ and ‘Dissemination of Existing Stock of Knowledge’. Both existing and new knowledge have had tended to be disseminated quickly over space, through time and among individuals. Dissemination of knowledge is primarily related to learning-teaching and propagation by other means, while generation of new knowledge falls in the domain of Research. Both these facets of knowledge have a theory and method. Epistemology, the theory or science of knowledge, comprises ‘Phenomenology’ and ‘Ontology’. All knowledge thus falls either in the domain of Ontology, or it relates to Phenomenology. Thus, Ontology and Phenomenology exhaust all knowledge among themselves. Phenomenology deals with the knowledge, which relates to the material world we live in, while Ontology pertains to the knowledge of spiritual domain. Phenomenological knowledge is further classified into two broad categories of scientific and non-scientific knowledge. Scientific knowledge pertains to sciences, which are broadly divided into two categories of physical/natural and social sciences. Sciences also comprise several disciplines. Para-psychological and Para-spiritual knowledge are beyond the scope of both phenomenology and ontology. The classification of the theory of knowledge may be represented by the following flow chart:

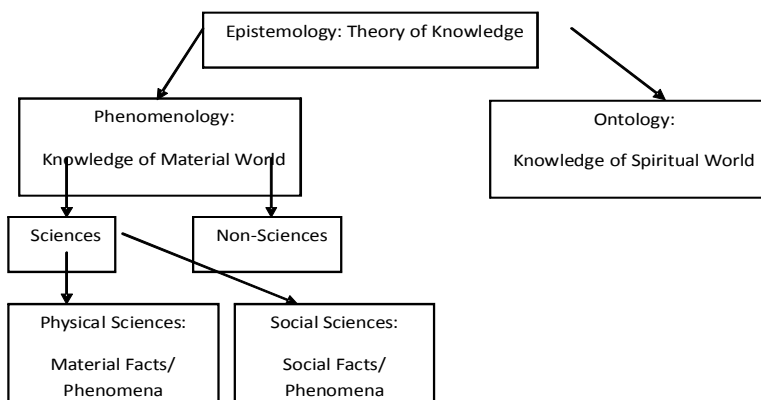


Figure 1: Classification of Theory of Knowledge

This chart naturally does not include knowledge falling within the purview of para-psychology or para-spiritualism. This chart also overlooks the ancient Indian thought about the classification of types of knowledge. Ancient Indian literature classifies Art (Kala) into 36 and Knowledge (Vidya) into 14 different categories. Acharya Charak defined even Thievery (Chori) as Chauriya Kala/Art of Thieving).

KNOWLEDGE AND FACTS

The term 'Epistemology' is derived from Greek word: *epistēmē* which means 'knowledge'; but it comprises 'Knowledge', 'Facts' and 'Theory'. Epistemology deals with the theory of knowledge, its nature, scope and methods and facts. But the knowledge of facts, which epistemology deals with, pertain to the phenomenal world. It is thus clear that the basic purpose of knowledge is to understand and explain *reality* which we are a part of. Real phenomenal world is an agglomerate of facts. Facts of the phenomenal world are infinite in number, complex in nature and intricately woven together by inter-relations. So, all knowledge, scientific and non-scientific, relates to the facts of human life, animate and inanimate matter of nature, including flora and fauna, wealth under and over the surface of earth, and materials in seas, rivers, mountains and valleys. Human beings and their society are also a part of this phenomenal reality. Human life comprises emotions, ideological convictions, faith, culture and traditions adhered to and followed by the people, human thoughts, actions, relations, and all material and non-material goods and services (Marshall, [1892] 1962). All facets of human life, and hence, human actions are associated directly or indirectly with the material and non-material objects of the phenomenal world. The inter-connections of human life with other parts of phenomenal world make the entire phenomenal reality relevant and interesting for scientific research. Phenomenal reality thus encompasses objective and subjective facts, which constitute the subject-matter of theory of knowledge. All sciences and non-sciences are essential parts of theory of knowledge. All facets mentioned above require encompassment in concepts, constructs and theories. Theories furnish explanation and elaboration of concepts and inter-relations between observed facts. Theory and science are explained in the ensuing pages.

FACTS AND SCIENCE

Knowledge and theory relating to the phenomenal world are empirical in nature; empirical knowledge is factual in nature. Thus, facts and theory are two essential but inseparable components of science. Science

is empirical, and hence, it needs facts as its base. Science is the means of accumulating or constructing the specific kind of knowledge. So, detailed discussion of concept, nature, types and functions of facts and functions of science is required. First, the concept, nature and functions of facts are discussed.

Following are important questions in this context. What is 'Fact' or what does 'Fact' connote? What is the nature of Facts? What are the functions of Facts? What are the facts that science deals with? Answers to these questions are attempted in the ensuing pages.

Facts-notion/concept

One way of conceiving facts is to recognize that facts are an inseparable part of the phenomenal world of reality. So, all elements of phenomenal reality are facts. But the facts of phenomenal world have certain distinguishing features. These are discussed hereunder. Fact is an empirically verifiable observation which may be expressed as the proposition. For example there are nine planets in our solar system. It is a proposition which is capable of being tested and verified. When an observed phenomenon is tested and verified it becomes the 'Fact'. Other alternative way of conceiving and perceiving facts is to assume that 'Facts personify and therefore, are a replica of the phenomenal reality'. But any given single fact is the miniscule part of hugely vast phenomenal reality. Facts may, therefore, be defined as the mirror image or an index which capture, reflect and display the reality in all its diversity and detail.

Reality is, however, part perceptual and part actual or real. Actual part of reality is mostly concrete and visible and has the specific shape, size/magnitude and structure. But Perceptual facts of reality need not necessarily be as concrete as the actual facts of phenomenal reality; perception lies in the mental eyes and thoughts of the person perceiving the fact, though s/he may paint the perceived fact on the paper, or it may be portrayed in visual or the literary form for the benefit of others. If this is done, then the knowledge of perceptual fact gets disseminated. So, the perceptual reality tends to embody subjectivity which makes it vary among the thinkers and analysts. As against this, actual part of reality should not and could not vary between the subjects of study which the facts relate to, and it should not and cannot differ among the investigators, who marshal and use such facts of reality for analytical purposes. This is the general view of factual reality. But the conception and magnitude of observed facts may not be unique due to errors of observation, and errors of measurement, if the given facts are

measureable. Perceptual errors and subjective differences are in addition to the errors of observation and measurement. Besides, degree and direction of errors of observation and measurement also differ among investigators. Errors of observation and measurement do not generally affect perceptual facts of reality. Perception depends mainly on the understanding and thoughts of the observer of reality. Perception, and hence, perceptual facts of reality vary among disciplines, objectives of study, persons, places and times. Intuitive insights and knowledge endowment differ not only among investigators in different disciplines due to their differential development stages of different subjects but also among investigators in the same discipline. Association of facts with individual human beings brings subjectivity into play perceptibly or imperceptibly to smaller or greater degree. Above differences make the same objective facts/reality appear perceptually different to different persons in different contexts. Knowledge endowment, experience and insightful ability of thinking differ sharply among individuals. Perception also differs between theoretical paradigms. Thus, the perceptual facts of reality are colored and conditioned by (i) knowledge and understanding of the preceptors/viewers of reality, (ii) stage of development of the subject of study, (iii) context of perception reality, and (iv) theory which the facts/reality relate to.

Types of facts

Facts are classified in the following two broad groups: (i) Common Facts; and (ii) Scientific Facts. Scientific Facts are further classified into the following sub-groups:

- (i) Material and Non-Material Facts;
- (ii) Observable and Non-Observable Facts;
- (iii) Actual and Perceptual Facts;
- (iv) Experiential and Experimental Facts;
- (v) Expectational and Hypothetical Facts.

These categories do not offer classification in a water-tight compartment, since many facts overlap into more than one category. Each of these categories of facts is discussed briefly hereunder.

Scientific facts and their features

Replicable observations that repeatedly occur through space and time are amenable to verify and easily confirmed; such facts are accepted as true and are considered to be scientific facts. But even such facts are

not final; it is possible that something/fact, which is accepted as true today, becomes untrue tomorrow. But scientific facts are totally different from non-scientific or common facts even otherwise. The reason is that science needs specialized facts while common facts do not possess such special characteristics of scientific facts. Absence or presence of the specified features in facts distinguishes scientific from common facts. Scientific facts are such facts as are taken seriously and considered important; such facts are thought to embody scientific implications. These implicit meanings and inter-relations, embodied in scientific facts, are not obvious to all, since the features do not lie on the surface; so, these features have to be brought out by scientific research and highlighted by research findings. In fact, the scientific meanings embodied in scientific facts are brought out to light by scientific research. Scientific research invests meaning in such facts.

