THE SOCIO-ETHICAL ASPECTS OF SCIENTIFIC THEORY

WITH PARTICULAR REFERENCE TO BIOLOGY.

THE SOCIO-ETHICAL ASPECTS OF SCIENTIFIC THEORY WITH PARTICULAR REFERENCE TO BIOLOGY.

by

Karamchand Saroop Ganga

submitted in part fulfillment of the

requirements for the degree of

MASTER OF ARTS

in the

DEPARTMENT OF PHILOSOPHY AND POLITICAL SCIENCE

in the

FACULTY OF ARTS

at the

UNIVERSITY of DURBAN-WESTVILLE

Supervisor: PROFESSOR G.A. Rauche

PROFESSOR EMERITUS of the UNIVERSITY of DURBAN-WESTVILLE. At present HEAD of the Department of PHILOSOPHY at the UNIVERSITY OF FORT HARE.

Joint-Supervisor: PROFESSOR R. SINGH. HEAD of the Department of PHILOSOPHY and POLITICAL SCIENCE at the UNIVERSITY of DURBAN-WESTVILLE

December, 1987.

PREFACE

My interest in scientific theory deepened on reading Professor G.A. Rauche's paper, The function of method in the constitution of knowledge (1983) and Professor Singh's on Knowledge and faith in philosophy (1981) both published in the Journal of the University of Durban-Westville. These papers made me realise that science was not the objective enterprise I had imagined. They showed that method, faith and belief had important roles to play in the constitution of knowledge. This pointed to the social and ethical aspects of scientific theory.

Another paper in The quarterly review of biology (59: 3): Fraud in biomedical research (M.M.Kristein) coupled with my experiences in the Faculty of Science in this university, raised many thought-provoking and uneasy questions concerning science and scientists. In search of answers to these questions I turned to the guidance of my supervisors. For their erudite guidance, infinite patience and their deeply valued friendship, I owe to Profesor G.A. Rauche and Professor R. Singh, a debt in gratitude.

I would also like to express my gratitude to Mr Nelson Govender (of the Academic Media Centre: U. D-W) for helping me with the computer. To Mrs P. Ramkisson and Mrs J. Nadasen who so willingly typed the manuscript, I am deeply grateful. To my wife for her continued patience,

encouragement and discussions on religion, and to my children for their patience and curiosity concerning the study- those simple yet searching questions, I am deeply indebted.

CONTENTS

CHAPTER 2

CHAPTER 3

PART II

THE EMERGENCE OF BIOLOGICAL EVOLUTIONARY THEORY AND ITS ETHICAL IMPLICATIONS

CHAPTER 4

CHAPTER 5

ABSTRACT

In this dissertation scientific theory is investigated in order to show its socio-ethical aspects. An historical approach shows that prevailing historical conditions influence the development of scientific theory. These conditions are also created by the theories that they influence. Thus there is a continual interaction between theory and practice, pointing to the socio-ethical aspects of theory. An investigation of scientific theory including biological theory also shows this continual interaction. Efforts to derive moral precepts from biological theory, e.g., Darwinism, sociobiology and genetic theory reveal the influences and prejudices of the particular historical periods in which the theories are developed. These aspects of scientific theory show that the scientific enterprise is not characterised by objectivity and disinteredness. The community aspect of scientific practice also shows that scientists are dependent on one another and that theories are interrelated. These spects of scientific theory show the transcultural and transnational nature of theory and lays a foundation for the basis of ethics and for scientific responsibility.

Positio questionis

In the light of the questionable nature of scientific theory, it is asked whether theory can indeed have practical implications. The question is answered in the affirmative but with the realisation that scientific theory is conditional. Since scientific theory is constituted under particular historical conditions its practical aspect becomes apparent, pointing to a critical relationship between theories. If historical conditions are important in the postulation of theory, then biological theory, as scientific theory, becomes problematic because of the deterministic qualities attributed to evolutionary theory, especially when seen in the light of the gene. When viewed in the background of historical conditions it can be seen that biological theory, like any scientific theory, is also rooted in experience. This points to a critical relationship between theories and shows their moral dimension. In such a view the responsibility of scientists becomes increasingly important.

INTRODUCTION

Our universe has always been a source of wonder. Attempts to understand the universe have led to investigations of various aspects of nature. These aspects have been interpreted as different natural processes through which a balance is maintained in the universe. Although these processes might seem to have contradictory effects, or, aspects of the universe might seem to be contradictory, the universe is accepted as an orderly whole. Human attempt to understand this order and to be a part of it or to identify with it is evident in the earliest works of art, from the Paleolithic Period. The desire to identify with nature shows at once that the human considers himself as not being an integral part of nature and yet, of wanting to belong to or be an integral part of the world. Awareness and understanding (of natural processes) are thus of profoundest importance, for while humans can free themselves of the surroundings, they are perpetually striving in thought and in action to identify with it. This striving therefore, represents an attempt to maintain a balance through contact with some power in the universe in order to intervene in the "play of natural forces" to understand - and to control (Bazin, G. 1958). "Ritual burial of the dead" and "the provision of supplies and food for an afterlife" (Tobias, P.V. 1969, pp. 29-30) show human need to discover something, some being or power that was greater than himself "with which he yet felt that he could harmonize his nature, in which he could repose his doubts, through faith in which he could gain confidence and hope" (Huxley, J. 1929, pp. 3-4).

Depending on the method of investigation of these natural processes, religious beliefs and scientific theory developed to satisfy this need. Faith in religion, to a large extent, provided a focus in which man could find some stability. But as religion itself came to be questioned, the focus was shifted to reason and a rational investigation of the Universe, for a possible factual foundation for belief. The focus thus shifted from faith (and belief in Scripture) to reason to provide knowledge in which man might stabilize his belief. Each construction of the world though incomplete, is not drawn merely to fill a void, but is tested incessantly till it is considered as the "essence of the body of veritable fact, having an existence independent of the wishes or ideals of mankind" (Huxley, J. 1929, p.6). This search in nature has led to the development of scientific theory.

Science and religion, therefore, more than any other human institution have to a large extent both influenced and governed human life and progress. Their being viewed as autonomous and mutually exclusive sources of knowledge have had divergent effects on society; but not without being influenced by society itself. Religion is seen as distinct from science in its method of enquiry. The authenticity of religious knowledge is based on historical Revelation. This also forms the basis for human conduct. Scientific knowledge is based on a rational investigation of nature by systematically organizing facts and formulating statements about observable phenomena. Consequently, general laws and theories are formulated, which show relational patterns between different phenomena. Scientific knowledge is dependent on the discovery of new relationships and integrating statements, laws and theories into more comprehensible theories. Observations are also explained by investigating the conditions accountable for the occurrences which have to be empirically testable, (Popper, K. 1959) and also predictive through logical consequences of hypotheses. According to Popper (Popper, K. 1959) the irrefutability of an hypothesis makes the hypothesis scientific.

Francis Bacon (1561 - 1626) had an influential role in the shaping of modern scientific theory. Together with Bacon John Stuart Mill (1806 - 1873) proposed that induction is the most important method of science. Its application to data avoided "subjective preconceptions" resulting in objectivity. Thus empirical and not abstract or metaphysical knowledge was obtained: "inductivism holds that the scientist should observe any phenomena that he encounters in his experience, and record them without any preconceptions as to what to observe or what the truth about them might be - truths of universal validity are expected eventually to emerge" (Dobzhansky, T. et al. 1977, p.476).

Inductivism, however, is problematic as scientists always work with a preconceived plan as to what they wish to observe, and study "objects and events" what will provide some answers to questions of interest to them. Also, universal truths cannot be arrived at through induction since any accumulation of observations cannot logically provide a universal statement or generalization - which must have "greater logical content" than the mere sum total of singular statements (Hume, D. 1711 - 1766). Scientific hypotheses and theories are formulated in abstract terms (refer,e.g. Mendel's unit "factors").

The method of contemporary science is based on the hypothetico-deductive model (of William Whewell (1794 - 1866), William Stanley, J. (1835 - 1882) and Charles S. Pierce (1839 - 1914)). Dobzhansky, et al (1977) however, feels that Popper (Popper, K.R.1959) characterizes scientific method precisely. But Popper's "piecemeal" approach does not provide a cohesive picture of science. His principle of "falsification" results in increase in "piecemeal", functional knowledge which is just one type of knowledge and does not "constitute the whole truth about man" (Rauche, G.A. 1983). Essential knowledge has not kept pace with the increase in functional knowledge with the result that only certain aspects of man and of nature are accounted for. This is largely in terms of mathematical equations providing only probable knowledge of functional aspects.

The expression of nature, including man, in mathematical terms greatly contributed to the view that scientific knowledge is objective and therefore reliable in reaching the truth. But the problematic attempts to reduce nature (and man) to basic constituents in physics (atom) and biology (gene) shows that science must despair of explaining man and nature in reductionistic terms. This shows also that science is a more complex enterprise which includes an imaginative (creative) aspect and a critical attitude which are interdependent. Science is, therefore, concerned both with invention or discovery and with validation or confirmation. Imaginative and critical attitudes are not unique to science. Artists, poets, philosophers are also creative and advance "models of experience" - just as the scientist does, for example, the "billiard ball" model of the atomic theory. Models are imaginative ways for expressing what is not observable in empirical science and like religious models are used to interpret and organize experience (Barbour, I.G. 1970). The use of models and the thematic approach (Holton, G.

1974) show that science has no "uninterpreted data" (or data free of being interpreted without preconceptions). This also undermines the view of the objectivity of science. A consideration of such aspects of science shows that scientific theory is not an indisputable picture of reality. Like in religion, faith and belief (Singh, R. 1981) have a role in the formulation, development and interpretation of scientific theory. Intuition, faith and belief thus also become sources of knowledge, like the application of reason to experience.

Science grows by the fact that its answers to questions pose new questions, and therefore new interpretations for old or past institutions. This is evident in Greek thought where science influenced morality and also social (and political) institutions, and also from the Seventeenth Century onwards where science assumed an ever-expanding cultural role as a substitute for religion. "Thus, the more the world came to be understood in scientific terms the more need there was for scientific education and the more has human progress been seen as a function of scientific advancement" (Richards, S. 1983, p.97).

The view that science is objective in its investigations has also led to the belief that the "scientific method" produces certain knowledge. This has influenced both the human and social sciences to adopt this "method" in an effort to attain certainty for their results. This has led to, what might be termed a "functional" approach to these disciplines. Human characteristics and behaviour are seen in the light of the Darwinian hypothesis as being derived, through genetic continuity, from the non-human world. Ethology and sociobiology attempt an almost direct link between human and non-human behaviour. Man is therefore, to a large extent, seen as a product either of his genetic or environmental determinants.

Undoubtedly, the scientific method, as it is popularly known, has produced a vast quantity of knowledge which has both beneficial and harmful aspects, depending on its use. The present questioning of scientific method, of scientific objectivity and consequently of scientific knowledge and certainty, has led to much uncertainty and doubt regarding the "scientific method". In this uncertainty man cannot see his way to a peaceful existence and consequently, turns again to religion.

However, in the background of scientific knowledge man could no longer rely on biblical literalism for an explanation of the world and of himself. The Bible thus can be seen as an explanation of the world in allegorical terms. Novel interpretations of the Bible also had novel implications for ethics. Science therefore undermined the authority of Scripture as a source of knowledge, and consequently, as the basis of ethics. Conflict between reason and faith, each interpreting the world in a different way, has its roots in the Mediaeval Period and contributed largely to the later and also the contemporary crisis of knowledge. For in virtually absolutizing reason as the basis of truth (through the scientific method) the metaphysical aspects of scientific theory could not be seen: that scientific theory is also based on faith - in reason; that its reality is also based in concepts, which can be traced to Greek thought. And viewed in the background of atomic theory, reality assumes a mathematical form.

Such a view of science lacks the "wholeness" of Greek thought. The Greeks, through rational investigation (and in this sense, scientific) attempted to find a single substance or principle that constituted the basis of both man and the Universe, and this included their gods. This is unlike modern scientific theory (rooted in the Mediaeval Period) which seeks to explain everything in material terms and where explanations of the immaterial or the metaphysical, is left to religion. Where (scientific) knowledge to the Greek had metaphysical, epistemological and ethical significance or implications, modern scientific knowledge is concerned with investigation only of the material, in reductionist terms. Metaphysics and ethics are not regarded as part of such an investigation.

Although modern science has ethical implications and although science has influenced ethics from Greek times, post-Mediaeval scientific theory has tended to disregard this aspect of science, that is, it has not taken into account its social and ethical aspects. Modern society is to a large extent the product of scientific theory of the post-Mediaeval Period. And in this is evident the influence of both physical and biological scientific theories. Since these theories have influenced society, they have also influenced ethics.

In any society ethics is of primary importance since its concern is with human relationships. In a wider sense, it also concerns man's relationships with the rest of the universe. And as society changes through change and development in scientific theory, so does ethics. Man, therefore, has to constantly grapple with the problem of good and evil, not only on an individual, but also on a collective level. Waddington feels that, "What is demanded of each generation is a theory of ethics which is neither a mere rationalization of prejudices, nor a philosophical discourse so abstract as to be irrelevant to the practical problems with which mankind is faced at the time" (Waddington, C.H. 1960, p.19). Teilhard de Chardin and others relate ethics to evolution throughout the cosmos whereas Huxley (Huxley, J. 1929) tries to show by logical steps a relationship between the processes of evolution and the ethical feelings that humans experience. This suggests that human ethical feelings are related to the feelings of, e.g., altruism and parental care, etc., that are present in man's non-human ancestors. The "social Darwinists" highlighted such aspects of evolutionary theory as the "struggle for survival" and "survival of the fittest" as the basis for moral conduct- since the Darwinian hypothesis was interpreted in these terms.

The problems of ethics, however, cannot be solved by a single unchangeable theory, as "changing historical conditions" influence morality. Waddington and Huxley (Julian) see ethics as a separate theory that emerges out of evolutionary theory, from certain aspects of animal behaviour (non-human behaviour). However, scientific theory has ethical implications as it developed through rational insight into the structure of the world. It is in this sense that ethics can be seen as an aspect of scientific knowledge for the basic structure of the world is determinative of moral conduct. Consequently, there is a close connection between ethics and metaphysics (Rauche, G.A. 1985, refer p.93).

Under "changing historical conditions" man constitutes and re-constitutes knowledge of the universe, and so reconstitutes himself, in relation to the world and also to his fellow-man. Man needs his fellow-man to reconstitute himself, his individualness, against that of his fellow-man. This need and dependence is the basis or ground for the development of "norms" against which man's actions might be judged "morally right or wrong". The function of ethics is thus shown in "the relationship between moral theory and moral act: the way a specific philosopher experiences the world (reality), that is the way he forms his image of man, and that is, in turn, the way he expects man to act towards his fellow-man (the moral act) (Rauche, G.A. 1985, p.94). In this need and relationship between man and his fellowman to constitute and reconstitute the world under "changing historical conditions," is evident the "moral ought."

Ethics is therefore closely related to knowledge of the world or of those principles that govern the world. Religion has also been important in the development of ethics as it (religion) also constitutes knowledge of the world - based on faith. Developments in scientific knowledge ("scientific" in the popular use of the term) has resulted in reinterpretation of religion and this has largely affected ethics. This also emphasizes the view that ethics is dependent on the development of knowledge which is related to different experiences of the world (reality) under "changing historical conditions". This is evident from mythological to contemporary thought and illustrates the metaphysical dimensions of ethics or moral theory, which results from man's need for freedom (Rauche, G.A. 1985, refer pp. 98-100). Such freedom is realized with man's identity with society and reality (nature) - when man is integrated with nature.

If "changing historical conditions" are important in the understanding of metaphysics and ethics, then it is profitable to investigate the influence of scientific theory on society and ethics, from a historical point of view. Besides showing how scientific theory developed, such a view would also illustrate the influence of society on science and also the influence and implications of scientific theory for both society and ethics. It would also illustrate how previous scientific and religious or mythological thought, had influenced the direction and development of scientific theory, and also the relationship of scientific theory to social and ethical systems.

The world-views of Copernicus, Kepler, Galileo and Newton changed man's outlook towards the physical world, resulting in a mechanistic-materialistic world-view. This greatly influenced biological theory, where animals also were looked at in the background of a "universal mechanism". Darwin's theory greatly affected ethics and consequently, morality. Against divine direction of morality, science (biology, ethology, sociobiology) seemed to show that human behaviour, even aggression, etc., were natural, in that they were derived from non-human forebears: the human therefore, could not act otherwise. "Universal mechanism" and the resultant deterministic view of behaviour greatly influenced studies in genetics. Reasons for certain types of behaviour were therefore sought in the inheritance of certain "particulate entities" or genes - which were thought to govern behaviour, just as they were responsible for the anatomical development in the biological world.