Features of scientific facts

Social and physical facts may be classified under scientific facts if these facts possess the characteristics of scientific facts. Scientific facts have the following special features:

Non-random nature

The scientific facts are non-random, and hence, these facts cannot be generated by random processes. However, scientific facts may be collected randomly, if sampling is required. Non-random nature of scientific facts may put these facts beyond the domain of stochastic (probability) laws. It also means that the scientific facts are definite, exact but may change within time and space domain. Climatic change is an example of this. Changes in social customs and traditions also offer an example of changing nature of scientific facts. Some thinkers may differ from this example. But our view is that the social customs and traditions are chosen on the basis of observed constraints, costs and benefits of preferred customs relative to others which were overlooked at the time of choice. But the changes in scientific facts are systematic and have a specific structure. Non-random nature of scientific facts is displayed by the systematic structure and pattern of change in values/magnitudes and amenability of such facts to analysis by non-stochastic methods/models. It does not mean that scientific facts are influenced only by systematic factors. In fact, all facts are subject to both random and systematic influences. But random components are separated from systematic component of facts to make the facts amenable to the analysis of their systematic and orderly

patterns of behavior and systematic changes in structure of the phenomenon.

However, random/ chance discovery of facts is probable, though it is only an occasional occurrence. Archaeologists and geologists several times stumble upon such chance discoveries. Columbus's discovery of America was also a chance discovery because he moved out in search of sea route to India. At times, some fact may be trusted to be scientifically true though it may turn out to be false later. For example, the belief that sun moves round the earth was ultimately proved false. The scientists' own belief that Atom is unbreakable has come to be nullified.

Infrequent discovery of scientific facts by chance suggests that the scientific facts are gathered carefully, systematically and in accordance with specified rules of procedure. Care and caution in fact gathering means that the fact gathering cannot be haphazard or non-systematic. Before one sets on fact gathering mission, one should know what facts are needed, what facts are not relevant for the proposed study; what are the sources or wherefrom requisite facts can be collected. Thus, systematic collection of facts means that some preparatory work has already been done in advance, there is a plan in hand, program of action for implementing the plan is also ready in advance so that the steps involved in the fact gathering are known before hand. In other words, the investigator has an appropriate approach or technique to gather or generate facts. Appropriateness and relevance of the facts to the objectives of investigation is a necessary condition for scientific research. The non random nature of scientific facts highlights the importance of Design of Experiment in the generation of experimental facts. The experiment is conducted to verify existing theory, one expects outcomes of change in causative fact to conform or contradict theory, but there is no certainty about the resultant outcome(s); this impart random character to experimental data; if new theory is being evolved, outcome of experiment is much more uncertain. Emerging facts may generally be such as differ from the expected results. This is one reason why sampling is required to be random in social sciences which needs Sample Design to furnish random data; sample data are often used in social science research.

Visibility, accessibility and amenability to observation

Such facts are needed for scientific research as are visible and observable; these are essential features of scientific facts/reality. Non-visible facts are difficult to observe and even more difficult to measure.

But visibility does not mean that the scientific facts lie on the surface to be picked up. These facts are to be discovered or generated/collected systematically. Besides, the facts should not only be visible but these should also be accessible for research. Generally, scientists select the subject of investigation with due care in order to ensure that either the appropriate facts are accessible or such facts can be generated by experiments or surveys.

Invisible facts or facts concealed/hidden in mystery are difficult, if not impossible, to observe and access. Inaccessibility means that even though facts exist, yet these are beyond the reach of the investigator. Gathering data from corporate houses is an example of inaccessible facts. Difficulty of accessibility to existing facts may be highlighted by cases cited below:

- (i) Dr Rajesh Jain, Executive Director and co-owner of Panacea Biotech, could get an appointment with the CEOs/Chairmen of only two pharmaceutical companies for design of data collection for his Ph.D. Thesis titled, Determinants of Success or Failure of Family Business in Pharmaceutical Industry in India
- (ii) Ms Renu Bharagava could not get any time from any pharmaceutical company in NCR of Delhi for her project research on 'Mapping of Divergence between Desired and Actual Competency of Workforce in Pharmaceutical Companies'. She could obtain only 21 filled up questionnaire without having an opportunity for personal interview. Needless to say that information provided as answers to some questions was not useable.
- (iii) Dr Brinda Balakrishnan, voluntarily retired Deputy General Manager, SAIL could not get any data from SAIL for her research relating to Competency Mapping of HR personnel in Steel Industry of India. Somehow she managed to collect data from some private steel companies.
- (iv) Authors of the recent study titled, 'A case study of Strategic Rewards System' were refused to use the name and the data of the company under consideration. The strategic process adopted by the company in this case thus remains hidden.

All information other than what businessmen are under mandatory obligation to supply to the Government is normally treated as confidential. Even non-confidential data, not needed to be supplied to the Government, are not made accessible to individual investigators

easily. Businessmen feel that giving an opportunity for interview to research scholars is a waste of their time; otherwise also they are too busy to spare time. Researchers in management, economics and commerce encounter this difficulty.

Relevance and objectivity

Scientific facts are objectively given and these are relevant to the objective of research. Relevance relates to real life situations which constitute the context of the facts. Thus, relevance refers to the relation with observed reality. Contextual framework of the facts imparts relevance to scientific facts. Only relevant facts may be related to some problem or issue needing research. Relevance does not mean that all scientific facts are in tune with the currently existing conditions. Relevance should be taken to mean that the facts are germane either to current or some future state in which these facts may be important.

Scientific facts are therefore neither abstract nor are these irrelevant to reality. Besides, the facts of science have to be relevant to the purpose of study. This is an important aspect of scientific facts because the choice of methods or models chosen should be appropriate for the analysis of facts and suitable for the realization of the objectives of research. But objectives may be related to the hypotheses formulated for the realization of the objective(s) of investigation. For example, if the thesis that public expenditure promotes economic growth is the hypothesis to be evaluated for estimating the impact of public policy of expenditure, then the econometric method/model may be used. Employment of such model to analyze data will furnish evidence to support or reject the hypothesis and also quantify the direction and magnitude of relation between per capita GDP and per capita public expenditure.

Objectives of research

Any one of the following may be the objective of research to which the scientific facts are to be related:

- (i) Formulation of new theory; (ii) Testing and Evaluation of some prevalent theory for its verification and validation; (iii) Forecasting future outcomes; and (iv) Filling up of information gap to match some existing theory developed deductively. Besides, relevance has three facets: first, it looks towards reality rather than speculation as the base, second, it is entrapped and encompassed within the current theory, and third, it is needed for new theory. All scientific facts encompass some theory.

Base of grouping

Scientific facts furnish criteria or factors of classification. These criteria provide measures of condensing huge data by classification and tabulation. Classification also facilitates the control over the influence of one category of facts on other categories. For example, classification of data by gender and/or age results in controlling influence of one category on the other; comparability of one with the other group is also achieved. This also helps in comprehending the main features of data and its pattern of distribution. Aggregation or averaging may also be used to reduce hugeness of size; it also helps in separation of more from less or totally unimportant facts for the purpose of study in hand.

Basis of concepts and constructs

Scientific facts embody concepts and constructs. Constructs are theoretical formulations that are based on observations but which cannot be seen either directly or indirectly; such facets as elasticity of demand, productivity of labor/capital, wellbeing of people, satisfaction, happiness, etc., are the theoretical constructs. Their numerical values are derived from calculations. However, the concepts and constructs are to be perceived and conceived by a careful perusal, examination and evaluation of available facts. For example, the concept of threshold income for the purchase of consumer durables was formulated and used in theory to explain the ownership of consumer durables; but it was not empirically measured and used in research. Then, twin concepts of threshold income were formulated: one threshold of income at which ownership of consumer durables is observed on the basis of data, and second concept of threshold income related to that level of income which is lower than the first but at which the consumer is willing and able to buy consumer durables with credit. It was determined from the data collected for the study of use of credit for purchasing consumer durables (Prakash, S., Sharma, Shalini and Bagati, 2009, Bagati, 2011). This study transformed theoretical construct of threshold income into an empirically measured reality by delineating the level of threshold income on the basis of analysis of sample data. Similarly, Sharma. Amit (2012) transformed the concepts of 'Impact of 'Up-gradation of qualifications' and 'productivity' and empirically determined their inter-relations.

Base of hypothesis formulation

Scientific facts are an important source of formulating testable hypotheses. A careful evaluation of data to detect pattern, and/or trend

or relation between two or more facts may be used for formulating empirical hypotheses.

Synthesis of concepts, theory and evidence

Scientific facts lead to the synthesis of the concepts, theory, and empirical evidence into an integrated whole. Scientific facts are thus inseparable from scientific theory, its constructs and concepts. Theory becomes fact and facts are transformed into theory by synthesis. The synthesis of facts and theory is an important feature of scientific research.

Base of identification of knowledge gap

Facts facilitate identification of knowledge gap, which prompts researchers to initiate research investigation to fill up the identified gap (s) in existing stock of knowledge. If certain facts have not been used in scientific research, it means that the theory about these facts has not been developed so far despite that these facts are known. It is also probable that the overlooked so far have made the theory inadequate and inappropriate to explain the known facts. Use of the facts overlooked earlier will help in filling up the gap between theory and facts. Such known facts furnish the base of exploration of new dimension of theory. Facts furnish the base for exploration, extension, modification and verification of existing theory by empirical evidence and/or for formulating new theory if such facts have not been already used as base of some theory, or some specific aspect of these facts remains to be used for theorizing. The examples are Dussenberry's Relative Income hypothesis and peer group's influence on consumers' Choices and George Katona examines the influence of relations between psychological and economic factors on in his Model of Consumer Behavior.¹ These are examples of incorporation of such facts as were not used in earlier studies of consumer behavior.

Acceptance/rejection of theory

Final acceptance or approval of a theory is done after extensive testing, verification and validation of theory by facts. The theory qualifies for acceptance and approval only if it has been tested by different data sets under different conditions of time and space. If the predictions of theory fail to explain different sets of similar facts, it stands rejected (Popper, 1968). If the facts contradict theory, or its prediction is not confirmed by testing, its validity is questioned and the theory is rejected.

Inadequacy or need for extension/modification of theory

Inadequacy of the given theory may be revealed by the facts used for its testing; facts may also highlight the gap, and hence, the inadequacy of theory with respect to the facts. For example, facts of depression contradicted Say's law of markets that supply creates its own demand. This example indicates the need for modification and/or extension of the existing theory. Depression of thirties led to the rejection of Say's Law of markets and its prediction of equilibrium at full employment level.

Change of focus and reorienting research

Facts may also lead to change of focus of on-going research investigations, if facts do not conform to the purpose of theoretical framework of investigation. Direction of research may also change due to the non-conformity of theory to facts. For example, all recent efforts of RBI to control inflation through the manipulation of interest rate have failed. This suggests investigation of the neutrality of interest rate with regard to demand for and supply of credit on the one hand, and inflation on the other (for empirical evidence, see Sharma and Prakash, 2014, Prakash, S. and Sharma, Sudhi 2016).

COMMON/NON-SCIENTIFIC FACTS

Common facts are the facts of daily occurrence in human life. Such facts are encountered almost every moment of life. Such facts are part and parcel of daily chores. These facts are mostly overlooked and dismissed as not being of much importance for research. However, any of these facts may acquire importance and may be transformed into uncommon scientific facts, if some researcher uses such facts in research. For example, once the then Prime Minister of India gave the slogan of 'Garibi Hatao' or 'Remove Poverty' in 1969, the fact of poverty acquired importance for policy makers, academicians and researchers. 'Poverty' thus became the scientific fact, crossing the threshold to move away from the category of common facts of life to the category of scientific facts. Poverty was probably treated as the fact of life to be lived with. 'Jyada Ki Nahin Jarrorat humko, thode mein gujara hota hein' (We do not need more because we can subsist on less), these lines of a famous Raj Kapoor movie depicted the prevalent mood, mind-set and thoughts of the masses, administrators, academics and policy makers of that time.

TYPES OF SCIENTIFIC FACTS

Scientific facts are generally classified into following categories which are distinguished by specific features, associated with each of these categories of scientific facts.

Material and non-material facts

Facts of physical/natural sciences are material. But social facts are material as well as non-material. Material aspect is generally loaded on non-material social facts and non-material aspect(s) are associated with material facts. For example, purchase decision of a good is a non-material fact but the good purchased itself is material. Purchase and use of services are non-material but payment made in money is material in so far as money is material in shape, size and denomination. Human behavior is non-material but more often than not it involves use of material resources. Even one human action (non-material) has several non-material aspects which fall in the subject matter of different social sciences. For example, conduct of an election is a political activity but it involves the use of material resources which pertain to economics. Similarly, canvassing by contestants focuses on changing voters' opinion in their own favour. Hence, material and non-material facet are often inter-mixed and inseparable from each other.

Material facts of science

Material facts pertain to the phenomenal reality, which is concretely visible, measurable and verifiable. These facts are mostly cardinally measurable, and hence, are precise in nature. These facts are not illusory or imaginary. These facts exist in concrete and material phenomenal world of ours. But these facts may both be experiential and experimental. Size, design, shape and structure are susceptible to participatory and non participatory observations. The above description of material facts result in certain degree of over-lapping classification. It will be obvious when other types of facts are discussed.

Non-material facts

Non-material facts are abstract rather than concrete. Abstract facts may also be measurable or non-measurable. The non-material facts shall be non-measurable if these facts pertain to attributes or some qualitative aspect of the object of observation. These facts cannot be generated by laboratory type of controlled experiments. These are rather perceptual and experience based rather than based on experiment or participation in fact generating process by the observer. In experiment or

participation based facts, observer participant himself/herself becomes the part of experiment or the process of generating the given fact(s).

Two examples are cited to illustrate such non-material or perception based facts. David Ricardo speculated that there existed a virgin island, which abounded in land. But land was assumed to be of three differential fertility rates: Most fertile, moderately fertile, and least fertile. Initially, supply of total land is not finite relative to total demand. But supply of most fertile land is limited to a given quantity. Then, human propensity to go for the best and most profitable land is taken as a fact to come into operation. As more and more of first category land come under cultivation, supply becomes scarce relative to demand for it. Eventually, supply of first category land is exhausted by demand. The same human tendency to opt for the second best if the best is not available then the second most profitable option comes into operation. Consequently, second category land is increasingly brought under cultivation. But the same amount of investment on equal sized holdings of land of first and second categories furnishes differential amounts of yields due to differences in fertility. This makes first category land to command rent. After supply of second category of land is also exhausted by demand, third category of land is brought under cultivation. No rent is paid on last category of land but rent is paid both to first and second category land. The facts of the speculative or imaginary phenomenon are (i) Supply of land of all three categories, (ii) Fixed quantum of land of each category, (iii) Rising demand for land for cultivation with rising population, (iv) Differences in the yield rates of different categories of land, (v) commanding of rent by first and second category land, (vi) no rent for third category of land which does not yield any surplus over resource cost, which is accounted by the concept of rent, (vii) set ordering of different categories of land to be brought under cultivation, which is based on the actually observed preference of the people for the best and most profitable option among all possible alternatives. All these are facts but the facts are hypothetical and non-material, which have been generated by intellectual experimentation or non-computer simulation by the author on the basis of his perception of human behavior. Such facts have an important role in social theory and astronomy.

Second example is that of the balanced growth theory, enunciated by John Von Neumann. He assumes that there is a vast tract of forest land which is inhabited by one rabbit couple and one human couple. There is nothing but rabbits to eat. It is an observed fact that reproduction rate of rabbits is many times more than the reproduction

rate of human beings. Now how will there be a balance between the growth of rabbits for ensuring supply of food to humans and growth of human population so that neither the land is totally overtaken by rabbits, nor are there too many human beings for whom there are no rabbits to eat. Growth of human population has to be kept at that level which is just sustainable by the growth of population of rabbits, neither lower nor higher. In this case, human and rabbit's reproduction rates are observed facts. These facts are matched by the growth theory so that there always remains enough number of rabbits for human needs for food. The fact of balancing the two growth rates is non-material and perceptual.

Visible and non-visible or non-observable facts

Visible and observable facts relate to the phenomenal world of reality. Physical phenomena are observable but changeable in most of the cases. Besides, these facts are generally finite also. Only God is unchangeable, un-observable and infinite. But God exists in the perception and the faith of the people. God is neither material nor visible. But the concept of and faith in God affects the life, thoughts and actions of believers. God is omnipotent and He is beyond birth, growth/decay and death. God is also beyond human actions. But matter, and hence, material facts are subject to decay and change. As against God, death is material and it is an observable fact. Above description portrays facts as such phenomena of reality that are observable, changeable and measurable.

Observable facts may, however, be concealed in the perceptual facts. But observable facts and/or the process of generation of facts may constitute the base of perceptual facts. This has been illustrated by the examples of Ricardo's theory of rent and Neumann's theory of balanced growth. Observable facts are visible concretely though non-created facts may also be part of such observations. For example, if a person takes a victim of an accident to hospital, his/her action of help is visible, but its display is a part of a non-visible concept of helping nature of the person. The helping nature of the person, an important aspect of character, is reflected by the outcome of the action of help.

Perceptual facts pose problems in measurement and verification also. Observable phenomena are concretely visible in the objects of observation. Such features as shape, size and structure are a part of visibility. For example, color of the red shirt is visible. But the degree of redness of the color may not be exactly measurable easily. An advantage of observable facts is that such facts are generally verifiable. Observable phenomena, however, need not necessarily be visible

concretely. Non-visibility of facts does not rule out their identification, measurement and verification. But these facts are of a different genre as compared to visible and material facts.

Non-visible phenomena and the facts associated with the same may also be described in words or symbols just as we describe visible facts in words or symbols. The 'Swastik' symbol and 'Om' illustrate this facet of particular type of facts. Similarly, company brand may be displayed by some specific symbol etched on products of the company. National flag of India represents the presence of the country in an event though the country itself is not present at the event. It is only India's representatives who are present on the spot.