Scientific developments have also influenced political development or change (Greek **polis**, feudalism, Capitalism, Marxism) in numerous ways, even from the times of ancient Greece. Most of the changes that scientific theory has effected in society have emerged from its challenge to religion which at first supported a static world view, intolerant to change. The interaction between scientific and religious ideas was complex. Initially, the new view-points which emerged from science continued to exist alongside firmly established views that were largely attributed to religious authority of previous centuries. The development of the steam engine resulting in the Industrial Revolution completely changed Western Society and man's view of the world. However, it was through biology that the impact came which had far-reaching consequences for society and ethics effecting a major revolution in human thought. Like Newton in physics, Darwinism "proposed a set of theoretical concepts which was able to encompass within a single unified scheme vast reaches of data from many types of phenomena - inanimate and animate, respectively" (Barbour, I.G. 1966, pp. 80-81). Newton's world-view saw nature as an "intelligently designed machine". Newtonian and deistic assumptions, therefore, merged in the "argument from design" which was also held by natural theology. Newtonian physics therefore tended to support natural theology. The Darwinian hypothesis, however, produced a world-view that saw both the animate and inanimate world as "dynamic" - changing in directions governed by laws within itself: change was a feature of all aspects of the world and of life.

Lyell (1830) and Cuvier (1801) had introduced the idea of evolution long before Darwin. To them, however, change was due to "catastrophism" or to divine intervention. These series of acts of divine creation or intervention was not dissimilar to the "Genesis" account of the Bible. Darwin's theory, however, refuted the belief in the "stability of biological forms" (as created), consequently affecting the status of man. The effects on society were far-reaching since they seemed to show that the divine was not necessary to account for the universe and for man. The ethical value of the Bible was questioned and society turned to science to find there the basis for its moral conduct.

From the biological view-point life is seen as a "struggle for survival" where the "fittest survive". However, in the light of contemporary biological theory (studies on embryology, genetics and behaviour) the Darwinian hypothesis is interpreted to show that co-operation and mutual aid are also part of biological processes. Determinative and indeterminative aspects of biological processes confirm the view of the dynamic interaction between animal and the environment.

Scientific theory can, therefore, be seen as the product of man's contingent experience of the world (reality). Through such experience he constitutes the environmental conditions in terms of theory reflecting his needs and problems which emerge from the particular conflict experience he seeks to cope with in specific historical situations. Consequently, the theory is a reflection of the specific historical conditions - and as such has both metaphysical and ethical implications.

Since scientific theories result from contingent experience, they constitute truth perspectives (Rauche, G.A. 1985) which, being controversial, enter into a critical relationship with one another. The continuing argument concerning truth constitutes a critical relationship between scientific theories implying a moral ought (Rauche, G.A. 1985) which forms the basis of the attitude in which a meaningful debate might be conducted.

If contemporary society, including the scientific society still looks at science as an objective enterprise or as institutionalized truth, man would do well to try and understand the way in which his forebears of the Palaeolithic Period saw nature and of their communal efforts to interpret nature, and themselves as part of the natural world.

From such a viewpoint, science loses its objectivity and can be seen as one method among others (faith, intuition, etc.) used to understand the world. The knowledge, therefore, obtained through the scientific method provides knowledge only from that one perspective - highlighting the subjective element in science. Scientific theory is thus operative within a certain framework, constituted by man himself, through his experience of the universe. Thus experience constitutes the basis both of scientific theory and ethics. In such a view of scientific theory religion and the other different disciplines can all be seen as constituting truth from different perspectives.

Viewing science in historical perspective shows man as a product of history, both biological and cultural. It shows also that he is both limited and unlimited through his dependence on his fellowman - for the boundaries of science are neither cultural, biological nor physical and that man alienates himself from his fellow man only in his mind, through concepts and ideas of his own weaving.

The present investigation is aimed at demonstrating the problematic nature of knowledge especially in its constitution as scientific theory under certain historical conditions. In an attempt to understand scientific theory it is therefore important to investigate the influences that surround its beginnings and also its changes and development under different historical conditons. In its beginnings in Greece is seen the attempt to understand the universe in terms of a **basic substance.** With the sophist and Socratic movements the emphasis turned to **truth** because of the changed historical circumstances from that of the Milesian School.

The emphasis on **truth** was accentuated during the Mediaeval Period when the problem arose between faith and reason, in the attainment of truth. The establishment of the primacy of faith with the use of reason by the Christian philosophers led to the authentification of the use of reason in the investigation of the world and finally to the development of the trends that led to modern scientific theory and the empirical approach. This emphasised the problematic nature of the scientific approach in the constitution of knowledge. It showed that science is a **method** in the constitution of knowledge; leading to the view that the certainty and objectivity of this knowledge is questionable.

Scientific theory, especially biological theory, is investigated in this light. An attempt is made to demonstrate that its ethical and social implications are not logical consequences of certain and objective knowledge, but that they, like the constitution of theory, are dependent on the interpretation of theory, under particular historical conditions. It reveals also that the practical dimensions of theory are coloured by social prejudices.

PART I

THE RELATIONSHIP BETWEEN SCIENTIFIC THEORY AND ETHICS IN HISTORICAL PERSPECTIVE.

CHAPTER 1

THE GREEK INFLUENCE

1.1. INTRODUCTION

Any investigation into the origin and development of western scientific thought starts with ancient Greece and those influences that had shaped Greek thought. These influences have been revealed through artefacts excavated in the region around the Agean Sea. Among other facets of their life, these show that the Aegean people had certain particular views about the dead, which pointed to the supernatural elements of their thought. Theological speculations are thus evident in Aegean thought. Whatever form these speculations might have assumed they represent an attempt to understand the world around them, so that they might live in harmony with the world. This need to understand the world has been the primary motive responsible for the development and for the continuously changing face of knowledge.

The Achaeans later came into this region and brought with them the Olympic cult (Bazin, G. 1964), which later was adopted by the Greeks as a whole. This was significant for, there never developed among the Greeks a predominant priestly class. Although the Greeks did have priests, they did not develop into a dominant class that could impose its teachings and will upon the people.

The Greeks, free of a dominant priestly class, gave full rein to their restless and inquisitive spirit and continuously tried to interpret the world around them, in mythology, in basic principles and finally through "cause and effect", at each stage their experience of the world constituting the grounds both for knowledge and the conduct of their lives. Their physical environment, too, had a marked influence on them. Mountain barriers separated one plain from another, keeping different groups apart and fostering in them a spirit of jealous independence of each other. This local patriotism greatly influenced the political development of the various groups independently of each other. Historically, therefore, from an early stage, the Greeks attained an individuality which is basic to development in other spheres.

1.2. MYTHOLOGICAL INFLUENCES

The influence of the advanced Minoan civilization on the Achaeans is unmistakeable (Robinson,C.E., 1966). At Mycenae, the Archaeans established a civilization that flourished for some 500 years (1600-1100 B.C.). This prosperous city had trade links from Egypt in the east to settlements on the northern coasts of Syria and the Western coast of Asia Minor. Homer's account of the gathering of the Greeks for the Trojan War, provides a good account of Mycenaean society. From this account and from the decipherings of clay tablets (found at Mycenae) "emerges a picture of a monarchical society with a feudal aristocracy, the wealth of the whole being based on agriculture" (Robinson, C.E., 1966, p.17), a manufacturing class, an independent merchant class and a bureaucracy of clerical staff. "The tablets also tell us something new about the religious beliefs of these people, for they record offerings of country products, and of gold, not to any remotely conceived principle of fertility in nature, but to the Olympian deities, familiar in classical times - to Zeus, Poseidon, Hera, to Hephaestos, Lady Athena and Appolo" (Robinson, C.E., 1966, p.16-17).

The offerings made to the deities show the extent to which the Greek felt himself exposed to the variable and varied powers of nature. His own personality, provided the Greek with a basis for understanding these phenomena, through himself: he himself was on occasions gentle, angry, jealous, etc. He therefore personalized natural phenomena filling the universe with gods, whom for his happiness and good harvests, for good winds to carry him across the seas, he sought to "propitiate with offerings and ceremonies". The Greek polytheistic religion therefore, developed in him a sense of responsibility towards his fellows and also towards nature. But this responsibility could only be accomplished if he gained knowledge of nature, which gained through his experience, formed the basis of morality. Knowledge therefore also had ethical implications.

The Greek therefore, saw himself as part of the universe. Nature therefore was not an object apart from him; he was part of nature -part of the phenomena of nature, which he had deified. He felt that he belonged in this family; the only difference being that he was mortal. This anthropomorphic character of mythological thought based on experience of nature is evidence of the depth of the Greek personal involvement with nature - to which both men and gods were subject.

The Dorian invasions destroyed much of Mycenean culture establishing a ruling Dorian aristocracy in the city-states. Here the Dorian commoners and the pre-Dorian people had virtually no political power. In this period Homer's **Iliad** and **Odyssey** portrayed the socio-cultural conditions of the Achaeans, serving education in very much the same capacity as the Bible in western Christian civilization.Thus Homer's classics constituted the basis for the development of the city state which was supposed to reflect the universal order maintained by the (Olympic) Homeric gods with Zeus at the head (first ordering principle). Homer's **Iliad** and **Odyssey** were addressed to the aristocracy for to him **arete** (excellence, goodness, virtue, order) dominated the city-state; it was a reflection of the Olympian order. Knowledge of the Olympian Order thus had both epistemological and ethical significance.

Hesiod's poems, however, were addressed not to the aristocracy but to the peasants. His **Theogony,** the Olympic Pantheon, as a **Cosmogony** introduces the ideas of **Chaos** and **Eros**. This was again linked to the historical conditions of the city-state in the 7th Century B.C. The governing aristocracy was oppressing the peasants. On the basis of this injustice in the city-state Hesiod felt that **arete** could not be the governing principle. He therefore sought for justice (**dike**) or natural balance.

Unlike Homer who assumed a first ordering principle (Zeus) Hesiod introduced **Chaos** in an attempt to picture a beginning or a "gap" or "gulf" devoid of anything. Hesiod thus sought something more primary than the gods. This he found in **Chaos** from which through the creative principle, **Eros,** natural phenomena and the gods came into existence in an orderly way. Hesiod's **Theogony** (origin of the gods) was also a **Cosmogony** (the origin of world order).

Hesoid's work shows that the inquisitive Greek could not rely on any traditional view or on any authority on which to accept the world. He relied on his own faculties; on his experience of the Universe. But this in itself was not adequate. He had to rely on ideas like those of Hesoid, to provide some ground for rational speculation.

With Hesiod, therefore, the understanding of the physical has already been placed on a metaphysical basis, in a primary principle beyond the universe whose order was derived by a principle of creation. Order was important to maintain the Universe, as it was important to maintain the city-state, for without order, neither could endure. The ideas of the "gulf" the "impulse" and "to get behind the "gulf" having been the driving force of both philosophical and scientific thought.

Just as each entity in the Universe had as important a role as the other, in the maintenance of order, so had each citizen in the city-state, a duty towards every other citizen - for the origin and maintenance of harmony. Consequently, from the experience of the harmony in the universe is derived the principle of natural balance which forms the basis for harmony or justice in society. In this harmony, society identifies itself with the universe.

Expansion and relationships with other societies results in new experiences which form the basis for the development of new ethical systems. Mythological thought therefore, is also a form of knowledge as it too is born of experience of natural phenomena which the mind translates into mythological symbols. Philosophical thought, however, attempts to detach itself from the senses and examine experience critically. Thus, while the mythologist symbolizes the philosopher abstracts concepts from, his experience of natural phenomena.

The scientific nature of Greek thought emerges from the fact that it is based in experience of the world. From this it is induced that there is something more primary than the observed phenomena. In this way scientific thought attempts to find what is basic to the observed phenomena, assuming a basic unity or order in the Universe. This basic concept can be compared with the hypothesis that underlies theories in the natural sciences.

1.3. GREEK COSMOLOGY

The transitory nature of physical things and their seeming lawlessness appeared as a perpetual struggle between opposites. This deeply impressed the Greek mind. Contact, with especially the Eastern peoples, had taught the Greeks about the cyclic nature of heavenly phenomena. They also learned mathematics which could be used to advantage to express systematically their observations of those heavenly phenomena. Consequently, they were able to formulate theories about the universe and about the earth itself. Discoveries in marine biology by Anaximander and of fossils by Xenophanes in places as far afield as Malta, Paros and Syracuse, were used to support their theories that the earth had been originally in a moist state.

These theories were based on palaeontological and biological evidence. Again, like in mythological thought, these theories were based in experience. But now the experience did not have to be expressed in "mythological garb" (Rauche, G.A. 1983) but could be expressed in the form of concepts. In view of the seeming transitoriness of physical phenomena and the cyclic changes of the heavenly bodies they felt that there was something more primary that persisted through change; "that could cease to exist in one form and appear in another" (Burnet, J., 1971, p.7), something that was "ageless" and "deathless". They arrived at this idea since they found that the interplay of opposites occurred as a natural rhythm and as a natural cycle, the natural balance of which pointed to an underlying basic principle that governs this natural rhythm.

This showed, however, that the "new form" of the universe expressed in terms of concepts, rather than gods could not express everything: there still remained "something" that could not be formulated. Already the metaphysical had appeared and was there to taunt whomever might attempt to express it in physical form.

The important character of Greek, especially of Ionian, thinking at this stage was that it did not resort to any theological speculations. To the Ionians "theos" meant "primary substance", having a non-religious use. Rational insight was the primary feature of Greek scientific thought at this stage and was concerned with understanding the heavenly bodies and other natural phenomena through knowledge of a "primary substance". Since knowledge of this substance was beyond experience it could only be understood through rational insight. This way of understanding the universe is best exemplified by the thinkers of the Milesian School.

1.3.1 The Milesian School

The thinkers of the Milesian School were among the first to attempt what might be termed a scientific explanation of the apparent order (Cosmos) in nature. Experience showed that everything was born of something. The **water** of Thales and the **Boundless (Infinite)** of Anaximander constitute attempts to find a primary cause. Anaximander thus postulates not any particular entity (e.g. water) as the "primary substance" but a metaphysical concept.

Anaximander also proposed the origin of life from water vapour ("the moist element as it is evaporated by the sun" - Clodd, E. 1897). This is in keeping with his Infinite, as water vapour creates the impression of being boundless. His view of man being "like a fish in the beginning" (Clodd, E. 1897, p.7) shows the evolutionary nature of his thought which is in accord with modern biological theory concerning the marine ancestry of vertebrates. The embryologist, Ernest Haeckel, also expressed a similar view in his **recapitulation theory**: "Every organism, from the unicellular protists to the cryptogams and coelenterata, and from these up to the flowering plants and vertebrates, reproduces in its individual development, in virtue of certain hereditary processes, a part of its ancestral history" (E. Haeckel, 1910, p.125). Studies of the early embryological stages of higher vertebrates do show the possession by them of features of more primitive vertebrates. This view also presages the theory of the mutability of species and, of consequence, the theory of evolution. The most important aspects that emerge from his theory, however, is the inorganic origin of life, the relatedness of all life forms and the role of **Strife** in their origins. (Reflected in later biological theory).

Anaximander's theories thus fit the life forms and consequently man, into the order of the Universe, for they too like the rest of the universe originate in the Infinite. They also gave a deeper meaning to the place and relationship of man to the cosmos. With the postulation of the Infinite (**apeiron**) as the "basic staff" of the Universe, Anaximander" referred the world of experience to a reality beyond experience" (Windelband, W. 1956) of the physical, so providing a metaphysical basis for the theory of Thales. Anaximenes, also felt that "cosmic matter" was infinite and single. For him it was air. Change was explained by the constant movement of the air during processes of condensation or rarefection. These processes also introduce the concept of space, air is rarefied or condensed in relation to space. Man, and everything else in the Universe, is thus explained in terms of physical processes, even the gods. Deity was therefore neither prime cause nor primary substance. Anaximenes thus provided the "space" in which the "atoms" of the Atomists could move about freely.

These first principles arrived at by inductive reasoning constitute the basis for the explanation of the Universe through deductive reasoning and provide for the hylozoistic principles that give form to substance. The Milesians thus provide a primary substance for the causal processes that give form to the Cosmos.

With the Milesians there is a movement away from the mythological explanations of Homer and Hesiod to explanations of natural phenomena in terms of concepts: of cause and effect. Observation (experience) and inductive reasoning provide the basis (arche) from which the Cosmos can be constructed by deductive reasoning. Herein can be seen the scientific nature of Ionian thought. The thinker did not see himself as a creature apart, but as an integral part of that universe he was attempting to explain and understand. This is amply evident from the view of Anaximenes that the soul both of the universe and of man is identical, "air". Consequently, all aspects of the universe had a single cause. It was at this point that later philosophers began. The search for a single or basic cause has continued into the present.

The Milesian move away from mythological thinking was due to a large extent to the changing circumstances in the city-state. As the city-state began to expand, so did its economy. Instead of an agriculture-based economy, the rise of a merchant class necessitated a commerce- or trade-based economy. Consequently, the environment had to be studied and the vagaries of weather understood if successful maritime trade were to be carried out. This led to studies of climatic conditions and consequent realization of their cyclic periodicity. Navigational procedures requiring accurate knowledge of the position of the stars and the storage of information necessitated the mastering of calculational and measuring techniques. Use of mathematics thus became important and was used increasingly to express different aspects of the universe. The resultant was a changed and changing universe explanations to which could not be found in mythology. The universe therefore, had to be understood in a novel way. Knowledge of the **arche** or **One** (which remained constant through all change) would thus afford man an understanding of the world, his position in it, and of consequence, a basis for his conduct (paideia). Man could thus place himself into the "cycle of nature", and understand, and accept, and play his part in the world, in accordance with his "natural destiny" (Moira). For the Greek, therefore, knowledge (of the Universe) also had ethical implications as it constituted the basis of both his understanding the cosmos and his conduct in society. The development of scientific thought in this direction was continued by the Pythagoreans who again showed the basic harmony of the universe.

1.3.2 The Pythagoreans and the Eleatic School

The Pythagoreans were influenced to a large extent by Orphism, a new influence from the north. Eastern influence on this doctrine is evident in the idea of the release of the soul from the "Wheel of Birth". As the body, according to the Orphist doctrine hindered the realization of "truth" and therefore "reality", knowledge (or realization) of the "truth" necessitated the release of the soul from the body. This could be achieved by "purity" and "abstinence" (Burnet, J. 1958, p.200). Orphism was a reaction against the growing material and commercial interests of the polis. Its followers were found among the "philosophers of aristocratic origin" who felt disgusted at the state of affairs in the polis.

The Orphist teachings were further developed by the Pythagoreans. To live correctly, was for them to turn from the material temptations of the world and to contemplate the divine, the representation of "truth, goodness and beauty". In this way both the body and soul could be purified. The body would thus be healthy by restoring the "opposites into right proportion with each other" (Rauche, G.A., 1966, p.30). After the body had been purged, the soul could also be purged through music which produced the "sweetest harmony" when contrasts were in the correct proportion to each other. Since this proportion depended on mathematics, music consisted of "Eros" and "reason". Music therefore constituted the cosmos and the world soul.

To the Pythagoreans, "numerical proportions and relations" could be used to express the harmony of the universe. Numbers therefore constituted the basis of cosmic harmony through which "truth, goodness, justice and beauty can be known". Even though these numbers symbolized the divine, they also had "rational significance", they were concerned with an understanding of the universe in mathematical terms through "intellectual intuition". The Pythagorean doctrine, therefore, provided a dualistic view of the Universe: material objects are considered imperfect images of "numbers and geometrical bodies". The material universe, therefore, is the imperfect reflection of the perfect mathematical Universe which can only be known by contemplation (which has in it an element of revelation).

Pythagoreanism came to represent a "way of life" in which man could realize his limitations since he was an imperfect image of the perfect form. The realization of this limitation constitutes the basis for his behaviour to his fellow-man. He can however, attain knowledge of the perfect through contemplation. This would develop in him a healthy body and also a healthy mind or a balanced life in which all the opposites are in their correct proportions. This would also provide for harmony in the city-state, and a stable society.

Knowledge of the perfect through contemplation thus also has moral implications for it constitutes the basis (ethical) for the way man could lead a harmonious life. Although his knowledge provided a basis for the conduct of life in the **polis**, its development was itself due to the unsatisfactory conditions in the **polis** where man had turned only towards his material needs.

Xenophanes, of the Eleatic school denied the possibility of knowledge of a primary substance, or of the gods. He saw that man looked at things and interpreted them from within the compass of his experience. The answers he would provide would thus be coloured by the depth of his knowledge and the extent of his experience. His answers therefore could not be conclusive, and even if by chance he did say what was right, he would not know that it were so.

Parmenides, like Xenophanes, considered the **all** as **one**. Heraclitus, however, felt that the basic law of all things was an all-pervading movement: harmony being maintained by opposed forces. For him **fire** was the primary substance as it remained unchanged through continuous change. He too found that processes in nature were always orderly: nature thus had an orderly form. The Pythagoreans felt that their number-theory could be used to provide, through the relationships of numbers, a more exact expression of the Heraclitean idea which, beginning with the **many** found permanency in change. This showed that Nature was never static or complete but was always in a "state of becoming". This view can be seen to be closely related to that of Anaximander together with which it provided the basis for Aristotle's idea of **Being** and **becoming**. This was again expressed in the later theory of evolution. Heraclitus arrives at this through abstraction (rational act). Consequently, the world of the many is governed by a rational principle. And since there is constant change its basis had to be some everlasting substance which was of an intelligible nature. This Heraclitus called **logos** (world reason). It constituted that to which everything in the universe and the universe itself was subject (destiny).

Man could rise above material interests by attempting to grasp the nature of change as a rational law and so come to know the **logos**. The search for this knowledge constituted the basis of man's conduct (morality). As change was inevitable, it should be accepted but with the realization that change was the basis of harmony in that it was governed by the **logos**. Comprehension of this **logos** would thus free man from material interests which was the basis of conflict.

For Parmenides, conflict arose because the world, which was a world of appearances (**doxa world**), was accepted as real. Man had to live in such a world, but if he could understand the reality or the essence of the world, there would be no conflict. His argument that all is one stems from intuition, or of thinking itself. (Since one cannot think of something that is **not**, one always thinks of something that **is**). This identity is called the "first science of being qua being or the first ontology" (Rauche, G.A. 1966). Parmenides was thus opposed to Heraclitus in that he saw being not as becoming but as **being** or **is**. The many is explained by Parmenides by the spreading and fusion of **being**.

1.3.3 The Emergence of Dualism

The Greeks had always sought to express the world in all its various aspects by a single cause or principle. Even in mythological thought, although there were numerous principles or gods there was always a principal god to whom the others were responsible and who in many cases was the cause of the others. This need to express the world in terms of a single basic substance was due to their striving to understand the universe and themselves so that they might find in this understanding the basis for their attitude to the universe and also towards one another. This is evident in the mythological thought of Homer and Hesiod, in the various basic substances of the Milesian School in the philosophies of the Pythagoreans and the Eleatics, Parmenides and Heraclitus. Each of the systems developed by each school influenced the others, and also succeeding philosophers. Each served for a time in the specific historical circumstances in which it was developed for both knowledge of the universe and also for the moral conduct of the society of the **polis**. Knowledge of the basic substance of the universe was therefore problematic in view of changing historical circumstances.

The solution offered by Parmenides and Heraclitus were contradictory. The question therefore arose as to what formed the universe and how it was formed. Such questions led to the view that there had to be formative principle (something that did the forming) which acting on a substrate produced the different forms: there were thus two principles, one active, the other passive.

1.3.3.1 Empedocles

Empedocles explains changes in the universe by the process of **fusion** (from Parmenides) and **separation** governed by love and hatred. These are seen as different aspects of an intelligence. He saw change as an illusion. Influenced by Orphism (through the Pythagoreans), Empedocles talks of continuous rebirth (of the universe) due to the mixture of the basic elements, by **love** and **hate.** The maintenance of order or the beginning of disorder is due to the preponderence of one or the other. **Love** and **hate,** are thus the principles responsible for the endurance or the dissollution of the universe or of order and disorder.

For the development of these principles, it is easy to see that Empedocles began with the experience of the human self. It was the self that both loved and hated. The unity of love and hatred lay in their being different aspects of a single self and it was the dominance of love that brought peace and happiness, or harmony, to the self. In the same way was harmony maintained in the Universe.

1.3.3.2 Anaxagoras

1.3.3.2 Anaxagoras

Anaxagoras posited (in rational terms) a world spirit (or world reason), **nous** as an intelligent principle. Against chaotic matter this was regarded as a formative principle. In this way the **nous** particles caused the forms to develop and made intelligible and knowable, and was so the cause of a world order. By a mechanical process the **nous** by impulse could produce other worlds - introducing the idea of a mechanical functioning of the universe. (Rauche, G.A. 1966).

Since everything in the world strived for the **nous** it was at once both the efficient cause and also the final purpose of everything. This principle, therefore, accounted for everything in the universe. Anaxagoras also showed that the senses were responsible for presenting an accurate picture of the world. From Empedocles, the senses could perceive things through the presence in the body of the same particles that constituted the world. Although the senses were not deceptive, Anaxagoras did show the relativity of sense perceptions.

In the view that the same elements composed both the universe and the body of man,. Anaxagoras showed a direct organic link of the body with the rest of the universe. Like Empedocles he believed that this was due to a vitalistic principle. However, the processes that caused the changes, both physiological and chemical processes were entirely mechanical. They were guided, however, by the **nous**, or the intelligent formative principle.

This identity of the constituents of the body and spirit of man with those of the universe showed that man was part of the universe and was therefore subject to those processes to which the universe was subjected. He was therefore an integral part of the universe and it was his responsibility to act in such a way that his actions reflected the harmony of the cosmos if he were to lead a life of peace and harmony.

1.3.3.3 Greek Atomism

The philosophers of the Eleatic School, together with Empedocles and Anaxagoras, provided the background on which the atomists could find the basic or primary substance of the universe in physical particles. The Greek atomists return to the physical world in their quest for a **basic or primary substance**. These philosophers laid down the foundations of physics, which, although"corrected" in some instances and modified in others,have endured even into modern times. To the atomists, Leucippus, Democritus and Epicurus the basic elements of substance or matter consisted of indestructible, indivisible particles which they called "atoms".

The atomists postulated a single **arche** in indivisible and qualitatively alike atoms. They were innumerable and imperceptible but they occupied space. Leucippus felt that since the atoms were substance they had magnitude and were consequently mathematically (from Pythagoreans) divisible. Mathematics thus constituted the basis upon which the indivisibility and the infinite number of the atoms could be understood without recourse to physical division -since they were imperceptible.

The dualism of Empedocles and of Anaxagoras was overcome by the atomists by positing the atoms as a single basic substance from which everything in the universe originated. They overcame the **love** and **hatred** of Empedocles and the mixture of particles of the **nous** with those of a passive basic substance causing them to become intelligible and knowable, by attributing to the atoms themselves a sort of intelligence, or **logos** (from Heraclitus). Leucippus did not postulate any source for the motion of the atoms in the void, outside that of the particles themselves. Although he did not elaborate on the motion of the atoms, he did deny the element of chance: " naught happens for nothing, but everything from a ground and of necessity" (in Burnet, J. 1958 p.340). Epicurus attempted to explain motion as the tendency ofthe atoms to fall through the void, since they had weight. The general view however, was that the movement of the atoms in the void was not purposeless since they were endowed with a **logos**. This intelligence and purposefulness was the explanation for the appearance of form.

Unlike antecedent systems, atomism showed how body or matter was to be regarded if it were to constitute ultimate reality. Everything in the universe was attributed to atoms and their movements; even the life of the soul was described in terms of the finest and almost perfect motion. Democritus felt that the soul was composed of "fire atoms" as these were the smallest of all atoms and being the most mobile were responsible for motion. These atoms also imparted their motion to inert material and consequently were distributed throughout the entire universe. This shows that the "fire atoms" were somewhat different from the others in that they could impart motion to other atoms - in other words, that the soul was responsible for life which pervaded the entire universe. This was very similar to the view held by Anaxagoras. Therefore, although the atomists thought they had overcome the dualism of Empedocles and Anaxagoras, they had not succeeded. And this dualism is inherent even in the contemporary view of the atom.

In organisms, breath held the "fire-atoms" of the soul together. With the loss of breath, therefore, there was nothing to hold these atoms together and they dispersed, resulting in the loss of the psychical life of the organism. In this way, man's spiritual individuality was also lost at death, it was completely dispersed. With the atomic theory, therefore, even the soul and death came within the compass of mechanical explanation. Even in contemporary times death is explained in terms of the cessation of physiological or mechanical functions.

Since the senses were incapable of detecting the finer stimulations of objects they could not provide any knowledge of true form. Such knowledge could only be attained by thought (which consisted of the gentlest movements). As the pleasures of the senses were due to the gross or violent movements of atoms, they were transitory and disturbing to the soul (the fine and gently moving fire-atoms). Only the pleasures of the soul were true and lasting as these consisted of the fine and gentle movements of thought (atoms). The soul atoms could only attain their condition of "gentle harmonius motion" through intellectual knowledge. In this way could man attain true happiness: by leading an harmonius life through the exercise of temperence and self-limitation. Man's peace could therefore come, only from within himself. The harmony and happiness of society thus depended on the attainment by man of true knowledge. This was gained by withdrawal from sense desires and exercising the intellect. Social worth was, therefore, measured in terms of "mental calibre".

Knowledge, therefore, which was attained by rational means (exercise of the intellect) was also the basis of morality. Knowledge had both, epistemological and ethical significance. It also provided a basis for man's freedom from superstition and fear of death. The atomist view of the dispersal of the soul's atoms at death freed man from any concern for his soul after death. Fear of what happens to the soul after death is often the basis for man's moral actions or for his "good-behaviour". The atomic theory freed man from such fear, substituting in its place, knowledge, as a guide to correct action. In this way the responsibility for harmony in society rested with man himself.

The atomists had arrived at the concept of the atom not through any physical demonstration, but through the inductive and deductive processes characteristic of scientific thought. Atomism thus constituted the basis of the first homogeneous world view obviating the problems inherent in **arche** or other systems: the problem of the origination of things (form) from the **apeiron** of Anaximander, or the **nous** of Anaxagoras. For **arche** the atomists had substituted atoms. Motion and pressure were the primary forces (which were inherent - logos - in the atoms themselves) responsible for the cohesion of atoms to form (material) objects. Atomism was thus able to provide explanations for a large number of phenomena which could hitherto not be explained adequately. Man, soul, breath, death and also cosmic forms were all explained in terms of atomic behaviour. Atomism explained the cosmos in mechanical terms - completing the "mechanism" of Empedocles and Anaxagoras. This was an approach that again manifested itself in the philosophies of the Seventeenth Century till the close of the Nineteenth Century.

Although atomism seemed to have answered the question posed by Thales two centuries before, other questions concerning the universe converged on the atomic theory for explanations. Their observations of what they considered "order" in nature had led the Greeks to call the Universe "cosmos". Their teleological thinking directed them towards a purpose in nature. Therefore, many could not reconcile teleologism with a mechanical atomism divested of purpose. The atomists, however, saw purpose inherent in **logos**. Consequently, atoms were rational and their movements purposeful, atomism contributing to an intelligible cosmos. The Universe was thus a reflection of cosmic reason. Thus a life "consistent with Nature" was the goal of human existence. This view provided the atomists with some basis to ask for man's acceptance of cosmic processes. Being composed of atoms, man was composed of the same basic substance as the rest of the cosmos - a view very similar to that of Anaxagoras. In this acceptance based ultimately on universal order and reason, man could purge himself of ignorance and emerge into a life of knowledge "consistent with nature", as it provided for man's freedom and happiness.

Much change had occurred in the polis since the times of Homer and Hesiod to the times of the Greek atomists. The city-states had been governed through various types of governments each organizing society in a different way. Coupled with the growth of the city-states arose the need for expansion. This led to war with neighbouring states. There was also internal conflict between the aristocrats and the democrats, the rising rich merchant class and the poor peasants. Internal conflicts and the Peloponnesian War (431-404 B.C.) finally led to the decline and fall of the city-state.

Thus, changes in the historical conditions or in man's experience of the environment led to changes in the philosophical climate of each successive period. This in turn led to changes in the city-states which were in search of just and stable governments. For the purpose of achieving this objective philosophical thought attempted to analyse the situation and provide knowledge, by which the cosmos might be understood. Knowledge of the basis of this order was essential if society were to be structured into a harmonious and moral whole.

1.4. The Search for truth and the Universals

1.4.1 The Sophist School

Like the preceeding philosophical views and systems, the Sophist school also developed in reaction to the historical circumstances which enveloped the polis after the Persian Wars. The search for knowledge of the cosmos, which had begun in mythological thought continued into an investigation of arche'. This was seen in terms of a single substance (Milesians) or as many substances (as one-Parmenides) or in the dualistic terms of the Pythagoreans and the atomists (although the atomists did not consider their atoms dualistic). No general agreement could be reached and the nature of the cosmos was described in contradictory terms. With the democratisation of the polis interest was diverted from the Universe to man for it was the individual who was important in such a government. Just as the atoms (which were identical) were responsible for everything in the Universe, so was every individual equal in the polis and responsible for the harmony of the polis. Each individual felt his views to be just as valid as another's, with the result that individual assertion became an important factor in the **polis**. There was therefore, still the struggle between the aristocrats and the democrats and between conservative views and modern ideas: the struggle between old cults and the new rational (or scientific) outlook. Democratic rule was also beset by corruption with the result that the gulf between the rich and the poor widened, with increased tension and controversy in the **polis**. In this situation, divergent views emerged. Atomism which had been postulated to explain the structure of the Universe and to show man how he might be free of superstition and pursue a harmonious existence in identity with the cosmos could also be used to support assentive individualism. Man therefore became the centre of interest. To the sophists therefore, it was important to develop that potential in man which was important to and enhanced his own interests. They were, therefore, often hired by the rich to teach them how to develop and enhance what was to their interests.