Totally invisible, non-observable and purely perceptual facts fall in the domain of Ontology rather than phenomenology that deals with the subject matter of natural and social sciences.

AWARENESS OF EXISTENCE AND USE OF FACTS

Observable and verifiable phenomena and the facts associated with these phenomena may be represented visually by graphs and described in words or symbols; besides, these facts may also be translated into concrete numbers/figures and symbols. All facts taken together are infinite in number, diverse and scattered all over and around the phenomenal world in which they exist. Existence of the visible or non-visible facts is a necessary but not the sufficient condition for their use in research. Mere existence does not bring facts into human reckoning. Reckoning of the existence of facts in phenomenal world, especially the reckoning by the researchers, makes the facts important for human beings in general and researchers and society in particular. Facts do not convey the meanings on their own: 'Facts do not speak for themselves (Marshall, [1892] 1962). Meanings are extricated from the facts by analysis and association of concepts and theories with the facts. But the facts, which embody meanings and relevance to human society, require recognition and identification for analytical use in research for extrication of their relevance for policy, research and analysis. Only research extricates meanings out of facts. Meanings, that facts carry, make them important. Facts, therefore, require awareness in human mind about their existence. Human beings acquire awareness about the existence of facts through observation, or learning, or experience. Observations are accumulated for fruitful uses. Observations precede the analytical use of facts in research. But this begs the question: what is observation? Let us look formally at the meanings of observation.

Observations

Observations are the outcomes of human knowledge, experiences, or encounter with the phenomenal objects. Experience and encounter of facts involve the use of senses and mental focus. Observation may also relate to just witnessing of the object, or occurrence of some event by humans with or without being a participant. Experiential and experimental facts embed the experimenter and the person experiencing the same. Experience is reckoned, gained and recorded for recapitulation through the agency of senses, especially memory. Experience is gained through willing or unwilling, conscious or unconscious participation in events or one being a part of phenomenal occurrences in natural ordering, structure, format/form or surroundings.

Participation makes the observer a part of the phenomenon through involvement in action or condition. Experience may also be gained through witnessing some phenomenon. Witnessing may involve seeing, hearing and touching, if it is concrete and material phenomenon; or hearing, feeling or even imagining and speculating to be the mentally/intellectually involved in some phenomenon one perceives to occur, if it is abstract and or non-visible. For example, heated exchange of angry words is just felt and experienced by those involved and witness of the same. For this reason all observations, and hence, facts are part real, part experiential, and part perceptual. Real and perceptual elements in facts are a matter of degree. Some facts may be predominantly visible, material and real, while others may primarily be perceptual. But real and observational facts are mostly concrete and visible, while perception is abstract and non-visible. Abstractness is an attribute of non-material objects and thoughts and the facets that relate to qualitative attributes. For example, a jar, half filled up with water, may be described either as half full, or as half empty; both these are correct statements of the same fact. Both water and glass are concrete, material and visible/observable, but emptiness or fullness of glass with water is relative and perceptual. Thus, the statement of fact and fact itself are required to be distinguished and differentiated. Both real and perceptual facts become different from the statements of the same facts. This distinction will become clear when other types of facts are discussed.

Expectation based facts

Expectation plays the pivotal role in human decisions and the resultant behavior. Expectations are based on (i) past experience or observed trend; and (ii) vision or perception of likely shape, size and structure

of change in future. Future may be expected to be an exact replica of the immediate past. In such cases, future reality or fact may be measured and expressed; it is represented by the expected value of the variable under consideration. This is represented as follows:

$$Y_{t+s} = \dots = Y_t = Y_{t-1} = Y_{t-2} = Y_{t-3} = \dots = Y_0$$

where Y denotes the value of the variable representing a given fact and subscript t depicts time. All future values of Y are expected to equal its initial/base value. This may be defined as the naïve expectation, which is likely to hold true only in a stationary state. In a stationary state, the system does not change. A variant of the above may be the expectation, which is based on the assumption that the variable will change at the same rate at which it has been changing in the past: $\Delta Y_t = \Delta Y_{t+s}$ for all values of s . Another variant may be that the rate of change will accelerate or decelerate by the same value as it has been observed to change in the past. All above cases refer to the projection of the trend into the future. In a more dynamic case, the trend may be expected to go through more than one break or twists and turns in future. Most of the economic, financial and business variables have this feature. Expected value may, however, also be expressed in stochastic terms as follows:

$$E(X_t) = \sum P_{it} X_{it}$$

where $E(X)$ is expected value of X_{it} , and P_i is the probability of X being equal to X_i at time t .

All facts based on expectation are basically hypothetical in nature and these may be defined as hypothetical facts. From the above discussion it is evident that facts related to expectation are based on assumptions. These are only one type of hypothetical facts. It is pretty well known that expectations had played and continue to play a great role in social science research. Facts cannot be overlooked on the ground that these facts do not represent observed reality, and therefore, these are ir-relevant. Too much concern for immediate relevance makes some professionals think and behave irrationally many times.

Facts based on simulation

Facts generated by simulation are virtual facts, which nearly approximate the real facts. Simulation has emerged as a tool of forecasting the future outcomes. Simulation is also used for training. For example, Pilots of Air Force undergo extensive training on the ground by simulating conditions during real flights on advance technology based air-plane. It verges on virtual in flight training before the pilots are taken for training in actual flights. Economists have

extensively used simulation for forecasting. Simulation is now used for learning by business schools to experience virtual business environment. Other social science disciplines may follow the lead of economics and management in due course.

Facts based scenarios

For forecasting the future outcomes, alternative scenarios are built by varying the assumptions on which different scenarios are constructed. Each set or sub-set of assumptions leads to the generation of one specific scenario. Each scenario is extremely sensitive to the assumptions on which the scenario is built. Even a slight alteration in any of the assumptions of the future state of the system will change the perceived scenario. Each scenario is a set of facts and these facts are encompassed within the set of assumptions on which the scenario is built. These assumptions may or may not hold. So, all scenarios are hypothetical in nature.

Experimental facts

Generation of facts by experiments under controlled conditions in laboratories has been an essential tool of advancement of knowledge in physical sciences. Experiments are designed to generate facts to match the hypothesis/theory under consideration. Alternatively, experimental facts may also be used for formulating theories.

Hypothetical facts

Generation of hypothetical facts and their use for formulating theory has been in vogue in economics since long. Plato was probably the first philosopher who conceptualized the division of society into rulers and the ruled in a city state. Ricardo was probably the first economist to have used hypothetical facts about the supply and demand for land for developing the theory of rent. Utility School of Thought evolved the concept and measurement of utility on the basis of hypothetical facts. Similarly, John Von Neumann developed his balanced growth model on hypothetical facts of virgin land being inhabited initially only by one human and one rabbit couple in order to highlight the balancing of growth of population of humans and rabbits.

Attributes based non-material and abstract facts

Facts pertaining to attributes are abstract, non-concrete and non material, though these attributes may pertain to material objects, or attributes may be material in themselves.

IMPUTATION AND EXPLANATION OF MEANINGS OF FACTS

Facts are also to be gathered by a systematic process of identification and selection. Facts do not speak for themselves, facts are made to speak. This needs appropriate classification/aggregation and tabulation; investing of meanings in facts requires the use of both commonsense and scientific knowledge. Meanings have to be extricated from facts by analysis (Marshall, [1892] 1962). Imputed meanings constitute the explanation of facts. However, some meanings may lie on the surface; such meanings are obvious and easy to detect and understand. But all meanings are not visible and these have to be extricated by analysis.

VISIBILITY AND ACCESSIBILITY TO FACTS

Features of visibility and accessibility to the observed facts are inevitably inter-related. Observation makes the fact known which facilitates the accessibility. Hence, these two facets of scientific facts go hand in hand. The phenomenal world is cluttered and covered with infinitely diverse and large number of observed and not yet observable facts and facets of observed facts. All facts and facets of the phenomenal world may, however, not be visible and observable to individual or group of scientists as these lie deep below the surface. Scientists have to dig out the facts from the phenomenal reality. Archaeologists and geologists fail to discover some expected facts in numerous excavations and explorations, while other facts become visible, observable, and hence, known after successful excavations. This holds for other scientific facts also. Excavations and explorations by archaeologists and geologists are systematically planned and organized rather than being undertaken and executed haphazardly. So, uncovering of the hidden and discovering of the unknown and collecting of the known facts can neither be haphazard nor can it be random in design or nature.

BASE OF SCIENTIFIC FACTS

The following parameters or factors constitute the base of scientific facts:

Awareness and knowledge

Awareness and knowledge of facts depends on discovery and the widespread knowledge about the discovery of new facts. Facts are, however, discovered accidentally/randomly or systematically by planned research for specific facts, which are needed for some specific purpose. For example, the planned search for sea route to India by

Vasco De Gama's was not a chance or accidental discovery. As against this, Columbus discovered America accidentally; he had set out on his journey in search of India. But he ended up in the discovery of America. Excavations of archeologists made Harappa-Mohan-Jodharo, Kaushambi, Ajanta-Ellora Caves, and old city of Dwarka in Gujarat known. Similarly, geologists discovered Mumbai High, Ankleshwar Gas and Oil fields, and Gas and Oil reserves in Assam. The finds of these discoveries were made known by wide publicity. Realization and recognition of power of energy, embodied in steam, was an accidental observation.