As far as knowledge was concerned, sophism was therefore subjectivistic and of consequence relativistic. Morality was dictated by what was important to the individual. In sophism itself, however, there were two streams of thought: one, that laws and customs existed of necessity to maintain social and moral order (since this made man rational and social) the other, that morality was conventional and used by the powerful to impose their will on others.

The Sophists' theory of knowledge however, brought to light many important questions concerning knowledge as an objective truth and as a basis for morality. This showed that the importance of the intellect could not be overlooked in the search for knowledge. On the assumption that reason or the rational judgement itself was competent to attain the truth, they did not question the intellect. Accepting sense data as factual (or valid) led to the view that the knowledge gained through the senses (or from experience) led to an objective truth. The Sophists showed that constitution of this truth depended to a large extent on the subject.

The Sophists conceived of "nature as 'human nature' and as 'human nature' limited to its physical, impulsive and individual aspect" (Windelband, W., 1956, p.122). Socrates, however, believed that this could be overcome by human reason. Sophist epistemology had led to relativism which led to a resistance to authority and the disintegration of social and moral consciousness. To the Sophist knowledge consisted in expertise. And since the demand of the time was for political oratory (important in a democracy as a means to retain power), their teachings consisted in large part of rhetoric. This neither provided answers nor strove towards a truth but was almost always directed against existing social institutions and religious tradition.

1.4.2 Socrates

In the midst of the destructive relativism of the sophists, Socrates strove towards stable, universally valid knowledge or truth. But to achieve this man had to rely on his fellowman. Man could not absolutize his views as he had done under the influence of sophism. To Socrates, it was self knowledge that was important, carried on in the presence of one's fellow man. Socrates believed that since each man constituted his own truth, knowledge of the Truth could be attained through reflection and dialogue. This method was the way to moral perfection, for it consisted in the methodological examination of knowledge constituted from different experiences. By rational examination (scientific approach, as far as the Greeks were concerned) knowledge of the truth and of morality could be obtained. Epistemology and ethics were therefore grounded in experience.

By the Socratic dialogue knowledge emerged through the "maieutic method", showing the dependence of man on his fellowman and also, that man is limited by his fellowman. Experience constituting both the ground and limit of knowledge. Socrates felt that the **truth** was latent in the individual. But this could only be realized by the individual if he "suppressed" his "sensual appetites". "Truth was therefore knowable to all and could be taught to all. All good acts were composed by the four cardinal virtues: **Sophia** or wisdom, **andreia** or manly fortitude, **sophrosyne**, or self-restraint and **dikaiosyne** or a sound balance or justice" (Rauche, G.A., 1966, p.45). Socrates believed that the pursuance of truth for its own sake would bring happiness, for it was virtuous. Truth and virtue were thus identical. Happiness, therefore, was not the aim of the search for truth, for this would be selfish. Happiness was the result of having attained the truth.

The philosophy of Socrates, therefore, showed the reliance of man on his fellow-man for the attainment of truth. In this realization man could live at peace with his fellow-man. Socrates' **truth** thus had both epistemological and ethical significance.

1.4.3 Plato

Plato's search for truth was largely modelled on the example of Socrates. While Socrates regarded **truth** as universal, Plato's search led him to universal concepts.

These were attained through rational insight into the soul and the universe. His idea of the pre-existence of the soul was the basis of the view that the universal concepts remind one of an objective (i.e., existing outside the mind) **perfect world of universals** of which the **Good (Agathon)** was the comprehensive idea.

Experience of conflict in the **polis** directed Plato's search for harmony in which man and the **polis** might be freed from conflict and attain natural balance or justice. This lay in the resolution of the conflicts of his soul which reflected the conflicts of nature of which man was an integral part. For Plato, conflicts arose in man's imperfection and was largely the result of man's dependence on sense perception for the attainment of knowledge - senses afforded knowledge of only the **doxa world**. Such conflict could only be overcome through the exercise of reason which would acquaint man with knowledge of reality and provide the basis for man's correct action, to obtain a natural balance. It was only in the state, however, that man could understand his relation to the cosmos. For it was in the realization of the rational nature of the cosmos that man could attain identity with nature and his place in the state in accordance with his natural capacity. Plato relates the soul to the Ideas through the soul's pre-existence. The soul's ability to construct and demonstrate mathematical figures without recourse to sense-experience showed that these Ideas could also be understood in this way. And just as mathematical figures that were demonstrated participated in the **Ideas** or pure **forms** so did the objects of sense-experience (imperfect objects) participate in their pure **forms.** It was only through rational insight that knowledge of this world of forms could be attained. The **world of forms,** however, was objective, i.e., it was outside the mind (emanent), but could only be understood through the mind. The world of sense experience thus participates in the **world of forms** or universals through likeness.

In the **Republic** Plato shows how justice in the state would be a reflection of justice or harmony in each individual in the state. Plato's theory **of Forms** therefore, leading to the Universal **Good** provides the basis **for** the harmony of both the **polis** and the individual. Knowledge (rational knowledge - in this case, knowledge of **the Good**) also has ethical significance in that it is a guide to correct action (morality).

Plato's philosophy went beyond the Greek ideal of individuality in that the individual was completely subordinate to political purpose or to a harmonious state. In such a society, harmony depended on, and was the responsibility, of each individual (**Republic**). Therefore, each man in the state was dependent on his fellow-man.

Although Plato's state was constituted as an aristocracy (as opposed to the democratic **polis**) no individual gained any material benefit from the state, besides virtue of every individual which consisted in living in harmony in the **polis**. The three classes, (**Republic**) their relation to one another, and the continuation of the order would also influence other institutions of society. The maintenance of the correct composition of society required the correct choice of parents (**Republic**, 416b). Consequently, marriage was not a matter of individual choice. This undermined the importance of the family unit as a source of stability in society.

The Utopian aspects of Plato's philosophy are, however, evident in the failure of the realization of his political ideal. In realising this failure, Plato, in his latter works, allowed other elements which were more suitable to the historical conditions, to replace his idealistic philosophy. Religion, nearer to the "national mode of thought", mathematics, useful in music and astronomy, and also some ancient customs were revived. His latter works, therefore, assume a "Mixture of monarchico-oligarchic and democratic elements" (Windelband, W., 1956, p.216).

Plato's metaphysics was based on nature as being teleological. Yet, in the Socratic spirit, he neglected to give any knowledge of nature, for, as the world of the senses was in a constant state of **Becoming** he felt it could not afford certain knowledge. Plato thus claimed not truth, but probability, for his theory of nature. It is principally in the **Timaeus** that he sets out his theory of nature. Here he discusses the "world soul" (**Timaeus**, 37) as responsible for setting the cosmos in motion. At the centre of this cosmos was the earth but it was stationary. And just as the soul of man is responsible for his life and proper functioning of his body, so the "world soul is responsible for the life of the cosmos".

Plato's latter works thus show that although man is concerned about his origin and destiny, he cannot understand or accept these on purely theoretical and metaphysical terms. Man has his experience (sense experience) only, to begin with. He therefore has to begin with nature and natural phenomena. By his rational capacity and the limitations of his historical conditions he attempts to understand the world around him though his sense-experience which is important in the acquisition of knowledge. It is at this point that Aristotle began.

1.4.4 Aristotle

Aristotle's philosophical forebears following the teleological trend were much concerned with motion as being rational and purposeful. They did not, however, consider an **efficient cause**. Since Plato's forms, for example, imparted only essences to sensibles, and not motion, he considered only formal and material causes. Empedocles also, for example, did not recognize that an efficient cause was responsible for the qualitative changes observed in the four corporeal entities he regarded as constitutive of matter.

Experience of the physical world and of biological processes showed Aristotle that things changed in accordance with their nature, i.e. that change was purposive and also that change required cause. An investigation into the nature of material substance would therefore involve a consideration of the constituent elements composing bodies and of the causes involved in continuous changing processes. Aristotle's concern was, therefore, with the extrinsic causes (the efficient or final and purposive causes) and with the intrinsic causes material and formal causes). Aristotle, therefore, considered nature "as a principle of activity or change, actual or possible" (Aquinas, T., In Durbin, 1968).

This required the primacy of substance, as other categories existed because of substance. Its primacy in definition is shown by its being involved in other things; in knowledge, because an object is best known in its being known as "What it is!" Aristotle felt that his predecessors could not arrive at a primary substance because they were not dealing with Being as such but only with parts of Being. Thus they could give no more than the essential attributes of those parts only. Ultimate causes were to be grasped of Being not incidently but of Being qua Being. Thus, "What is Being?" really amounts to "What is substance?" It was substance that many of the early philosophers described as one or many, as numerically finite or infinite, so that it must be our first and principal if not our only subject" (Warrington, 1970, pp. 167-168). Aristotle was asking therefore, "What is the essence of things? What is the nature of the Universe?"

The answer to these questions, he felt, is contained in the understanding of the dynamic relationship that exists between potentiality and actuality and in the realization that actuality is prior to potentiality. Nature could thus be viewed as "potency". Actuality then becomes prior (in time) in the sense that a "actual member of a species precedes any potential member, though the individual is potential before it is actual" (Aristotle:In Warrington,J. 1970, p.237). Consequently, the relationship between potentiality and actuality is representative of that relationship existent between substance (matter) and form. Inherent in the potentiality of matter are intrinsic causes: material cause (the potential form of matter which can become different objects) and formal cause (determining the form of an object actualized from matter), and the extrinsic cause, purposive cause (teleological) and efficient cause (referring to the energy or the actuating force). These forces operative in matter are responsible for the actualization of form or the reality of matter. From sense experience of the particular organisms of nature (or formalized potentiality), the universal is arrived at by abstraction. Unlike Plato who taught that (the form) the Universal is prior (refer, the objective world of Forms (Republic, 476 d-e, 505 a-b), Aristotle viewed the particulars as the substance from which the Universal is derived.

Aristotle arrived at these conclusions not only through rational argument but also through his studies and observations on plants and animals especially the variations and gradations in their organisation. His study of variations also showed him the force of heredity as a potential for change. Studies in embryology also revealed the inherent principles of purposeful change, the teleological aspect of biology and the intrinsic and extrinsic causes operative in embryological development. Taxonomic studies showed the hierarchical order of life-forms and that although they displayed enormous diversity in morphology and habitat, in the relationships of these life-forms with their habitat and to one another, in coexistence and in lineage, they mirrored and so revealed the basic order and unity of nature; of a changing nature in a changing universe. Change was therefore an inherent and integral part of nature and should not be regarded as illusory.Sense experience thus had to be accounted for in any attempt to gain knowledge of the universe.

From these observations he laid down the foundations of classification and a basis for the development of biological theory. Aristotle showed therefore, that in an attempt to understand the universe and obtain knowledge of its forms and processes, only rational argument (in the sense used, e.g., by Plato) was not sufficient. He emphasized that sense-experience also, viewed in the light of inductive reasoning should be the basis for general laws, in scientific theory. General principles should not be accepted on logic alone. Laws of nature are formulated on experience of the regular sequence of occurrence of certain phenomena. He, therefore, rejected the element of chance. Principles inherent in nature-directed her productions. Consequently, "germs" responsible for the production of life forms were not "chance" productions. Being the simplest life forms, they were the same for both plants and animals. This implied the common origin of both plants and animals - which provided grounds for the view of the basic unity of all forms.

Aristotle's views, therefore, show different aspects as whole within themselves and as part of a whole: as part of the Cosmos. The varied parts also change each in accord with those principles inherent in them, in response to changing circumstances to maintain the harmony of the Cosmos.

For Aristotle, therfore, knowledge gained through experience and the practice of reason had both theoretical and practical or moral value (Ethica Nicomachea, VI 2, 1139a 11). As theory, it constituted theoria, or scientific knowledge (episteme) and as practical knowledge or phronesis, tekne). Practical reason itself was also theoretical in that it provided insight into the correct principles for action which, as tekne was necessary for aristic creations and as phronesis for justice in public and political life (Ethica Nicomachea, V.5). The individuals' exercise of the knowledge he possessed, however, depended on free choice: thus his action was dependent on his will.The responsibility for moral action therefore, fell on the individual. It was through his attaining knowledge of the truth (through the exercise of reason) that the individual would know how to live a moral life.

Since the Good, therefore, is the goal of human endeavour, the highest goal being Happiness (through knowledge), depended, of consequence on the exercise of reason (Ethica Nicomachea, II I 6. 1097b 24). Good habits, (Ethica

Nicomachea, II 4, 1106b 11) or virtue in man allowed him the perfect use of reason from which only pleasure (Ethica Nicomachea, X 4, 1174b 31) could result. Reason, therefore, is concerned with knowledge, which formed the basis for morality. Consequently, the action directed by reason is correct action as it is both grounded in and obtains its directive from knowledge. Aristotle thus distinguished between dianoetic and ethical virtues (Ethica Nicomachea, I 13, 1103a 2).

Whereas Socrates and Plato had not considered material possessions and "good fortune", Aristotle allowed these also so long as they were subject to reason. The potential value of material possessions could not be discarded if reason in ethics were to reach its perfect development. Consequently, pleasure was not the motive, but the result of virtue.

Knowledge thus covered the understanding of objects, their relationships and cause of activity and also of teleological processes. The highest knowledge was that sought for itself and for no ulterior purpose. In the Metaphysics (XI 7, 1072b 24) and in the Ethica Nicomachea, Aristotle shows that the highest happiness consists in the possession of this perfect knowledge or pure Form, which constitutes the perfectness of God. According to Windelband, "This is ethically, as well as metaphysically, the fundamental principle of the philosophy of Aristotle. It is rooted in his personality: and is the expression of that pure joy in knowledge that forms the basis of all science and is the absolute condition of the independence of science. In the logic of Aristotle Greek science recognized and formulated its essence, and in his ethics, its practicability (Windelband, W. 1956, p.284).

The practicability of ethics, however, is dependent on the Will which controls the desires, preventing their exercise in extremes. Knowledge, both of objects and of human nature is necessary if insight is to recognize the correct mean for action (Ethica Nicomachea, II 5, 1106a 28). Thus from his knowledge of the world and of human nature Aristotle developed the fundamental principle of the "value of moderation". This value Aristotle recommended in all walks of life, individual, social, political and economic.

Aristotle, realizing the importance of man's individuality allowed him his independent development and did not submerge him into the state - as Plato had done. Social education was important for the development of virtue. In such education the individual could realize his dependence on others. Although the individual was subject to society and the state he had much freedom in private life. Realizing the importance of the family unit for the stability of the state, Aristotle contended against the community of wives, children, property, etc. of Plato's state. Marriage was therefore valuable for Aristotle saw in it the basis of moral relationships whose practice in the state could lead to stability. The family unit, through marriage thus constituted the basis for the love and responsibility needed to stabilize the state. It thus constituted the basis for the prototype of political forms.

Aristotle's view that nature has inherent principles governing her productions or actualizing the possibilities of potentiality, both explains the hierarchical order of the universe and also provides an explanation for the constant striving of entities in the universe for perfection. This striving is guided and integrated by desire and love for perfection or pure intelligence. Aristotle arrests the constant striving by introducing the Unmoved Mover (pure intelligence) which by its very existence causes everything in the universe to strive for it. The existence of the Unmoved Mover is explained by its desire for itself and its contemplating only itself. It is therefore detached from the world. This ultimate Universal is also reminiscent of Plato's dualism. Matter therefore is pure potentiality and exists because of a pure intelligence.

This view of the Universe in evolutionary terms finds man's place in nature, his relationships to the rest of nature and of consequence, to the Cosmos. The "germ" can also be seen as the pure potentiality of the biological world and comes from the non-biological world. In this way it becomes the basic intelligence connecting the non-biological to the biological world establishing a relationship between these two: Man's origins and place in Nature is thus brought within the sphere of scientific explanation.

It is evident, therefore, that even from the mythological explanations of Homer and Hesiod, to the culmination of Greek thought in the works of Plato and Aristotle there is no distinction, between physics, ethics and logic. Science and philosophy, knowledge and morality (Rauche, G.A. 1985) are therefore inseparable - as all thinkers formulated their conclusions from observations of nature or from experience, constituted by the rational faculty of the mind, in a particular way.

That the Greeks had an intensely humanistic approach to life is evident in their literature and art. The symmetry of the Parthenon symbolizes the restraint and balance of the Greek mind. Their striving for perfection can be seen in the detailed beauty of the sculptures of Apollo, Pallas Athene and Aphrodite. The mysteries of the universe, they felt, were not beyond solution which lay in correct attitude and action - and this depended on rational knowledge.

By the Fifth Century, B.C., the great Greek minds had worked out, on a rational basis, systems to explain the Universe. These constituted the basis of both, man's knowledge of the Universe and, consequently, moral conduct. The method of Socrates, culminating in the philosophy of Plato, regarded the world as unreal, as a reflection of the real world (of Forms). Aristotle, however, restored the "reality" of the world showing that experience and reason both, were constitutive in understanding the world. Even though the rational and self-contained or complete systems of these two philosophers provided the basis for the development of society and its moral conduct, the events of history made these systems appear unreal. The collapse of democracy, and the **polis** and the influences that came with war introduced again the feeling of insecurity and the question of Man's attitude to life rose once again. Man turned away from the rational explanations of the world towards the supernatural - a thread that runs through most societies in history, even into modern times when man attempts to cope with the daily problems of living, which at times assume monumental proportions. And of this is born the perennial questions which man answers alternatively in rational and supernatural terms: "Whence my origin? What my purpose? and wither my destiny?".