As against this, if a researcher starts with some theory or proposition which requires such facts as have not been discovered as yet, the veracity of the theory remains suspect. Such theory or proposition then becomes the base for search of relevant facts. Formulation of new theory without the relevant facts leads to the discovery of facts needed for testing and verification of validity. As against this, known facts for the explanation of which no theory exists, may lead to the formulation of new theory. Thus, the inter-relations between facts and scientific theory have lead and lag structure. In some cases known facts become the base of formulation of new theory and in other cases, theory leads to the discovery or generation/collection of facts needed for the verification and testing of theory.

Theory as base of discovery of facts

Facts and theory are bi-directionally related to each other. Existence and awareness of facts facilitates evolving of theory on the basis of such facts as have already been discovered. Discovery or generation of facts depends on theory also. Theory defines and determines the facts needed for its enunciation or verification. Discovery of facts arouses awareness and makes the existence of the given facts known in due course. Awareness and knowledge of the existence of facts encourages researchers to undertake research investigation which use the discovered facts. Then, such facts become the basis of formulation of new theory. For example, numerous tribals have been living in remote areas of India. Little was known about these tribes. But researches of Rahul Sanskritayn and Elvin Verrier brought to light numerous facets of the life and living styles, customs, faith and beliefs. Similarly, creation of OPEC and oil crisis of 1970s created awareness about the repercussions of scarce supplies and high prices of energy resources. American economy suffered serious recession in 1973-74 and 1978-79 as the consequence of high energy prices due to control of

members of OPEC on production and export of oil. No satisfactory theory has been evolved about such crises. Similarly, an appropriate theory to explain the sub-prime financial crisis is still awaited. Emergence of control over democratic processes in Nepal and Pakistan led to the formulation of the concept of 'Guided Democracy'. This is one dimension of relation between facts and theory. As against this, testing of Friedman's permanent income hypothesis by Prakash and Sharma, Shalini (2006) on Indian data showed the thesis to be invalid. This is other dimension of relation between facts and theory. In this case, Indian data were used to test and verify the theory which has already been formulated and verified with other data sets.

If a researcher starts with some theory or proposition, which requires such facts as have not been discovered yet, the theory cannot be considered as valid and acceptable. Such theory or proposition then becomes the base for search of relevant facts as an evidence to support the theory. As against this, formulation of new theory without the relevant facts leads to the discovery of facts needed for testing and verification of the validity of such theories. Experimental sciences generate facts by experiments need of which is determined by theory. The experiment is designed to generate facts needed for formulation or verification of theory. If facts needed for theory are known, the investigators collect and compile the requisite facts so as to examine the constructs of the theory and test and verify the theory.

Chance/accidental discovery of facts

Above are the explanation of deliberate/conscious, planned and well designed search for and use of facts. At times, man stumbles upon facts that were not known to him earlier. Ancient man stumbled upon fire by accidental rubbing of two stones. James Watt realized the existence of tremendous energy power in steam to create movement, while he was watching the plate, which covered boiling water, rising and falling. There are several examples of such discoveries of facts; some of these are cited hereunder:

- (i) The function of penicillin as the barrier to growth of bacterial fungus;
- (ii) fact that incision of the pancreas in dogs leads to diabetic systems;
- (iii) radium exposes films even in opaque objects;
- (iv) a freely moving pendulum of a given size covers equal distance back and forth, the distance moved in both directions being proportional to the length of pendulum;

- (v) Discrimination and classification of animals into aggressive and non-aggressive categories may all be attributed either to chance discovery, or personal observation and experience. Aristotle spent lot of time in studying animal world. He discovered and discerned that certain features of behavior of animals were similar to the pattern of behavior of human beings (cited from Kuper and Kuper, 1996);
- (vi) Frequent experience of field investigators reveals that housewives, non-working members of the households, are easier to contact and interview than the head of the households, or working members of the family.

Such facts, as are discovered/observed/experienced accidentally or by chance, are unplanned, unanticipated and unexpected outcomes of actions performed for some purpose other than the discovery of given facts. As these facts become known accidentally, these are designated as unplanned or unanticipated facts.

Un-recognized known facts

Infinite facts are literally littered all around the phenomenal world. Facts are as infinite as the phenomenal world itself. But neither all facts merit attention, nor all facts are unknown. Several facts are considered to be ordinary due mainly to their repeated occurrence in daily life. Human experiences and observations are also immensely huge. Neither it is humanly feasible, nor is it necessary to take cognizance of all these myriad experiences and observations of facts in real life. This feature of life and living make many facts pass away without attracting attention. Certain facts might have thus been known to exist for long but these remain un-recognized as having scientific character. Scientific facts differ from common and routine facts in several respects, so scientific facts are specialized facts. The routinely occurring facts may be dismissed as routine, unimportant, and not worthy of being taken any special note of. Such facts are not considered appropriate either to be associated with concepts and constructs, nor can these be incorporated in building or testing theory. These unrecognized facts are neither recognized to be important nor are these facts incorporated in the corpus of scientific facts and research. Thus, the awareness and knowledge of the existence of facts may be a necessary but not a sufficient condition to consider all facts worth being considered as scientific facts. This anomaly about known facts is attributed to their negligence by scientific community.

Scientists and researchers may fail to recognize the importance of certain facts as these may not be considered relevant either for the formulation of theory, or for the testing and verification of some existing theory. But such facts suddenly acquire importance without any previous precedent, if such facts are related to some gap in existing stock of knowledge, which an analyst attempts to fill up. This gap in knowledge may be explained by the negligence on the part of researchers; such facts may pertain either to divergence between facts and theory, or existence of no theory for a given set of facts, which necessitates enunciation of new theory. But once these facts are recognized and incorporated into analytical apparatus or theoretical corpus, such facts acquire an importance of their own *ex post facto*. Strategic nature of facts thus depends on the use of facts in research and analysis for diffusion of existing and generation of new knowledge. For example, poverty of the black people, their living conditions, deprivations and destitution existed for long in U.S. The contrast between the poverty of the black segment of American population and riches and prosperity of the white people persisted for equally long period. Discrimination against the non-white people was also taken for granted by different segments of the population, including those who were discriminated. Discrimination became live political and economic issue only when Martin Luther King launched his non-violent movement against it. Ever growing gulf between the prosperity of white and poverty of black Americans did not attract the attention of any economist or sociologist also. But Gunnar Myrdal (1955), husband of Alva Myrdal, the then Ambassador of her country to US, made this fact important by incorporating it as the base of his concept of 'Vicious Circle of Poverty' and the process of 'Cumulative Causation'. He subsequently incorporated these twin concepts to analyze the divergence of facts of international economy from the predictions of classical economic theory. Economic theory predicted convergence, whereas facts highlighted divergence between levels and stages of growth and differences between per capital income of different countries of the world. He further chiseled and refined these two concepts into a celebrated theory in his 'Asian Drama' (1968), which fetched him Nobel Prize in economics. Besides, the fact that poverty in countries like India is not a uniform phenomenon. Poor may be classified into following three groups; (i) Those who live at the starvation line; (ii) those poor who live a bit above the poverty line; and (iii) those who live at the poverty line. This distinction enabled Prakash, S. and Sharma, Shalini (2003, 2006) to discover Engel's law to

be inapplicable in its original form. So they extended the law to incorporate the neglected categorization. Subsequently, Prakash and Sharma (2010) incorporated these categories of poor in the conceptualization and measurement of poverty and modified the Engel's law of family budgets.

Earlier negligence and belated realization and recognition of importance of such known but not reckoned as scientific facts may probably be explained by (i) these facts appear too common and unimportant and part of routine facts of life to merit any attention; (ii) ignorance and incompetence or disinterest of large majority of professional scientists make them either do not take up research involving such facts and/or they remain satisfied just with the dissemination of current stock of knowledge among learners; (iii) Even among those, who take up research, only few may have little or some intuitive insights and vision to recognize such facts as important and identify gaps in existing stock of knowledge due to the negligence of these facts, so they do not use such facts in research; (iv) not many scientists and researchers have ability to take up research in virgin and untested areas, where known but unrecognized facts may be used as the base of investigation. Many researchers tend to conform to the prevailing professional ethos and dominant view. Consequently, they take up imitative research, or at the best, they try to test existing theory on different data base. So they tend to ignore such known facts, which have not been incorporated into the corpus of scientific facts as yet; (v) Ingenuity and genius of an intuitively insightful and visionary scientist alone prompts him/her to use his/her ability and willingness to challenge the established theory and explore the unknown. Till then, such facts remain in background till some perceptive researcher transforms apparently mundane and ordinary into an extra ordinary and pivotal fact or facet of the given phenomenon into a core fact to constitute the base of some strategic concept, and/or sophisticated theory; (vi) another reason of such anomaly of treatment of scientifically dormant facts as ordinary and commonplace is that 'no facts, including strategic and scientific facts' speaks on their own'. Marshall ([1892] 1962) rightly observed that facts are made to speak'. It is implied in this observation that all facts are recognized as facts autonomously. We add that 'facts need recognition as important so as to be associated with some concept or construct, which invests facts with importance and meanings. Incorporation of facts in theory brings out the dormant meaning into the open. Thus, this is the function of scientists and researchers to identify and select facts from the available corpus of

infinite known facts of phenomenal reality and use the same for formulating concept and construct and enunciate theory so that facts are used meaningfully.

Researchers also impute meanings to facts by incorporating these as part of assumptions of the theory. For example, Dada Bhai Naoroji recognized the fact of transfer of huge amount of resources from colonized India to Britain. This was draining Indian economy of its precious resources which could have been used for development. Dada Bhai enunciated the concept of Drain and formulated 'Drain Theory of Underdevelopment.' Thus, he laid down the foundation of Economics of Underdevelopment. P.N. Mathur (1992) formulated an input output model on the basis of Naoroji's theory of 'Draining of Resources of underdeveloped countries to promote the growth of developed countries. He attributed underdevelopment of developing economies to the prevalent iniquitous 'International Economic Order', which ensures continued draining of resources from the developing to the developed economies of the world. The fact of iniquitous international economic order, treated as given, was not recognized by any one before Mathur, who incorporated the impact of this on the development of developing economies.

MAIN FUNCTIONS OF FACTS

Above discussion has focused on the importance of facts in scientific research. The discussion has also highlighted the role that facts play in research. But the facts also discharge some other important functions in scientific research. These are briefly discussed hereunder.

Facts as initial step/stage of research

Gaps in information constitute an important type of knowledge gap. Discovery of unknown facts, or recognition of the known facts as important for scientific analysis is an elementary but first step and stage of research. Discovery of facts fills up the prevailing gap in the information base without which scientific research cannot be undertaken. But research should not end up with the discovery, or collection/compilation of facts, which is only the preliminary stage of research. In order to qualify as research, a descriptive portrayal of the discovered facts has to be presented in a well structured and systematic form. Discovery of new facts or recognition of scientific nature of the known facts for the first time will qualify the outcome of discovery as descriptive research. It may thus be inferred that the descriptive research begins with the discovery and/or collection of facts and their

systematic presentation to convey important meanings that are embodied in such facts. This includes the description of nature and pattern of distribution of values. Literary portrayal may be illustrated with well designed classification and aggregation, which will highlight the dormant meanings and features associated with facts. Graphical portrayal of facts also helps in displaying the basic features of facts unambiguously.

After the identification of the knowledge gap, which is sought to be filled up by research, next step is to identify the objectives of research. The identification and statement of objectives of research define the nature and expanse of facts required for investigation. Second step is to find whether the requisite facts are available from secondary sources. If secondary data are not available, researcher him/herself will have to collect and compile or generate requisite facts for which population /source) is to be identified or experiment is to be designed. Thus, research based on primary facts is initiated with the discovery or collection and compilation of facts. Sample design, including the determination of size of sample and method of collection of facts, development of questionnaire and its finalization after testing in the field conditions have to be done. These initial steps constitute the initiation or first step of research in such cases. Thus, such facts perform the task of initiating research investigation.

For experimental facts, investigator has first to design experiment and execute it to generate requisite facts. Designing and execution of sample and experiment require specialized knowledge and skills. Reliability, adequacy and representative character of facts is a necessary condition for ensuring validity of research findings and their amenability to generalization as the theory. Thus, discovery or generation of new facts or collection of known facts is considered as the initial step of research.

Facts as base of concepts and constructs

Facts facilitate the formulation of concepts and constructs and enables the enunciation of assumptions to be associated with the theory. Unless the concept and constructs are related to some specific fact(s), these will have no relevance for real phenomenal world. Therefore, concepts and constructs are conceived and formulated for directly relating these with facts. Facts acquire relevance for existing or proposed theory by their linkage with concepts/constructs. Theory also acquires relevance and importance by having facts of the phenomenal world as the base. This link facilitates the incorporation of facts in relevant and meaningful

theory. Any given phenomenon is influenced by various factors though the influence differs between factors. Theory generally concentrates on the influence of very few, mostly one to three, pivotal factors which decisively influence the outcomes. This necessitates the control over influence of all other factors. Physical scientists control such factors in laboratory conditions; social scientists do this job partly by the assumption about constancy of these influences, or these are controlled by means of classification of data.

Unless the concept and/or theory is related to facts, facts will connote no significant meanings. As against this, if the concept or theory is not related to facts, it has no relevance. Thus, facts, concepts and/or theory are intimately related to each other. Facts are needed for evolving concepts and constructs, which then are incorporated in the formulation of theory. Without facts as counter parts or support base, concepts/constructs and theory are like designer clothes in a show window, which no one wants to purchase. Similarly, facts without concept/construct or theory as back-up, are like a rudderless boat without boatman, which drifts in an ocean with no destination to reach and direction to move in.

Facts as base for verification and validation of theory

Relevance and validity of any theory require testing against facts. Theory cannot be tested and verified without facts. But facts also serve another related purpose. More often than not, theory is evolved as hypothesis, which is tested and verified extensively with different sets of facts and conditions. Only after repeated testing and verification with different facts, hypothesis or a proposed/preliminary or interim version of theory qualifies for final acceptance and approval as theory (Popper, 1968, ch. 1). Hypotheses are interim guesses or conjectures. These guesses or conjectures are proposed with a view to test and verify their validity and relevance to real phenomenal world. Without repeated testing and verification, hypotheses are not accepted or rejected. Without facts there is no valid ground to accept or reject the hypothesis or theory, though want of logical consistency with the general understanding may also be a rational ground for rejection of a thesis. It is, therefore, implicit that no hypothesis or theory is put forward for testing unless it meets the requirement of logical consistency. Repeated validation of an hypothesis with different facts and under different conditions qualifies it to be accepted as law or principle. But such testing and verification cannot take place without relevant facts.

Facts in their raw form or format never peep out of the stock as the ready material for use. Raw facts are to be properly arranged and classified to meet the needs of testing theory. A careful perusal of systematically arranged and classified facts enables researchers to detect regularity and systematic pattern and crude form of interrelations underlying the facts. The regularity of occurrence or frequency of a facet and pattern of its change may be used by researcher for the formulation of concepts and hypothesis. Thus, facts constitute the base of both formulation and testing of concepts and hypothesis.

Facts as base of rejection, extension/modification of theory

If some theory or hypothesis is found to diverge from the facts time and again, it stands rejected. If, however, hypothesis/theory is partly in consonance and partly in divergence from facts, then two possibilities are to be explored and examined. Theory may be revised for forging conformance between all facets of facts and theory. In some cases, theory may be modified thoroughly and extended to cover such facets and parts of facts from which earlier theory diverged. Thus, the theory will not be rejected outright but it will be modified and even extended only marginally or substantially, if the divergence of theory from facts is substantive. For example, Engel's Law of Family Budgets states that (i) a rise in household's income results in an increase in the level of expenditure, and (ii) but the proportion of income spent on food decreases, while proportion of income spent on non-food items increases. Thus, rise in income results in the change of level and structure of expenditure. The law implicitly encompasses two assumptions: (a) Food comprises homogenous items of expenditure, (b) wants and preferences of households of all low and high income groups are uniform. Both these assumptions are in dissonance with the facts. As growth of income of the poor mitigates their inadequacy of income partly or wholly, though they may still be trapped in poverty, they tend to spend larger proportion of increased income on food, if they have had some pent up demand for it at the earlier level of income. This has been extensively supported by empirical evidence with regard to the consumption and sales of self produced food grains by farmers to the market in Punjab and Haryana (Prakash and Tripathi, 1990, Prakash and Rani, 1988).