1.4.5 Lucretius

The teachings of Lucretius are expounded in his poem, De Rerum Natura based on Epicurean philosophy, a combination of Aristotleian Cosmology and Atomism. Epicurean philosophy had been much malignant because it was interpreted to mean indulgence in sensual living. His view, however, was that peace and happiness could be obtained in the pursuance of "pure, high and noble aims" (Clodd, E. 1897, p.21). With Empedocles he (Epicurus) agreed that only the fit and capable forms survived - this is much later echoed in the Darwinian hypothesis, seen as a law in nature.

Lucretius also emphasizes the "unvarying laws of nature" as the basis for the combinations of atoms and the natural changes of one form into another. Even the soul, he taught, was composed of very fine atoms. Those of finer constituency formed the essence whose property governed the character both of man and animals, and died with the body. Thus natural agents governed both the origin of the celestial bodies and of life. But these were not the result of design or some pre-determined plan. This view is very similar to contemporary views of evolution which, it is felt is not predetermined, but is the result of the mutual influences of and between organism and environment. This is consonant with Lucretius's view that man's history included a struggle out of primitive savagery. Based on atomism, he saw man's evolution and change in mechanistic terms, governed by natural causative agents. This called also for man's acceptance of natural processes and of seeing himself as part of and a product of these processes.

The work of Lucretius, because of its anti-theological spirit, was obscured for many centuries. Aristotle, on the other hand was much admired by the latter mediaeval theologians. Christians interpreted his work to regard him as a "pillar of the faith". His philosophy, therefore, was interpreted in the light of prevailing living conditions by Christian thinkers to support their theological views.

1.5. Discussion

The scientific nature of Greek thought is evident in their attempt to understand and to explain changes in the universe, and that proceeded in orderly fashion, in terms of a basic substance, and the cause of change, on a rational basis. Understanding these changes and the processes in nature effecting them, man would be freed of fear or apprehension and be the better able to cope with the changing circumstances of life on his own strength. In mythological thought man feels too exposed to the vagaries of the natural elements and events which, to understand, he represents in terms of "anthropomorphic plastic images", of gods (or demons) whom he must appease or propitiate. Man has (in mythological thought) to accept his "lot" almost as an imposition by the gods. His fortunes, therefore, could be either good or bad depending on whether he had given the gods their due.

A rational understanding of the universe freed man from such fears. It also urged him to accept his "lot" or his position in the world, not out of fear or resignation but from an understanding or knowledge of the principles that governed it. This would also place him in "authentic" relation to the world so that he would see himself as part of the world. And as part of it, his was the responsibility to maintain the order. But released from fear, he could also resort to excesses, and cause the imbalance in the order. Philosophy had to show therefore,that order could only be maintained through man's identity with the cosmos. This imposed on him a responsibility for he had to maintain order as he not only lived in the cosmos but was also a part of it. In this way he was placed in direct relation to the cosmos, society, and the state.

That man was part of the cosmos affirmed his relationship to the principles that governed its order. The basic substance (of the cosmos) thus had to be such that it explain the origin both of the cosmos and of man. The Milesian School offered its explanation in terms of arche (or first cause: Thales, water: Anaximander, apeiron; Anaximenes, air).

The Milesian approach introduced the problem of unity and multiplicity. Heraclitus and Parmenides felt this was due to the materialistic approach of the Milesians. They (Heraclitus and Parmenides) felt that the One was inaccessible to the senses and therefore, could only be grasped through reason. Thus Heraclitus arrived at the One as a principle, the logos. Parmenides' postulation of the One as pure Being introduced a dualistic picture of the world. This formed the basis of the idea of multiplicity in nature, on which the Pythagoreans introduced numbers as being involved in the harmony of the universe. Numbers thus assume rational as well as ontological significance, in their expression of harmony and beauty of the world in numerical relations.

Empedocles and Anaxagoras attempted to reconcile the cosmological views of Heraclitus and the Eleatics. Empedocles uses Paramenides' fusion and separation to explain the disintegration and birth of the cosmos through love and hate (Rauche, G.A., 1966), two aspects of a single entity. Here again is seen the anthropological character of Greek thought, not in mythological terms, but in terms of the emotions that govern human conduct.

Anaxagoras completes the dualistic approach by postulating an intelligent nous, which, acting on a chaotic substratum produces harmony from chaos. The Atomists attempt to do away with the nous and duality with the logos of Heraclitus, an intelligent principle, both causing and directing atomic movement, in the production of form.

The mechanical approach resulting from the substratum - mind (nous) dualism coupled with the materialist interests that resulted after the democratisation of the polis, resulted in the Sophist movement. This focussed attention on man as the active agent in constituting reality. The relative values that emerged from the Sophist movement, prompted Socrates to search, not for reality, but truth. The emphasis thus shifted from reality to truth and man as the constituter of this truth. The rational approach is again evident in the Socratic dialogue. This approach is employed by Plato in his search for the truth or the Good. It also leads to a dualism in which the world is regard as unreal in that it is a "shadow" of the real world of Forms. In this view the senses by which man investigates the universe produces only an imperfect knowledge of the universe. The universal truth or the Good is beyond the reach of the senses.

The removal of the "mythological garb" from the forces of nature by the Milesians did not rob it of its vitalistic and purposive characters. The hylozoistic nature of Greek thinking is evident in the Infinite of Anaximander, the air of Anaximenes, in fact, in Greek thinking as a whole, leading to their regarding the cosmos as an organism: it had to be regarded as an organism since the changes in it were purposive. To this the mechanical view of the atomists is no exception as atoms were regarded as being rational (logos), their movements purposive, forming intelligible objects. Thus even the mechanical view of the atomists included teleological features.

The teleological aspect of Greek thought is apparent from the beginning of Greek philosophy, even in Anaximander's teachings which reveal the beginnings of evolutionary theory. However, the logos of Heraclitus, the homoiomeriae of Anaxagoras and the logos (in the atoms) of the Atomists all display evolutionary features (purposive change). Eros, or love of Truth, is also the driving force of Plato's rational insight for the purpose of attaining knowledge. It is also the cause of the motion of the cosmos in its striving for knowledge and truth -

the Unmoved Mover. This can be seen in Aristotle's causality in the actualization of potentiality as form, in a hierarchical order.

The doctrine of the eternity of the cosmos and the evolutionary character of Greek thought underlay the principle that "nothing comes from nothing". This directs Greek search towards knowledge of a first cause, from which the structure of the cosmos could be explained. Each first cause (or basic substance), Arche (Milesians), Logos (Heraclitus), nous (Anaxogoras), Agathon (Plato) and Unmoved Mover (Aristotle) also constitutes the basis from which a cosmic structure is developed, each leading to a specific way of life and conduct (paideia), since man and society are also part of the cosmos. This is also applicable to the pluralistic approaches of the atomists and the Sophists, who explain the world in terms of atoms (atomists) and subjective human truths (or opinions). The anthropological approach of Socrates finds the "first cause" in the moral world of human reason, through the maieutic method.

The principle that "nothing comes from nothing" and the search, on a rational basis, for the first principle or cause of the world consequent on it ("that nothing comes from nothing"), constitutes the scientific character of Greek thought, which also has an ethical dimension, for, from it the structure of the world could be explained of which human existence and affairs were an integral part. Thus, the nature of the first, cause permeating the cosmos determined man's way of life and conduct or his relationship with his fellowman (society and the state).

The development of inductive and deductive reasoning in their search for the first cause also constitutes the scientific aspect of Greek thought. This includes the problem of the one and the many, of the particular and the universal, and beginning with the ontology (the identity of thinking and being) of Parmenides, culminated in the syllogistic logic of Aristotle (Rauche, G.A., 1987 Personal communication).

On these grounds Aristotle finds the Universal in the "things themselves", affirming the reliance on the senses (for inductive reasoning). He, therefore, begins in the sense world which is regarded as real. In Aristotle's approach is evident the basis for an empirical investigation of the Universe, such as that of modern science, seeking reality or principles in the experienced world. Although investigation of the world (reality) began in experience, knowledge of the world (reality) was constituted in terms of principles or concepts (arche, nous, Agathon) that were beyond the world of experience (or the physical world); even the atoms (material particles) were beyond sense perception and moved about (purposively) because of an inherent logos. Knowledge of the world, therefore, through the scientific approach (rational) was given in metaphysical terms. Even the dualistic approachs of Empedocles and Anaxagoras was overcome by the nous, and that of the Atomists by the logos - to preserve the ordered hierarchy and unity of the cosmos. Unity and order thus become the basic values of the cosmos. However, the dualistic approach is again evident in the philosophy of Descartes and in the separation of philosophy and science from theology at the close of the Mediaeval period.

The teleological aspect of Greek philosophy in general and especially that of Aristotle, of a hierarchial order impelled by a love of perfection to attain perfection (Unmoved Mover), forms the basis of the view of evolution as a constant and inexorable movement towards perfection. This is also evident in the humanist views of evolution (e.g., those of Waddington, C.H., 1960; Huxley, J. 1948; 1953; and Tobias, P.V., 1969), which stress the compassionate aspects (love, understanding, etc.) of Humans.

Platonic and Aristotelian philosophy also infiltrated Mediaeval theology. Mediaeval theologians thus used the Greek rational approach, and Aristotle's syllogistic logic that reflected the Greek cosmos, came to reflect the cosmic structure of the second half of the Mediaeval Period, and also its social structure, (Thomas Aquinas) (Rauche, G.A. 1985).

Thus the rational trends of thought that began with the Milesians (in about 600 B.C.) were developed by different Greek philosophers still they culminated in the Aristotelian World View, which, was introduced by the Arab philosophers into the latter half of the Mediaeval Period and so influenced Western ways of thinking.

Although rational knowledge of the universe had, besides epistemological, also social and ethical implications, the latter implications also arise from the fact that each philosopher, or group of philosophers, depended on preceeding theories for the development of their own: preceeding theories thus provided a basis on which other theories could be developed. This points to the limitations of each theory, which reflects human limitations. The fact of dependence on and the need for others in the development of knowledge and understanding also shows the social aspect of scientific theory and constitutes the basis for one's moral conduct towards one's fellowman. It also constitutes the basis of responsibility to one's fellowman. This becomes of increasing importance in the trends of scientific thought that continued from the Mediaeval Period into contemporary times.

CHAPTER 2

THE MEDIAEVAL PERIOD

2.1 Introduction

Greek philosophy in general and especially the works of Aristotle laid a scientific basis for understanding the Universe (and Nature) in both its physical and biological aspects. Many aspects which had previously been attributed to the Gods or to some supernatural agency could now be understood as "natural events" following from the properties of whatever basic substance the world was thought to consist of. The effect of this was to distance the Gods from the events of the world. Divinity was thus not immediate in the understanding of natural phenomena, as mythological thought had been.

During the post - Aristotelian period, the great unitary systems, Platonism and Aristotelianism, whose ultimate thought was concerned with a "unified conceptual knowledge of the world" providing for the direction of the polis a unitary political and ethical system, began to dissipate into separate specializations. Scientific activity became concerned with special researches into nature study, history, etc. Theophrastus (the foremost pupil of Aristotle) developed botanical studies, Aristoxenus, the theory of music and Dicaearchus, historical sciences. The resultant was different schools of thought existing in sharp contrast with one another. Interest in the problems of metaphysics and the speculative spirit so active in the formation of fundamental unitary systems was slowly pushed into the background. It seemed that scientific activity was relegated to corroboration, through diverse specializations, of the works of the great philosophers. Different branches of science became independent (Windelband, W. 1956). The different schools of thought often differed only slightly in their interpretations of the works of the Great Masters, leading to rivalries between them. Philosophy thus became more utilitarian than explanatory. Conflict between different schools was over practical, not, theoretical issues: it seemed, that of Aristotle, was the final word of the speculative movement. Deficiency of originality, characteristic of this period, was due to early Greek science providing its successors with the necessary conceptual principles for comprehending reality. The main concern was for using these inherited principles fruitfully in the new conditions of life.

The Pelopennesian War had destroyed Athens, the centre of Greek culture, Persian power becoming dominant in Greek politics. Greece was eventually conquered by the Macedonians whose conquests spread far into the East. Greece, finally lost her independence on her incorporation into the Roman Empire. During the Second Century A.D., the conquering Romans assimilated much of Greek culture and Greco-Roman civilization spread with Roman conquests of Europe, Asia and North Africa. Not only the imperial might of Rome, but shared cultural concepts created an unifying system of values primarily "Greek in origin and Roman in execution", which spread throughout the entire Mediterranean World and also other parts of the Roman Empire. And as a result of their mixing with other nations both the Greek spirit and culture slowly dissipated. Thus the political decadence which was unfortunate for Greece was fortunate for the Western World.

In the ensuing maelstrom of cultural anarchy succeeding the fall of the Roman Empire it was the individual who strove for the security inherent in the peace of mind and the joy of individual life. Philosophy was one more called upon to provide some direction for the individual to acquire happiness through peace of mind. Unlike Greek philosophy which sought to provide man with happiness through life in the polis, the philosopher of this period did not have the polis to reflect the harmony of the Cosmos and so show man his place in it. Rational arguments - Reason - had not been successful in providing any lasting stability for the polis wherein the individual might find some peace of mind; as an integral part of a microcosm that reflected the Cosmos at large. To the mass of the people, therefore, the knowledge born of Reason was not adequate for the provision of happiness, as it did not provide directives but required a realization on the part of the individual. Philosophy was, therefore, required to provide practical wisdom. Knowledge became an ancillary to living, its ideal being the development of a perfectly free and happy man. Ethics became individualistic, its function being to release man from the grip of the outer world. In the turbulence of the time the "terrified mind" seized upon religion to provide it with some peace. Philosophical interest thus passed from ethics to religion. Platonic transcendental metaphysics with its separation of material and immaterial substances was adopted by religion to provide it with some scientific form. It was ideal for this purpose: its teleological principles give to the life of nature and man a divine cosmic purpose. Its philosophic material became the basis on which Christianity could constitute itself into a didactic system (Windelband, W. 1956). Ethics was thus gradually transmitted into religion. The enlistment of Platonism into the service of religion shows that it was no more regarded as a philosophical system that could provide a basis for man's understanding of nature and his place in the Cosmos: this was the basis for his ethics. Philosophy was thus pressed into the service of religion which now became the basis of ethics.

It was Christianity that came to answer the religious needs of the time. In the empire with its diverse peoples the Christian ideas of universal brotherhood, the existence of one almighty, merciful, loving God and with the promise of eternal salvation found fertile soil in the confused and unsettled minds of the period (Harrison, J.B. and Sullivan, R.E., 1975). Christianity thus became the object towards which man could orientate himself in order to attain peace and a lasting happiness.

The dawn of the Mediaeval Period saw the Christian faith firmly established. As it was not an abstract philosophical system, faith, not reason, led man to God. As a revealed religion it provided the truth and Christ had shown the way - through love and faith. There was nothing for man to "work out" or to understand; he had only to follow "the way" and was assured of "eternal salvation", from his uncertainty and his unhappy condition. Faith assured this joy in this world and the afterlife.

2.2 THE FIDEISTIC PERIOD

It was Augustine who tried to penetrate this faith with reason (Copleston, F. 1962) so that he might see human life in the light of Christian wisdom. A mere acceptance of Revelation was not enough. Man should know why he should have Faith. Reason could provide this answer and prepare man for faith. Even though he felt that Reason could lead man to knowledge (through Faith), Augustine was aware of man's dependence on his senses for knowledge of the external world, which was necessary for his practical life. Through the senses he learnt of the mutability of objects. This showed that these were not the proper objects of knoweldge. To Augustine the mutability; the constant state of flux of the objects of the external world was due not only to the relativity of sense perceptions but also to the "deficiency" (imperfection) in the objects themselves. Like Plato, Augustine felt that true knowledge consists in the knowledge of unchanging objects: man should thus concentrate on the immutable as it is the "correlative object" of the soul. Perception of imperfect objects led to belief in the perfect.Thus Platonism was used for the exposition offundamental Crhistian doctrines, (Copleston, F. 1962), although Christianity differed from Platonism in that it was aimed at the attainment of, not an impersonal Good, but a personal God. And whereas The Good ((Plato) was attainable only by the "philosopher kings" (Republic), the God of Christianity could be "attained" by every individual who followed the teachings of Christ. Thus could man find happiness and free himself from the surrounding unhappiness and uncertainty brought to him by his senses. Christianity therefore, placed within the reach of every individual an ideal that would give him peace of mind. Faith assured him of this.