Income, family size, priorities and preferences, habits and hobbies, etc. differ significantly among the households across income groups both among the rich and the poor households in India and abroad. Naturally, income spent on food differs widely both proportionately

and absolutely among the Indian poor households also. Application of the Engel's Law to Indian data (1951-1997; disposable income and expenditure in constant 1980-81 prices) highlighted the great divergence between data and the prediction of the law. Reason is that both the implicit assumptions of Engel's law do not match realities at the grass roots. Prakash and Sharma (2006), Sharma, Shalini (2005), and Prakash (2010), Prakash and Sharma (2010) classified poor into three categories: (i) Poor living at the starvation and/or the liberty line, (ii) poor below the poverty line but above liberty line, and (iii) poor living at the poverty line. Food items were also classified into 3 groups: (i) items of bare subsistence that comprise largely cereals, (ii) essential food supplements as vegetables and pulses, onion, ginger, and garlic, etc., and (iii) protective foods such as fruits, milk and milk products, eggs and other animal products. The study revealed that an increase in the income of the first group of the poor leads to two distinct consequences: (i) increase in absolute amount of expenditure incurred on the increased quantum of essential food items, comprising cereals which were being consumed earlier in quantities less than required for two square meals. This moves such households away from starvation/hunger line. Increased absolute expenditure represents a higher rather than lower proportion of increased income; and (ii) if increase in income is more than what is required for moving away from starvation line, more expenditure is incurred on addition of some quantity of supplementary foods like pulses or bits of low priced vegetables. As against this, an increase in the income of the second group of the poor, who live above starvation line, induces them to include limited quantities of protective foods that they can now afford with higher income in order to move above the mal-nutrition line. But the poor of the third group, who move away from poverty line with rise in income, increase both these. The poor of this group also change their over-all pattern of consumption in order to raise the standard of living. They may also include more of confectionary and ready to eat/cook products to their food baskets. But increased income of those, who were already above poverty line, induces more frequent eating out, and emulation of peers of the higher income group to which they have moved now. These are the inferences, and hence, predictions of the thoroughly revised and extended version of Engel's law. This may be considered to be the general law of consumption which covers all types of consumption goods and all patterns of income distribution (for details, see Prakash, 2010). This also highlights the role of facts as the base of extension or modification of an established theory.

Facts as Base of Redefining and reorienting Theory

Real life is like a motion picture. Human life, society and nature all change with time. Chain of actions and reactions and even inaction in response to an action provide new contexts and some entirely new facts emerge from such changes, some earlier facts become obsolete, and some existing facts emerge in new light, shades and shadows. Both new and existing (unchanged in light, hue, shade and shadow) facts have specialized and unique as well as some common features and facets. But concepts, constructs, hypotheses/postulates and theories remain invariant. Theory is the statement, and hence, an encapsulation of a general tendency which relates to causal factors. This encapsulation of general tendency in a theory does not change autonomously, or reorient or modify and extends itself on its own to match the changed reality. So the testing for validating the theory with the existing and emerging facts confronts the theorists/researchers with challenge. The theories periodically acquire cleavages and divergences from facts. This is more so in social theory. If the degree of cleavage and divergence of theory from facts is small, it necessitates reorienting and/or redefining the currently prevailing concepts, constructs and theory. If the cleavage and divergence is highly marked, minor adjustment or modification or redefinition may not bring back one to one consonance and conformity between facts and theory. Theory will need either replacement by a totally new theory, or it may require substantial modification to match old facts in new light and extension to cover newly emerged facts of the ever changing phenomenal world.

For example, increasing number of women in employment and fast clip urbanization, involving migration, have resulted in the breakdown of joint families. Joint families have mostly been replaced by nuclear families. Parents and grand-parents are no more there to look after the children of the young working couples in urban India. The working parents do not have much time to spare for children or their parents. Children are left to the care of maids and servants. Thus, educational institutions, especially schools, have to take increasing responsibility of value education, inculcation of proper habits and hobbies. Similarly, either very little or no time is available to cook at home. Young married and working couples eat more out than at home. They also prefer to have ready to cook stuff to save time. This has directly affected demand for restaurants/hotels and fast food on the one hand, and the level and style of living on the other. Business of supply of meals to homes and offices, and supply of domestic help are now flourishing business in India. So both the educationists and

economists/marketers have to have a second look at the existing theory for its relevance to facts.

Similarly, continuous media exposure of institutionalized corruption in Indian polity and bureaucracy periodically shakes both. Hoseni Mubarak's long reign in Egypt has been uprooted by the use of face-book/internet to avoid arrest and torture. As against this, intervention by U.N. in prolonged armed revolt in Sudan has resulted in the division of the country by democratic means. Libya and Tunisia are free from their erstwhile tyrant rulers. These are new waves of opinion building and solution of politically ticklish issues. Political scientists have to look again at the various modes of uprising against the political system so as to reinvent the theory of revolution and/or reorient it.

One party rule over prolonged periods in India was replaced by the rule of coalition Governments, when Congress party lost its majority in legislature and no single party was able to form the government in several states in 1969 and congress party was replaced by Janta Party at the center in 1977. But Janta Party was itself a conglomerate of several parties, which drifted apart after ruling at the center for some time. Late eighties witnessed the emergence of first coalition government at the center. A new paradigm of supporting the ruling coalition from outside also emerged. Ever since then, center has been under the rule of coalition governments. Similarly, even though Britain has had three political parties in operation for long, labor and conservatives almost routinely exchanged their positions as ruling and opposition parties, now the coalition of liberal and conservative parties is ruling the country. Only in the first decade of the twenty first century has Britain witnessed the coalition government of Liberal and Conservative parties. This presents political scientists to have a second look at the elected governments in India and Britain. Other European countries are not averse to this type of mixed governance.

Rise of urban middle income class in India has witnessed more rapid growth of civil aviation than the growth of rail or road transport. Ever expanding geographical limits of cities has altered the pattern of rural to urban migration. Now the cities are migrating to villages just by incorporating villages within themselves. Rapid growth of private sector has made the Indian youth to change their preference from public to private employment. Globalization and privatization of Indian economy and tertiary led growth have resulted in ever rising demand for management education, which has eclipsed the growth of both general, and professional and technical education in India. New private-

public partnership model has resulted in mushroom growth of private institutions of professional and technical education. This has facilitated rapid growth of deemed and private universities. All these new facts, new forms, facets, structure and contexts of earlier facts necessitate reorientation, redefining and even extension or modification of earlier theories. All disciplines of social sciences face the scenario of changed and changing facts, necessitating modification or extension and in some cases even replacement of old theories. It reminds us of Tennyson's poem *Idle Tears: Old Order changed yielding place to new*.

Bi-directional relations between facts and theory

Above discussion amply highlights that (i) scientific theory and its under-lying facts are intricately, intimately and inseparably interwoven into each other. Theory becomes sterile without facts, while facts without theory are meaningless and useless entities. Facts reinforce and validate and even reinvent theory. Theory, on its part, generates (hypothetical/speculative, experimental) facts and even invents new facts. Thinking of those, who learnt social science theory before starting researching, is directly affected and conditioned by the theory they have learnt. The review of literature, considered to be an essential step of research, guides and conditions the thinking of researchers in many cases. Theory, however, provides new modes of thinking, it teaches rational way of decision making and influences attitudes, inclinations, and even tastes and preferences. Thus, theory conditions the mind set. For example, Keynes' theory was the base of state economic policy in the Post Second World War era for a considerable period of time. Theory also shapes and guides the everyday behavior of people and/or decisions, which directly create facts. This is an indirect mode in which theory invents facts. Continuous exposure of human beings to given thoughts and situations conditions their thoughts and behavior. Brain-washing was used as state instrument for enlisting support for the ruling class and system in some countries. Macaulay, the British Governor, who was the architect of Western Education in India, envisaged education as the potent means to generate support for British rule in India (Prakash, 1977). It may, therefore, be concluded that facts and theory are two legs and hands of science without any one of them it cannot move and survive.

SCIENCE AND SCIENTIFIC THEORY: MEANINGS

But what is science and what is scientific theory? These questions require formal answers. There exist two competing streams of thought

about science and scientific theory, which are in contradistinction to each other. But the views about science and scientific theory are inseparable, and hence, indistinguishable from each other. One of these two views is the commonsense and common men's view, and the other is the technical and professional view of science and scientific theory. Both these streams of thought are discussed below.

Commonsense meaning of science and scientific theory

Commonsense and popular view of scientists and scientific theory does not portray either scientists or science and its theory in any flattering light. Scientists are viewed as those people, who are mostly busy in their laboratories in boring white attire even during late hours of night. They live in their own world of make-believe, world far removed from reality. Scientific world is radically different from the real facts of life. Scientists are different from average human beings in so far as they do not have any time for social inter-action, entertainment and merriments of life. They remain lost in their own thoughts and/or experimenting with some funny things in the laboratory. Scientists are dull, unimpressive and uninteresting people like erstwhile philosophers of the past. A corresponding strand of this thought is that 'Science and its theory' are as much peculiar entities as the scientists themselves. Hence, the relevance and importance of science and scientific theory is confined to books and laboratories. Science and its theories are nothing but a bunch of hunches. Such hunches comprise unrealistic, or imaginary, or 'speculative flights of sterile and meaningless guesses'. The fact is that 'Science and its theory are 'highly abstract, indefinite, uncertain, and far removed from reality.'

Above is the common but uneducated view of science and scientists. This view postulates that the importance of theory is only academic and its relevance is confined to the books and class room learning and teaching so long it has not been verified and validated by facts. Some social and even natural scientists, who have spent substantial time in Government and/or have not done any research, always decry all research as academic.

Another strand of this thought is that only such research is relevant as focuses on policy. But policy formulation is generally guided by theory, objectives and targets of policy relative to the given state of economy, its business and society. Past experience of one's own and others may also be used for policy guidance. But, one important aspect is to be kept in view, if a policy succeeded in the past in some country, the very success of policy renders it irrelevant due to changes due to

the success of the policy. Similarly, if some policy has been successful in one country or spatial unit at some time, it may not be useful for other countries due to differences between the two countries (Prakash, 1994).