Augustine's ethics, like that of the Greeks, was eudaimonistic. Happiness, however, was in God, not in the "abstract ideas of Plato. And the way to this happiness is through love; (expressed by Christ in Matthew 5:44). With this Augustine introduces moral obligation (the obligation of a free Will) for the ultimate attainment of happiness. Augustine, presented a notion of God and divine creation, which was easier for the "common man" to understand and accept on faith alone. In this way he was able to establish a much "firmer" metaphysical basis (realized through creation) for moral obligation. This led to the relationship between the individual, the state and the church. Individual moral responsibility became the basis of harmony.

The scientific character of Augustine's thought can be seen in his method of attaining to higher goals. He began in experience (of what he considered) of real objects (although mutable). Although he did not consider this experiental knowledge as true knowledge it was nevertheless indispensible in the acquisition of true knowledge. Added to this was the fact that he also saw history as the development towards the truth through the "dialectic" between good and evil. For Augustine the spread of Christianity was the assurance that this "dialectic" was leading towards the Good and eventually to God. He thus showed the importance of the historical dimension in the acquisition of knowledge.

Augustine's philosophical and theological views are therefore also a "child of the times"; born of the struggle of the human mind in its search for peace and knowledge of the way to attain this peace. History had shown that Greek "rationalism" could not lead to this knowledge. His own experience of nature showed him that there were higher and more perfect forms of knowledge or truth, that of mathematics and logic, based in reason. Logical deductions further led to a single Form, the "timeless One" (Rauche, G.A. 1985) which can only be intuited, but defies comprehension or definition. Consequently, God (One) could not be reached by Reason. Intuition, aided by Grace and based on love and faith, was the only way to reach God. But this depended on free will. Acquisition of knowledge of God depended thus primarily on Will and not on reason. The Will thus becomes more primary than love and faith and shows that permanent striving of the human mind to attain Truth. The responsibility of the acquisition of this knowledge thus rests in the individual.

Abelard, following Augustine (through Neo-Platonism, -Plotinus), endorsed Plato's view that the formae exemplares (divine ideas, generic and specific) being ideas in the divine mind are identical with God. His contention was with the ultra-realism of William of Champeause. Logically he showed that such realism was absurd (refer Copleston, F. 1962, p.171). Although the concepts formed by abstraction bear no individual reference it did not mean that universals were only subjective constructions or mere words. The content of generic and specific ideas was in their objective reference. Consequently, Abelard's "nominalism" (of which he was accused) was no more than a denial of ultra-realism. Thus he asserted the distinction between universals derived by (logic) reason, and real objects, by denying the objective foundation of universal concepts.

Viewing the teachings of Abelard in Aristotelian perspective, John of Salisbury regarded genera and species not as the objects of sense but as **forms** derived from the activity of the mind comparing likenesses in different objects, and abstracting these likenesses and unifying them into universal concepts or **forms**. Thus universal concepts are not devoid of objective foundation and reference. In this way mathematics and physics could also be used in the description of objects. Mathematics treated of lines and surfaces, neither of which exist apart from objects. And physics was concerned with motion and other elemental properties of objects which in reality exist in varying combinations.

Anselm generally followed in the footsteps of Augustine: God was the external and subsistent truth and as such the ontological cause of nature. He also felt that belief should be based on understanding: "For I do not seek to understand in order that I may believe, but I believe that I may understand. For I believe this too, that unless I believed, I should not understand" (in Copleston, F. 1962, p.177). Consequently, since belief was at the basis of all understanding it was important that one understood what one believed. For if one did not understand, belief would be blind. This would involve a denial of both Will and responsibility. Consequently, action or conduct could thus not be moral, for choice, which involves will and responsibility, are both implicit in morality.

Like Augustine, Anselm did not make a clear distinction between theology and philosophy, for he felt that belief should be understood on a rational basis. On this basis he accepted the primacy of faith. The argument he uses as proof of God's existence (and therefore the justification for Faith) concerns the "different degrees of perfection found in creatures". For experience shows the different degrees of qualities in objects: showing their striving for perfection. This implies a standard of perfection (showing that the argument is Platonic in character). Although following in the Augustinian tradition, Anselm's thoughts are more systematically elaborated displaying a "methodic application of dialectic".

2.3. THE EMANCIPATION OF PHILOSOPHY AND THE EMERGENCE OF SCIENTIFIC THOUGHT

The development of the university system during the Mediaeval Period led to a greater systematization of the thoughts leading up to and of the period. Universities, especially the university of Paris, became the centre of Mediaeval European culture. The Papacy represented the "supernational character of Mediaeval religion". Culture and religion became more closely bound together by the intellectual outlook and the common language they used, Latin.

Resultant increase in nationalism showed that the political Unity of the Roman Empire was more theoretical than objective. Nationalism, however, was to some extent checked by the intellectual outlook, feudalism and the Mediaeval political and economic institutions.

It was inevitable that the expanding university life result in intellectual and academic expression. This took the form of systematization (based on Aristotelian logic) of the science, knowledge and speculations of the period. Typical of the system was the classification of science provided by Hugh of St. Victor (refer Copleston, F. 1962, p.188, 189). From this classification it can be seen that science was regarded as the sum total of all knowledge, theoretical, practical and technical. According to Peter Lombard, God's existence, creation and the soul's immortality fall into the province of natural reason as they can be understood before they are believed, by faith.

Influenced by the **Timaeus** the School of Chartres (Copleston, F. 1962) was inclined to ultra-realism. For Bernard of Chartres matter existed in a chaotic state before being ordered in accordance with the ideas existing in God. He saw the whole of nature as an organism and maintained the idea of a world-soul. Bernard of Tours depicted the world-soul as animating nature, so giving order to chaos (or prime matter). But this order was also in accordance with the ideas of God.

John of Salisbury, not being one of the ultra-realists saw the School of Chartres as attempting to mediate between Plato and Aristotle. Thus while some members saw corporeal form as copies of the ideas in God, others saw matter in a state of continual flux. In general, the hylomorphic theory was adopted and interpreted in the light of the **Timaeus**.

In the background of dissention between the Holy See and the Empire, John of Salisbury drew on the political writings of Cicero, the Stoics and the Roman jurists and also on the Civitate Dei in expounding his views for society. From his idea of natural law he felt that no ruler is above the law and thus could not enact laws counter to the natural law. The ruler was, therefore, an instrument of natural law and had to follow it out of love of justice. Since he followed it out of love, it showed that he did so of this free Will and sense of responsibility. Thus John of Salisbury accepted the supremacy of natural law or of "ecclesiastical power".

2.3.1 The Arabian Philosophers

Although Platonic and neo-Platonic philosophers dominated the first half of the Mediaeval Period it was used only as a preamble to Christian philosophy. The second half of the Mediaeval Period was dominated principally by Aristotelian or neo-Aristotelian doctrines. His introduction to Western philosophy was due principally to the Arabian philosophers. They commented and developed on it, interpreting it, in the main, in the spirit of neo-Platonism and in the back-ground of Islam. Consequently, much of the philosophy was coloured by islamic thought and so was incompatible with Christian theology. Thus Aristotelianism was largely opposed by Christianity in the Thirteenth Century. It seemed to be opposed to the views of Augustine, Anselm, and other great philosophers of Christiandom.

Alfarabi introduced Aristotelian (syllogistic) logic to Islamic philosophical thought. His principal use for the Aristotelian argument was for the proof of the existence of God. Islamic theology also held the view that objects are passive. Consequently, the idea of God as first mover and Cause (Aristotle) served well Islamic theology. Neo-Platonic influences were also evident in his work: the Ideas in God as examplars and the source of ideas in the human mind. Thus he felt that it was man's duty to orientate himself towards knowing God.

Similar to the system of Alfarabi, Avicenna divided philosophy into logic, speculative philosophy (Physics, mathematics and theology) and practical philosophy (ethics, economics and politics). Of the speculative or theoretical sciences, metaphysics (in true Aristotelian tradition) he calls the "higher science", mathematics the "middle science" and physics the "lower science" (Afnan, S.M., 1958). Physics, as a "particular science" was concerned with the properties of changeable, existing natural bodies. Metaphysics, however, as a universal science had to prove that its premises and principles were correct.

Although the study of Being was metaphysical, (Aristotle - but reached through experience and abstraction), the mind, of necessity, could apprehend the idea of Being through self consciousness. Thus he distinguishes between "necessary" in the sense of an object's "coming into being and passing away" and "necessary" in the sense that the existence of an object is determined by an external cause - whose action is determined, although the being "produced by the cause is contingent". Through this argument he arrives at the uncaused Being or necessary being in whom essence and existence are identical. Basing his argument on Aristotle's theory of potentiality through which he arrives at "Pure act", Avicenna (though he does not say "Pure act") says that God is Truth, Goodness, Love and Life and from this derives the identity of Goodness and absolute love. And since God is Goodness, He radiates his Goodness and so creates necessarily. (Since He is necessary being his attributes are also necessary). This view tends to deny God's freedom and supports the "emanation theory" (which is Greek in origin).

Avicenna also investigated atomism as most Islamic theologians had adopted it as an "explanation of generation and corruption" (coming into being and passing away) (refer, Afnan, S.M. 1958, pp. 208-210). The Mu'tazelites and other theologians of the Islamic world had also adopted Democritian atomism and (with some modifications) had used it to explain creation (on earth). In this way a purely materialistic theory was derived from Divine wisdom. Avicenna, however, in the Isharat adduced various arguments against Atomism (Afnan, S.M. 1958).

Averroes wrote numerous commentaries on the works of Aristotle and considered his (Aristotle's) system as the "Supreme Truth". This brought him into direct conflict with Islamic theology. Consequently, he attempted a reconciliation between his philosophy and theology: that philosophy is a scientific (reason), while theology is an allegorical formulation of the same truth. In this way Averroes made theology subordinate to philosophy as it meant that theology or the allegorical formulation of the Truth was for the "unlettered". The Islamic theologian interpreted this as meaning that what is true in philosophy is false in theology. This led him into conflict with Islamic theologians and resulted in the prohibition of Greek philosophy and burning of Greek philosophic works in Islamic Spain.

The translations of the works of Aristotle and the commentaries, by especially, the Arab thinkers showed Latin Scholastics that the view that only theology could settle questions concerning the Universe, and man's attitude towards God and the Universe, was being challenged by knowledge gained by reflection of the human mind, on the Universe. Added to this was the fact that these commentaries were by Islamic thinkers who obviously had to reconcile their philosophy with their theology.

Consequently, systems that were independent of Christian theology, in particular, could also produce knowledge of the Universe. Indeed, knowledge of these systems had been used by theology to prove the existence of God. The systems of Aristotle, Avicenna and Averroes showed Mediaeval Scholastics that an order of truth concerning the Universe could be attained independent of Christian revelation. It became apparent also that it was not only a set of revealed dogmas but the work of human reason that had arrived at these truths. The relation between theology and philosophy became more apparent and led to a "delimitation of the provinces of the two sciences". The Mediaevals began to realize the extent and achievements of the human intellectual endeavour.

In contrast to this general acceptance many of the Mediaevals still resisted the works of Aristotle. This was, in large part, to certain writings being erronously attributed to him, which shed a "false light" on his work. Although his Logic and ethics were retained, his works on natural philosophy and metaphysics and commentaries on them, were often prohibited on pain of excommunication. These works contained doctrines which were at variance (e.g., eternity of world) with Christian teachings. This later led, often to persecution of, especially scientific thinkers.

Graeco-Islamic literature thus had a marked and disturbing influence on Christian theology. Although theology was yet supreme and following Anselm the correct course was "Credo ut intelligam", the doctrine of the "twofold truth" emerged, to which many adhered. The work of Averroes, however, took this further when he spoke of philosophical and allegorical truths. This effected an enduring separation between the "two truths" and helped in large part towards the autonomy of philosophical thought which allowed the emergence of the modern scientific outlook. This view together with the work of Avicenna greatly influenced the theology and philosophy of Thomas Aquinas. According to Afnan, "in the field of rational and also religious speculations it may be safely said that as long as Thomism is studied in European centres of learning ... the Persian philosopher will continue to be heard" (1958, p.288).

Graeco-Islamic literature thus changed the course of philosophy and through the influence of Thomism that of Christian theology also. The authority of experimental science also greatly increased in the wake of his studies in medicine and the natural sciences. The attempt of later philosophers to harmonize reason with revelation or to see revelation in the light of reason (and later, science) is already evident in Avicenna (Afnan, S.M., 1958). Since he could not be satisfied by Orthodox dogma or by Aristotelianism, he sought a synthesis rather than a rejection of one of them. In this way he showed that knowledge is dependent on experience, a total experience, and consists in the synthesis and not the rejection of any part of experience. The Greeks also attempted to construct their systems in the light of "total experience", but not having a set of revealed dogmas like Christianity or Islam, they did not experience the depth of the crisis of faith between philosophy and religion. The depth of the crisis or conflict can be seen from the questions that emerge from Avicenna's work; questions that tantalised the searchers before him, questions that plagued the mediaeval Scholastics, questions that yet lead the searchers:

> "Is reality as distinct from facts a simple element or the product of two or more; is it an entity or a relation; must we seek it through analysis or synthesis?" (Afnan, S.M., 1958, p.290).
>
> Or is it "organic and unitary?"

The works of both Avicenna and Averroes revealed an attempt at the reconciliation of the truth of philosophy and that of theology (truths of reason and of faith). Averroes considered them as equally valid as they were but two different ways of looking at the world; hinting that understanding of the world depended on experience. The consideration that revelation was the "unlettered" way of understanding the world, seemed to point to reason (philosophy) as being superior to faith. The theologian, however, still saw faith as being superior to reason.

2.3.2 Emergence of philosophical autonomy

Bonaventure's views were typical of those of most theologians. His unshakeable belief in God obviated any questions concerning God. More was he concerned with the relationship of man and God, of man's attitude to God. Since he felt that union with God was the most important aim of life, knowledge of God was essential to predispose the soul towards a closer union. The sufficiency of Scripture for the attainment of this knowledge obviated the need for any study of philosophy. The fact that Aristotle's metaphysical philosophy did not consider personal communion with God, led to his mistrust of the system. He felt that the world should be seen in "relation to the creative Word": Christ was the "medium" or Centre of all sciences.

Although he rejected Aristotelianism, his view that knowledge of creatures or of objects was the first step in the soul's ascent to God is Aristotelian. This conviction, coupled with that of the Unmoved mover is distinctly Aristotelian in character. His view was that the soul can know God in its recognition of dependence on

God. The soul can, therefore, know God through contemplation of its own consciousness. Thus the soul can attain knowledge of God without reference to the external world. In his belief that man must strive towards Gods, Bonaventure shows that it is man's choice, for God does not override man's free will (he thus shows man's responsibility for his actions) as this is consonant with his purpose. Consequently, man can reach God through his own actions. This union with God is what constitutes true happiness. In this way Bonaventure showed man's responsibility for his actions. The metaphysician cannot attain knowledge of God unless he receives "illumination" by the **Word**. The science of the metaphysician can therefore only be complete when it is "crowned by theology".

Unlike Bonaventure, Albert the Great saw the foundation of theology both in revelation and reason. That part of theology that was reached by reason he called **metaphysical philosophy or first theology** and treated God as the **First Being**. The philosopher works under the general light of reason present in all men while the theologian, under the supernatural light of faith through which he "receives the revealed dogmas". In this way he distinguished between philosophy and theology. Through his dependence on the Aristotelian tradition he sees God as the "Unmoved Mover, pure act and the self-knowing intellect". To explain creation he used the emanation theory interpreted in the neo-Platonic tradition (Copleston, F., 1962).

The view that the soul through its own consciousness could realize God (Avicenna), and that through contemplation of its consciousness come to realize its dependence on God (Bonaventure), are probably at the base of St Albert's view that both philosophy (reason) and theology have their part to play in the realization of God. Thus faith and reason have both a common goal. With this view in mind St Albert's interest in the physical and biological sciences can be understood: the world of creatures also contributed to knowledge of God. For him only experience could bring certainty as far as the investigation of the physical world was concerned.

The physical world also influenced the animals themselves: he saw the relationship between habitat and adaptation (thick white coats of Polar bears, etc.). He realized also that many observations made are in terms relative to the observer. Consequently, apriori arguments are not as valid as those from experience. His reliance on observation and experience and on the confirmed experiences of others, brings him nearer to Aristotelian views for like the latter he realized the value of scientific empirical research.

John of Salisbury had already in the Twelfth Century established a theory of science (refer Rauche, G.A., 1985, p.160). The work of St. Albert can be seen as an expansion of this theory. On the basis of this theory can be seen the development of the scientific method in which observation and experiment are prominently featured. This method was further expanded by Roger Bacon till it emerged as a separate method or way for the investigation of nature. The expansion of this method in the Aristotelian tradition (with reliance on observation or experience) also led to God. Consequently, both reason and faith were instrumental in the realization of God.

The work of St. Albert thus shows that both reason and faith have their part to play in attaining knowledge of God. Thomas Aquinas saw this also but wanted to use philosophy in theology without in any way disturbing the "essence and nature of theology", and to do the same for philosophy.

Added to the changes in the philosophical climate from the Augustinian Period to the Thirteenth Century there was much developments in the social order resulting in a period of revival all over Europe. This was a direct result of the feudal and manoreal systems, which, although very limited, provided a basis for the development of small associations of men. These institutions provided some measure of economic stability and prosperity and on these "basic patterns of organization, social control, thought and belief" (Harrison, J.B. and Sullivan, R.E. 1975, p.207), men were able to constructively apply their energies. Their capabilities were directed towards a wide range of intellectual, spiritual and aesthetic pursuits resulting in varied cultural achievements.

This was largely a result of the loosening of those chains that held philosophy in bondage to theology. During the first half of the Mediaeval Period (the fideistic period) almost all activity and thought was subordinate to theology. During the second half, however, due largely to the works of the Arabian philosophers, Aristotelianism was adopted into philosophy or into philosophical argument. Consequently, experience and reason became extremely important in theological argument. This is evident in the works of Peter Abelard and Albertus Magnus. The reason that had been used by these men to attempt a logical proof of God's existence, could now be used in attempts to understand natural phenomena. Consequently, along with the freedom of philosophy, scientific thought slowly emerged. Already Augustine had postulated his theory of "natural causes". These causes could now be studied scientifically in an attempt to understand the processes worked by God; to reveal the "glory" of his works. Natural phenomena could be investigated without being directly attributed to God. Nature could be understood as working by processes within itself. An understanding of these processes could thus enhance the understanding of nature, removed from direct divine intervention.

There was also much social change during this period. The most significant was the emergence of a wealthy middle class as a result of economic transformation. Being engaged in commerce and manufacture, they required greater recognition as a class and greater freedom, for on this their livelihood depended. Having more freedom and being able to accumulate wealth they became a major force in shaping the fortunes of Europe. They promoted other aspects of social life and consequently it was from this class mainly that the intellectuals and scientists emerged. Science, law, political theory and literature all took on a new form. The rise of new monarchies resulted in conflict for supremacy between Church and state. Political theory was therefore necessary, which would justify the powers both of Church and state and be so related as to promote the peaceful regulation of society.

The emergence of philosophical and scientific thinking from complete subservience to theology, is also evident in the broader and more open thinking of the people, as shown in their architecture. In contrast to the Romanesque, the

Gothic style of architecture emerged out of the new intellectual desire to develop a rational view of God. He was seen in terms of reason, light and proportion. According to Harrison, J.B. and Sullivan, R.E. "The Gothic Church was an attempt to leave behind the mystery-shrouded awesome world of the Romanesque, and move into the light and purity of paradise", (1975, p.267).

It is apparent, therefore, that Mediaeval Thought also, expressed in Mediaeval art, was a quest for the light of truth beyond the world of men. This attempt to transcend the mind and imagination came from man's belief that his duty lay in knowing and worshipping God, for it was He who controlled the Universe. Thus the talents of artist and writer were directed to the service of God.

The permeation of the Mediaeval philosophical milieu by Aristotelianism thus resulted in changes in the philosophical and theological and consequently the ethical and social values of the era. The teleological and eudaimonistic ethics of Aristotelianism seemed to be misinterpreted. Since the end, telos, of mortality was happiness, for this ensured harmony, it was interpreted to mean harmony in this life as contributory to his happiness in this life, and of eternal happiness in the afterlife. Consequently, the tension between philosophy and theology! This tension in the unity of truth manifested itself in the conflict between "reason and will, knowledge and faith" (Rauche, G.A., 1985, p.159), and consequently in the social and political fields.

To "save the unity of truth" Thomas Aquinas saw that he had to establish a balance between philosophy (especially Aristotelianism) and theology, and validate the "use" of philosophy or Aristotelian reason in theology. Christian theologians, however, e.g. Bonaventure felt that reason could not reach the truth for, as truth was revealed (revelation to the Christian), it could only be reached through faith. Influenced by Aristotelianism, Thomas Aquinas felt that truth could be reached by rational argument and also accepted (on faith - Intuition) by the theologian on the authority of Scripture (Revelation). Thus the difference between theological truth and philosophical truth was not that of content, but a difference as far as their formal aspects as concerned.

Like that of Aristotle, the ethics of Thomas Aquinas is also teleological and eudaimonistic. Happiness or beautitude is the goal of man in his natural order. Sense experience is the ground of knowledge. Therefore, as far as Thomas Aquinas was concerned, the metaphysics of Aristotle could not lead man to perfect happiness. Aristotelian metaphysics was concerned with man's happiness in this life and Thomas Aquinas felt that perfect happiness was not attainable in this life; only in the afterlife. For man in this life could attain knowledge only through his sense-experience, and since this knowledge was imperfect it could lead only to imperfect happiness or beautitude. Such knowledge was natural knowledge since it was attained through sense experience and the love of God. Perfect natural beautitude is attainable only in the afterlife and consists in a "vision of the divine essence". And since man is always seeking the First cause the attainment of this vision is a natural desire in man. And those acts are moral which are directed to the attainment of this end. Moral acts also had to be performed of one's free will; as a rational and free being.

According to Thomas Aquinas, the primary precept of natural law is the preservation of life, for on its fulfillment is dependent the attainment by man, of God. Like all other creatures, man has a natural inclination to self-preservation; this is evident in his acts of protecting himself, and also in his desire of species propogation by reproduction, and parental care for children. The reason reflects on this natural inclination and directs man's actions to the fulfillment of this purpose. As a rational being he is also inclined to seek the truth (God). Reason therefore, imposes an obligation - which is rooted in human nature itself. Moral law is therefore rational and natural, having its basis in human nature.

Since human nature is created by God and society and Government are "pre-figured" in human nature, government has a divine justification. Due to the "inequality of gifts", one of superior knowledge and righteousness should be allowed to rule and so exercise his knowledge and ability for the common Good. The Christianised Aristotelianism of Thomas Aquinas helped him avoid the view of Hobbes that the state is founded on "enlightened egoism" and that of Augustine that "sin" consitutes its basis. Being rooted in human nature the State and society were grounded in the Will of God. Consequently, it was an institution in its own right and functioned in a sphere of its own. This resulted in his not being able to hold extremist positions in regard to relations between State and Church. In this way the State became a "perfect society" with all the necessary requirements to attain this end - the common good of all the citizens. This would bring peace to the State, the activity of the citizens be given unified direction and provide the necessary conditions for the requirements of life. Consequently, the citizens had their "God-given" positions in life. To function properly the citizens of the state had to be divided into classes: peasants and artisans to work, nobles to rule and priests to pray and administer sacraments. The ruler should idscover the principles of natural law so that he might rule society in accordance with divine order. Thus every individual had to play his part in the State so that the State as a whole be directed to the common good.

Thomas Aquinas felt that sovereignity was given "to the people as a whole" who gave it to the ruler: thus sovereignity came from God to the people, who gave it to the ruler. Thus the people had the right to depose any unjust ruler; but this must be provided for in a constitution. He advocated a "mixed constitution" in which place is given both to aristocracy and democracy, where the people elect certain magistrates to "temper" the power of the monarch. Thus his political theory, based on his ethical views and his epistemology is characterised by "moderation, balance and common sense", which in the words of Rauche, would lead to the "conception of a Christian Cosmos" (1985, p.159).

The doctrines of Siger of Brabant were also grounded in Aristotelianism but he looked at this from an Averrocian point of view. God thus became the first creative cause - not the Unmoved Mover of Aristotle. He followed Avicennia in his view that God operates through intermediate causes. Like the Arabian philosophers he also held the view that the heavenly bodies determine terrestrial movements.

Motion, therefore, was not eternal but had a cause and a beginning - and this was God. The Scientific nature of the thought of Siger of Brabant can be seen in his view of the relatedness of causes; as this was grounded in experience.

The further development of scientific thought can be seen in the work of Roger Bacon whose philosophy was a curious mixture of science and theology. Since reason was also from God, its use could not be condemned. But theology held a dominating position among the sciences since all truth was contained in the Scriptures. Elucidation of the Scriptures, however, required the use of Reason. Consequently, although the Truth was given in the Scriptures (through revelation) it was philosophy (reason) that showed man the relevance of Scripture leading him to knowledge and service of God. This constituted the basis of moral philosophy. Thus the incomplete pgan speculative and moral science reached their completion in Christian theology and ethics. His justification for the use of philosophy in theology lay in the fact that it was revealed to the Patriachs. Human depravity had obscured revelation which was rediscovered, however, with the help of pagan philosophers (Aristotle, Avicennia, Averroes).

In the continuance of the use of philosophy, in theology, he saw the opportunity to maintain and perfect the work of his predecessors. Truth led men to God. Therefore, studies that did not seem to have immediate relevance to theology should not be ignored, as all truth led to God.

He also realized the importance of mathematics and considered it the "key" to the other sciences: it was presupposed by the other sciences since it was less dependent on experience. The Patriachs, Chaldeans and the Egyptians had also studied and used mathematics to good advantage. The Christians were still using much of the knowledge that they had inherited from their pagan forebears.

Value of mathematics was evident from its numerous uses. Its use in astronomy showed the insignificance of earth to the other planets. It could also be used to correct the calendar, which was based on the Julian Calendar and to help solve the chronological problems of the Scriptures. His works show a variety of interests in light and optics, eclipses, tides, spherical shape of the earth, geography and astrology and the basic unity of the Universe. He also felt the study of astrology relevant and important as the "influence and movements of the heavenly bodies affect terrestrial and human events and produce even natural disposition in human beings, but they do not deny free will" (Copleston, F. 1962, p.168). All knowledge was thus important since it could be used to a purposeful and good end.

His work in experimental science shows Bacon's leaning to Peter Lombard who did not accept a priori answers to questions, but insisted on "questioning" nature herself. Although reason could guide the mind to the correct conclusions there was no assurance of this save by experiment (resting on sense experience often aided by instruments). He also allowed spiritual experience, but knowledge gained in this way could only come from Grace. Thus he allowed two types of knowledge.

Bacon was of the view that whereas, philosophy, mathematics and experimental science were related to action (involving will, direction, etc.), moral philosophy was related to action that makes man good or bad and guides his relations with God, himself and his fellow-man. Moral philosophy is, therefore, related to theology. His work on civic and personal morality was based on the works of Greek, Roman and Moslem philosophers. Acceptance of the work of non-Christian philosophers required recourse to reason but the Christian religion was accepted on the grounds of faith in Revelation (Authority). Thus philosophy and science could lead to knowledge of the existence of God, his unity and infinity.

2.4. Discussion

The Mediaeval Period can be seen as a "melting pot" in which the ideas from the ancient world embodied in Greek, Roman and Christian theology were mixed with Islamic trends of thought. Non-Christian elements contributed to enrich Christianity so that it could be accepted not only on faith (fideistic period) but understood on a rational basis, (post-Arabic influences) effecting a reconciliation of reason and faith culminating in the Thomist synthesis. Reason and faith thus had an important part to play in the aquisition of knowledge, of the Truth. Experience (of nature - God's creation) informed of "nature's rational being" (Rauche, G.A., 1985) while reason pointed to (through higher stable forms - "mathematics and logic") **the timeless One** which identical with God could only be reached by intuition, based on faith. Thus reason led to faith. In this way the search for essential knowledge led to God. Belief, therefore, was grounded, not only on faith but on reason as well allowing for an acceptance of faith.

Unlike the Greeks who attempted to gain essential knowledge of the universe on a rational basis, Mediaeval theologians found all essential knowledge in knowledge of God, on the basis of faith. However, just as essential knowledge had ethical implications for the Greeks, so did it for the Mediaeval theologians. Belief, therefore, was grunded not only on faith, but on experience and reason as well. This provided the basis for the emancipation of philosophy from bondage to theology. Philosophy could thus investigate reality on a rational basis and not be tied to theology and used as a rational argument to confirm the existence of God or to corroborate what knowledge could be attained through intuition. The emancipation of philosophy from theology allowed the eventual emergence of scientific thought (empirical) (based on observation and experiment) from philosophy. Consequently, three different trends of thought, concerning knowledge, emerged from the Mediaeval Period: Knowledge based on faith (in Religion; and demonstrated by rational argument); knowledge based on rational intuition (philosophy) and knowledge based on observation and experiment (the contemporary concept of scientific knowledge) beginning largely in Baconian philosophy.

During the fideistic period, therefore, the tension between faith and reason was resolved in favour of the primacy of faith in the aquisition of knowledge, although reason played a prominent role in assuring its validity. It was on the basis of experience that reason demonstrated the primacy of faith. Thus the imperfect world of objects had its correlates in the perfect ideas in God. This view, however led to the controversy between nominalism and realism. Abelard's view tht universals (or objects of reason) had an objective reference (in the world of objects) showed his anti-nominalist approach: the world was therefore real; a world of real objects which could be investigated by the rational approach: constituting the basis for the emancipation of philosophy from its subserviant role to theology.

To Augustine and Anselm the world could be understood because of belief (or faith in God). Without this belief in the basic unity and perfection of God, the world would be meaningless: God was the origin of the world. Abelard, Albert the Great, Thomas Aquinas and the Arabian philosophers, however, felt that it was understanding, that led to belief. An understanding of the basic order and unity of the world showed that belief in a supreme order or God was reasonable. It was on this view that Aristotle's philosophy could be introduced (by the Islamic philosophers) and be accepted by Christian theology, for it seemed to "prove" God's existence. It showed that reason led to belief: that an understanding and acceptance of the (real) world would lead to belief in God. The importance of this approach was that it showed the autonomy of philosophy; that it was through a rational investigation of the world (of real objects of the world - scientific) that belief in God was justified. Mediaeval science thus "proved" the existence of God.

Although this approach showed God's supremacy and omnipotence and provided the justification for belief and faith, it also revealed the importance of philosophical thought for acceptance of faith. In this way the problem of reason and faith was solved, to show the relationship between reason and faith.

The views of the post-fideistic theologians leading to the autonomy of philosophy also constituted the basis for the emergence of scientific thought (on the basis of observation and experiment - Roger Bacon) from philosophy. For, since philosophy showed the importance of a rational investigation and understanding of the world for the justification and acceptance of faith, it implied that a better and deeper investigation of the world would enrich the meaning of faith nd lead to a deeper understanding of God. This approach laid the foundation for an investigation of the world, of the processes and mechanisms that maintained the order and harmony of the world: of the ways in which God maintained the order of the entire world. The value of such an investigation was that it would lead to a greater and deeper acceptance of God: Knowledge of the world was thus important for the understanding and acceptance of faith (ethical significance of knowledge). It was this investigation of the world, based on observation and experiment that later came to characterize scientific activity.

It was through Augustine, therefore, that Greek philosophy which contributed much to the development of the scientific attitude was saved and preserved during the Mediaeval Period. Its "absorption and utilization" slowly increased and was eventually at the foundation of those directions of thought that led to the emancipation and autonomy of philosophy from theology and to the emergence of science (from philosophy). In the development of scientific thought during the Mediaeval Period can be traced the change from the neo-Platonism of Augustine to the atoption of Aristotelianism (through the Arabic philosophers). The Thomist synthesis of the latter half of the Mediaeval Period, thus did not merely represent the substitution of Aristotelianism for Augustianism, but was a synthesis from the various elements of Greek and Arabic philosophers with the original ideas of Christian thinkers. The utilization of Greek philosophy and Arabic commentaries in the development of Thomist thinking also showed that the mind could reach an order of Truth independent of Christian Revelation.

Abelard, and especially Albertus Magnus, building on the scientific theory of John of Salisbury, showed the importance of reason and experience in their development of the theory "Natural causes", whose understanding laid the foundations for man's relationships with God. For with an understanding of these processes Man is no more in fear of God. He is in awe at the variety and intricacies of these processes by which God maintains the workings of the Universe. In this way man realizes the power and greatness of God, and also, the love that God bears him, having created him, in His own image and placed him at the head of Creation. God has endowed man with reason. Therefore, an investigation of the world through reason was justified so that in his understanding of nature he might realize his relationship to God not through fear but through love: that love that God has given him and which he owes to God. Man had thus to love God (through Christ) for that was his due to God. Consequently, the Reason through which man understands the workings of Nature, also affords him knowledge of the love of God; of the faith he ought to have in God, and consequently, of his responsibility to God.

This relationship to God, however, was based on the I - Thou relationship (Rauche, G.A. 1985) in which God was removed (distanced) from man. This was unlike the Greek view which saw man as an integral part of the Universe; God also was part of the Universe. The Christian theocentric attitude, however, saw God as outside the world. It is this view that contributed to the development of Universal mechanism of the Late Mediaeval and Renaissance periods. Thus the reason that had led man to God, also served to alienate him from God. For in understanding the processes of nature without direct reference to God (through science) man has been able to remove God farther away from him. And as God was moved farther away from man, with him went the value systems that man received through Revelation, which had regulated Mediaeval society.

However, although God was removed from the world, the Mediaeval scientist still investigated the world with a view to understanding the mechanisms that operated in nature; mechanisms that God himself had placed in Nature. Thus even though nature was investigated on a rational basis, through observation and experiment, faith in God still remained and served to maintain the unity of the various process in nature. Thus, although nature or the world could be investigated on a rational basis, this still led to support theology. Thus the variety of the world still derived from the mind of God a common origin. It also showed that all knowledge, secular or otherwise, pointed to God.