It is further opined that, as against theory, facts are conceived to be concrete, definite and certain and are always indistinguishable from reality with self evident meanings. But theory is only hypothetical and speculative postulation which requires to be tested against newer and newer facts before being finally approved and accepted (Popper, 1968). Besides, theory holds only if its assumptions holds true. But the very purpose of assumptions is to abstract from factual details to eliminate the diversity of reality. Thus, assumptions of theory take it away from most of the facts that characterize reality.

Another strand of such thoughts is that the only function of science is to generate or collect and compile facts. It may, therefore, be surmised that science is nothing but a pile of facts upon facts, which speak for themselves. The only function of science is collection and dissemination of facts. Speculation is the function of philosophy and it should be left to the care of philosophers. Philosophers alone have the liberty and opportunity to speculate and live in their ivory towers. An anecdote may be cited to illustrate the point under discussion. During Second World War, Mr Churchill, the then Prime Minister of Britain, called a meeting of leaders, military officers and intellectuals of the city of London to devise strategy to meet the reported challenge of German Army attacking from the British-French channel. Several suggestions were made and almost all those present spoke out their minds except one individual. Mr Churchill asked him to express his opinion. He responded positively and said, 'In order to prevent the German Army from entering the channel, the water of the channel should be brought to boiling point. Pin-drop silence descended in the room. After a few moments of pause and thought, Mr Churchill remarked, 'it is a brilliant idea, but there is one problem. How do we boil the water of the channel? Kindly tell us the way to do it'. The gentleman replied, 'I am a scientist and theoretician, this is not my function to find out means and ways of doing things, or determining the mechanism of implementation of theory.' This is a popular myth about theory and science. But such views are erroneous.

Basic view of science and theory

Basic and professional view of science and theory is naturally radically different from the above mentioned common-sense and biased views.

Science is factual rooted as it is in the realities of phenomenal world which we live in, see, encounter and experience in daily life. Therefore, science is as real as the facts that it deals with. Facts are indispensable for scientific knowledge but science involves an intricate and fundamental relation between theory and facts. The relations between two or more facts that science seeks to forge and verify are causal in nature. As all theories also forge and or examine causal relations between facts, all theories are science in nature and orientation,

Scientific theory

Meanings of theory are not self evident, these have to be elaborately explained. Theory is a proposition comprising the statement and explanation of general tendency embodied in the systematic pattern of behavior of the variables and the parameters attached to them. The theory deals with the relations between causes and their consequences; the causal relations hold true within the assumptions of the theory. The assumptions help in abstraction from the unimportant factors and simplification of the complexities of reality. But theory is an imaginary postulation or conjecture which requires factual evidence for its testing and validation.

The above definition does not specify extent and expanse of the empirical evidence required for the validation of the given theory. Besides, theory deduced by deductive logic neither requires extensive empirical evidence for its formulation nor does it need evidence for its verification. But the deductive theory has to be logically consistent with its constructs, concepts and assumptions. Deductive theory is generally based on commonly known generic systematic facts; these facts are used in the formulation as well as verification of deductive theory. Mehta (1954) opines that the deductive theory does not require any verification because it cannot be falsified by empirical evidence, He cites an example of the claim of a black cat having been securely locked in a totally pitch dark room located in a thick forest at dead of moonless night, when there is no light of any kind and the room in which the cat has been securely locked has only one door and no windows. No one can disprove that there is a black cat locked in the room. If room is opened, cat may run out furtively without being sighted. There is no way to disprove the proposition or supposition that the black cat has been locked in the pitch dark room. Deductive theory is like the black cat of this example.

But once the inductively formulated theory is shown to be valid, and hence, true, all its speculative elements, features of abstractness

and uncertainty are removed. Then, such theory becomes as concrete and obvious as facts. Therefore, empirical theory after being validated becomes in-distinguishable from facts, which have been used for its formulation and/or validation.

There is another approach to consider the concept of scientific theory. Once in the context of defining Economics, Lord J. M. Keynes remarked that 'Economics is what economists do'. He also observed that 'Economics is the training of mind to think and act rationally'. If this view is accepted as the valid paradigm, science may be defined as '*Science is what scientists do*' and that '*scientists think and act rationally*' (Goode and Hatt, 1982). This concept of science greatly differs from the common view and concept of science. Science comprises concepts and theories and all the facts that scientists use in the formulation, testing and validation of theory. Facts are the raw materials used in the construction of scientific theory; once the facts are massaged, processed and incorporated as a part of theory, facts lose their identity to become an inseparable part of theory just as yarn loses its shape and structure in the texture of the cloth in which it is used as raw material. Science also includes the methods of formulation, testing and verification of theory; the procedures of generation of facts needed for twin purposes of formulation and testing of theory are an inseparable part of scientific research.

Nature of scientific theory

Science evolves or formulates theory to furnish an explanation of causal relations encompassed in the observable, measurable and replicable facts. Thus, science comprises theory, statement of which pertains to causal relations which are discovered and discerned from the facts. This definition has two components: (i) causal relations embedded in facts, and (ii) causal relations contained in the statement of theory. Science brings about a fusion or synthesis between these two components. Thus, facts and scientific theory are inseparably interwoven and inter-twined into each other.

Scientific theory is accepted and approved only if it has passed through rigorous testing and validation more than once. Testing and verification of theory are feasible simply because scientific facts are not unique, or these are not the result of once for all occurrences and their observation. Scientific facts are concrete, observable, replicable and measurable; these are objective and verifiable in nature; these facts may be replicated by anyone, anywhere at any time. Scientific facts are also amenable to classification, systematic ordering, and susceptible

to manipulation according to the needs of theory. Scientific facts are, therefore, susceptible to control and manipulation, which make the formulation, testing and verification of scientific theory possible. Without these features, scientific facts will not lead to theory that is capable of verification and prediction.

Predictability of scientific theory necessitates control over facts. Control and manipulation of facts facilitate identification and separation of core from non-core variables/factors so as to focus on detection of regularity of patterns and structure of change in behavior of matter in response to the given external stimulus. Such facts as these endow scientific theory with universality under specified conditions. Consequently, scientific theory is neither speculative nor is it indefinite, uncertain and conjectural. Predictions of scientific theory hold true within the conditions stipulated as a part of the statement of theory. For example, H_2O states that a mixture, having two particles of hydrogen and one particle of oxygen, will become water at the specified temperature. Now if the prediction of this law is tested by disturbing the proportion of two components, prediction will not hold; or if the temperature differs from the temperature then the law will not hold.

Functions of scientific theory

Like the scientific facts, scientific theory also performs multiple functions and plays the varied roles in research. The following are the important functions and roles of theory in research:

- (i) Pre-conception stage of theory defines the nature, expanse, extent and type of data or facts required for the formulation of the proposed theory;
- (ii) Theory facilitates the formulation of concepts and postulates for the classification and condensation of data/facts;
- (iii) It enables researchers to systematize and/or condense the observations about the phenomenon under consideration;
- (iv) It endows facts with meanings that become the base of constructs and concepts associated with the theory;
- (v) It facilitates the generalization of research findings with empirical meanings and relevance to reality;
- (vi) It also facilitates the weeding out of irrelevant and less useful information so as to concentrate on meaningful aspects of facts;
- (vii) It leads to accumulation of the system of generalizations which may ultimately result in the evolution of the General Theory to replace several existing theories; and

- (viii) Theory highlights the knowledge gaps to provide direction to future research.

CONCLUSIONS

Above discussion and elaborate analysis highlight that

- (i) Epistemology, the theory of knowledge comprises methodology and ontology. Methodology deals with the material world; methodology is an inseparable part of research. Methodology is the theory of methods and it operates from the inception to the end of research investigation.
- (ii) Facts, science and theory are three important components of research, which are intricately and inseparable related to each other.
- (iii) Theories and their concepts are empirical in nature and orientation.
- (iv) Facts are the pillars on which scientific theory is erected. Facts and theory are so intermingled that these cannot be separated from each other. But facts are the raw materials of theory which lose their identity once these are inter-woven in theory.
- (v) Scientific facts are different from common facts. Scientific facts are observable, measurable and susceptible to manipulation. But awareness of existence and recognition of importance for scientific research transforms common facts into scientific facts. Both facts and theory perform distinct but complementary functions.
- (vi) Theory is of two types: purely deductive theory which cannot be falsified, and inductive or empirical theory which is enunciated, tested and verified with facts.
- (vii) Theory should be consistent with its concepts, constructs, assumptions and data.
- (viii) Theory needs extensive testing and verification with different layers and types of data before it can finally be accepted and approved.
- (ix) Observed facts, however, change with the passage of time and difference of space and these changes may necessitate the revision, extension and/or modification of theory with a view to eliminate cleavage and divergence between facts and theory.

- (x) Divergence between facts and theory constitute gaps in knowledge which can be filled up by research.

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Note

1. For a comparative study of economists' and managerial approaches to consumer behavior, see Prakash (2010).

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