The two-truth view of Averroes also supported the view that reason was just as legitimate a way to investigate and to understand the world as intuition (which led to God). His view that the value of religion lay in the fact that it provided an understanding of the world for those who could not understand the way of reason, showed that he considered (the use of) reason as the more correct way of understanding the world. This, perhaps, led to the adoption of a more scientific (observation and experiment) outlook into investigations concerning the world, leading to an understanding of the world without recourse to religion - an understanding based on the separation, not the integration of the two world views. Since knowledge of the world through faith (God) also constituted the basis of ethics where man looked to religion for directives to moral conduct based on free will and responsiblity, the failure to integrate the two world views led to religion being seen as the basis of ethics while science provided only knowledge of the world (physical aspects of the world) or the understanding of the working of natural laws. Knowledge of these laws thus allowed their utilization for man's material benefit. Unlike Greek science which also had ethical implications, placing man in meaningful relationship with the Universe, post-Mediaeval science assumed a utilitarian aspect as it had done for Mediaeval theology. Ethics seemed not to be the concern of science, for that was regarded as being part of religious theory. For the Greek the problem of this separation did not arise as he did not have (religious) revelation to contend with. From a slight distortion of the two-truths (Averroes) could have emerged the Western view that science is concerned not with ethics but with the acquisition and utilization of knowledge for the betterment of Man's material needs.

Although Mediaeval theologians saw everything in the world leading to God, the separation they had effected removed God from any direct contact with the world. As a creator and legislator of the world, he prescribed rules for man's moral conduct. The basis for ethics thus no more lay in man's identity with the cosmos, but in man's intuition of God. Even though the rational approach (Greek) also identified man and the cosmos through intuition, it did not acquaint him with the personal God, as did religion. Thus, the rational approach was without any directives (from a personal God), for moral conduct.

Beginning in the Fideistic period, the rational approach (during the Mediaeval Period) slowly gained ground till it attained equal status with faith, in the Thomist synthesis. Following this, it slowly increased in stature, till it ws emancipated from theology during the late Mediaeval period. With the increasing rational approach, Nature began to be investigated on the grounds of observation and experiment (Roger Bacon). This led to the later development of the scientific approach in the Renaissance Period.

CHAPTER 3

THE REVIVAL OF SCIENTIFIC ENQUIRY

3.1 Introduction

Scientific thought during the (theocentric system of the) Mediaeval Period was direct to "proving" the existence of God so that the Relevation could be accepted as the source of the true knowledge. The mediaevals realized that reason could not be ignored as a source of knowledge and therefore, pressed it into the service of theology. Towards the close of the Mediaeval Period, however, reason became important as a source of knowledge and later, together with observation and experiment (John of Salisbury, Roger Bacon) formed the basis of the scientific method (in contrast to intuition). Whereas the contrast between faith and reason had characterised the Mediaeval Period, the era following it was characterised by the tension between the rationalists and the empiricists. This approach is closely related to changes in the historical and social development of the period.

The voyages of discovery, coupled with the emergence and development of a strong middle class who depended on trade, the growing acceptance of the Copernican heliocentric theory and the developments in biological studies (already begun in the Mediaeval Period) evident in the work already begun by Galen (in the Second Century) and continued by Vesalius (De Corporis Humani Fabrica) who disproved the myth of the rib of Genesis all contributed to the revival in secular interests and the development of scientific enquiry (empirical).

These developments were important for the relationships between theology and philosophy, theology and science and philosophy and science. The "use" of reason to establish the existence of God (during the Mediaeval Period) showed that a scientific investigation could also establish an order of truth independent of theology. Thus although philosophy was at first subservient to theology, it eventually attained independence since it was felt that philosophy could also attain the truth. In this investigation, philosophy and science were identical in reason. However, science came into its own when observation and experiment were used in the investigation of natural phenomena which began to be expressed in terms of natural laws.

3.2 The emergence of scientific autonomy

With the emancipation of philosophy from theology the understanding of nature assumed a different form. This was significant as it permitted the freedom of the intellect which could apply itself to an understanding of nature unhampered by dogmatic authority. This allowed the development of scientific thought and its final breakaway from philosophy.

Although it might not have been evident in the Sixteenth

Century, Galileo's view of scientific autonomy on the grounds that the expertise required being different from that of theology would result in the complete separation of science and morality (ethics). Science was directed towards an investigation of nature on the grounds of systematised experience. It was left to theology to develop those concepts that would guide the conduct of society. The development of scientific knowledge, however, increasingly challenged the authority of this guidance. Although Galileo had felt that the truths of science and theology could not be in conflict, science itself has negated this view. Developments in science have continually challenged theological explanations of the Universe so that theology has had to modify its views and science to evaluate its position in society.

In the Sixteenth Century, therefore, as a result of the transformation in scientific thought, philosophical thought moved away from Aristotle. His "Physics" was considered as "qualitative, not mathematical; it was teleological and functional, not exclusively mathematical" (Randall, J.H. (Jnr); in Durbin, P.R. 1968. p. 24). Thus, even though Aristotle's "Physics" had been preserved in the Thirteenth Century, though subserviant to Theology, it was unacceptable to Sixteenth Century philosophers. They regarded Pythagorean and Platonist mathematical physics and astronomy, a combination of "atomism and mathematics", as "real science".

By the close of the Sixteenth Century, that trend was evident that led to the later attempts to understand the Universe and nature in terms of "atomism and mathematics". Nature was thus expressed in mathematical terms. The investigation of nature (through experience) had passed from the holistic systems of the Greeks, through the theocentric systems of the Mediaeval Period, to the investigation and understanding of processes in nature, towards the end of the Sixteenth Century.

Galileo had contributed much towards such an understanding of nature. This was due mainly to his use of the telescope to view the depths of space. Both Copernicus and Kepler thought that the solar system filled the whole of space. Bruno had thought that the "firmament" was infinite and that fixed stars were different solar systems. Although this view of his was partially incorrect, yet the idea of infinity and different solar systems, showed the belief in the vastness of the Universe and that it consists of more than one solar system. Galileo's observations contributed to enrich the Copernican theory. This was made possible by the help of "technology" - the telescope. Even from this early stage in the development of science it is evident that science and technology are complementary. And it is this complementarity that is the life of increasing scientific knowledge.

It is interesting to note, however, that this increase in knowledge which should enrich existing theories was viewed with mistrust by the Church (for its authority is challenged), and more surprisingly by scientists also. The old school of scientists felt that Galileo's discoveries endangered their tenets which were grounded in Aristotle. In a letter to Kepler Galileo says, "But what will you say to the noted philosophers of our University, who, despite repeated invitations, still refuse to take a look either at the moon or the telescope and so close their eyes to the light of truth? This type of people regard philosophy as a book like Aeneid or Odyssey and believe that truth will be discovered, as they themselves assert, through the comparison of texts rather than through the study of the world of nature." (in Reichenbach, H. 1970, p.23-24). Galileo was also the first person to investigate the law of falling bodies which formed the basis for the science of mechanics, together with his conception of the Universe.

Speculative philosophers, therefore, although not making discoveries, contributed much to the direction of enquiry and methods of research which resulted in nature being explained by the formulation of general principles. Lord

Bacon, for example, advocated the collection, examination and comparison of groups of facts in order to extract general principles in an effort to explain natural phenomena. The particular facts, objects or phenomena of the world; the facts or objects that could be perceived by the senses, were therefore the basis for understanding the Universe. This meant that the world of objects could be considered as being real, in the sense that they could be perceived by the senses. Often, what could not be directly perceived by the senses was considered as being non-existent. Galileo's simple telescope, however, showed that the senses had their limitations (showing human limits) and that aids to them were often necessary. It was through these aids that man could supplement his senses and so enrich his understanding of the Universe, despite his limitations. In the recognition of these limitations lies the springboard for technology and also the basis for the realization of his ignorance. But so engrossed was Sixteenth Century science with its discoveries and inventions that it did not realize that although it had enhanced the understanding (of the Universe), it did not mean that science could explain all aspects of the Universe or that its discoveries were "Truth".

However, Galileo's work, built on the Copernican system showed that mechanical laws governed even the remotest reaches of the Universe. Harvey's discovery of the circulation of the blood, combined with its functions, produced a mechanical picture of the human being. This implied that those same laws that presided over the mechanisms of the Universe also governed the human frame. Thus was man brought, through the development of scientific thought, into the system of the Universe. No scientist had seen this but Rene Descartes who, on the basis of Galileo's theory, had combined observation with theory and saw this as a logical consequence of the theory. This was a result of Descartes' own philosophy of the body as substance (by "accident") and of the mind as "pure substance" (Descartes, R. 1969). From his Meditations he also derived the idea of God who was responsible for the workings of the body. From his ideas of God, mind and matter, Descartes thus saw the body as matter and like all matter (in the Universe) as governable by those laws that governed the mechanisms of the Universe. Descartes greatly influenced Spinoza who reduced the Cartesian analysis of God, mind and matter into a single phenomenon, God, whose attributes were matter and spirit, thought and extension. The Universe was therefore, manifestations of these attributes.

3.3 Development of the anthropocentric world view

Consequently, developments in the natural sciences, especially physics, and to some extent biology resulted in the rise of the anthropocentric world-view in contrast to the theocentric world-view of the Mediaeval Period and the beginning of the Renaissance. This world-view was reinforced to a great extent by the expression of the "natural laws" in mathematics. The mathematical form made these "laws" easier to understand and later, also to use. It also made it easier to interrelate "laws", showing that "natural laws" function in relation to each other. This showed how the different mechanisms operative in the Universe were separate mechanisms and yet interrelated so that the entire universe could function as a cohesive whole. Mathematics also gave what might be termed an "objective view" of the Universe. The world therefore became an object separated from man and subject to his investigation. Just as Christianity and Islam had objectified God, so now, did anthropocentricism objectify the world. The consequences of this objectification of the world are felt even in contemporary times. Completely changed was man's relationship to the cosmos.

And in a world where man felt that he was able to extract and to express in a form clear to him the "laws" of nature, God became irrelevant to his understanding of the Universe. Where God was once the basis for understanding, or knowledge of God, was the basis of man's moral conduct, now there was nothing but mathematical formulae. These expressed processes or mechanisms in Nature.

3.4 The Classical mechanistic view of nature

The advent of the Counterreformation changed the character of philosophy during the Seventeenth Century. Renaissance discoveries and inventions had led to the collapse of Mediaeval theocentric systems and the rise of Anthropocentricism. Man's interest in especially himself, and the world around him assumed increased dimensions, resulting in "Renaissance animism" (Brehier, 1968).

The Counterreformation checked the "exuberant spontaneity that men like Bruno saw in nature" (Copleston, T. 1963, p.9). Authority and Reason thus became the grounds for the individual's belief in order and unity - with resultant waning of the "individualistic ardour" of the Renaissance. The "vital spontaneity" of nature was therefore lost in Galileo's theory of Universal mechanism. A large number of "laws" concerning functional relatins were drawn together by his synthetic method under a few formulae. Physics and mathematics preogressed together with the consequent rise of the problem of the relationship between nature which the mind interprets mathematically and the mind, or the author of mathematics. For Galileo, therefore, it was only the measurable that could be considered in any investigation into reality. Universal mechanics, being of a technical nature, was not grounded in the nature of mind. Galileo felt that observation (sense perception) and experiment were basic in the aquisition of knowledge. No amount of argument could produce knowledge with the certainty of one experiment or one conclusive demonstration. Logic was serviceable only in ordering and ascertaining the validity of thought processes; it was, by its nature of operation inadequate for investigations of nature where "new truths" were being discovered. He distinguished between sensous and absolute qualities; the former being subjective, the latter, mathematical, and of consequence, objective. This distinction between primary and secondary qualities was to influence later philosophers like Hobbes and Locke.

It is probably from such views of Galileo that subsequent concepts concerning the objectivity of nature and the absolute validity of experiment and their expression in mathematical form, take root. Also from Galileo arises the view that only the measurable is consequent in scientific theory. The immeasurable was inconsequent. As its failure of being expressed in mathematics showed it was no more than subjective sense perceptions which were secondary qualities and therefore could have no part in the permanence of truth. Mathematical form, it was felt, had a permanence and therefore, was constitutive of reality, or of truth.

In his insistence on observation as a ground for knowledge, Galileo did not see that he was to an extent being contradictory. His support of Copernicus in "The Dialogues Concerning the two principal systems of the world" did not take into account that the supremacy of the Copernican over the Ptolemaic world-view lay in the fact that Copernicus broke away from traditional systems of thought, in that his theory was contradictory to immediate sense-perception. This alone was proof that sense-perception or observations alone could not provide knowledge of nature. Knowledge was a function of both sense-perception and the constitutive faculty of the mind. The constitutive faculty of the mind itself was, however, also dependent on sense-perceptions. Experience was enriched by sense-perceptions so that understanding was operative above the level of sense-perceptions and the mind's constitutive faculty. The understanding, of consequence, penetrates beyond the physical world.

Although the rise of anthropocentricism emphasized the individual's importance, the world-view of the Mediaeval Period, that nature is primarily the creation of God still influenced to some extent the scientific view of the world of the late Sixteenth and early Seventeenth Centuries. Kepler (1571-1630) wrote in the **Mysterium Cosmographicum** (refer Heisenberg, W. 1958) that God based the world on law and order. He endowed man with senses and a mind so that he might realize from his observations of nature the "causes of their being and becoming" (Heisenberg, W. 1958, p.72). He felt that nature had been created (out of the void) for man out of God's love for him, ("The purpose of the world and of all creation is man", Heisenberg, W. 1958, p.72). Nature was created for man's mind to investigate so that through a scientific understanding of nature man might contemplate the perfection of creation and so place himself in a meaningful relation with God. Man could thus accept his place in nature and his relation to the Creator. Kepler thus finds a purpose for scientific knowledge. This knowledge, however, was only an "accidental discovery of relations" and could not afford an understanding of nature, which could only be gained through intuition. Experience thus afforded knowledge of the "works of God" and intuition, the "mathematical and intelligible laws, the "thoughts of God", (Heisenberg, W. 1958, p.84) or the relationship between qualities and geometric forms.

Properties of bodies could therefore, be confirmed by experiments: but these were confirmatory only of agreements between definitions and phenomena or "basic relationships between hypotheses and experiments. The mind evolves assumptions for the observations of nature, which must be valid mathematically and logically. However, this validity itself is no proof of the real existence in nature of the reality implied by the assumptions. Only when the latter are used as empirical hypotheses and are proven by experiment, do they assume the character of natural laws" (Heisenberg, W. 1958 p.86).

Consequently, observations of nature are not of nature alone, but are guided by certain "definite rules of thought" or of mathematical formulations. Thus, experiments were only means of determining what agreement there was between theoretical concepts and observation.

Kepler's empirical approach, therefore, is consonant with the scientific spirit of the age: he attains knowledge of the world and of God from experience and mathematics (by which world-order can be expressed). Thus, although the natural sciences (through experience) provide knowledge of the material aspects of the universe they also constitute the basis on which peace might be attained through contemplation of natural order showing the eternal truth of creation. In this way could man place himself in meaningful relation with God and understand his place in the Universe. Kepler's science thus provides the knowledge for man's moral relationships, with God and the rest of nature. In Kepler's science the influence of theology is still evident and is the reason for the distinction between science and theology. He however, relates science to theology and in this relation lies the basis and reason for man's moral conduct.

Galileo's views on science, however, differed from those of Kepler. He gave to science a historical perspective, investigating phenomena from the viewpoint of artificial hypotheses. Thus the answers to investigations of nature were limited in that they were conditioned by hypotheses. Like Leonardo da Vinci, the scientific method of Galileo proposed that observation and consequent hypotheses, guided by experiments and the results expressed in mathematical form, was the basis for man's understanding of the reality of nature.

The ethical aspects of Galileo's views (on knowledge of the Universe) arise from the fact that he regarded God as "a mathematical mind" (Rauche, G.A. 1987. Personal communication). An understanding of the laws of the Universe led not only to understanding of God, but also to man's relationship with the Universe since he also was subjected to these laws.

It was Isaac Newton, however, who combined the discoveries of Copernicus, Kepler and Galileo into a single astronomical system. He realized that the force of attraction (gravitation) perceived by Galileo was applicable to "all mass" and determined planetary motion and behaviour across cosmic distances. With this as a basis he was able to compute and predict other related phenomena. He was thus able to incorporate into a single uniform system the fundamental facts discovered in preceeding centuries: the Copernican heliocentric motion of the planets, Kepler's laws about the orbits of the planets resting on the Galilean laws concerning falling bodies in a gravitational field. Newton thus gave a formal proof of Kepler's dream: "the harmony of cosmic motions". He established the Copernican conception of the world; where definite "laws" formed the basis of and governed a cosmic order.

Newton therefore, systematized the empirical approach of Galileo. He felt that discoveries originating in observations of Nature showed that hypotheses were no longer arbitrary creations but formulated on close observations of Nature. From these, single relations were isolated and generalized in mathematical form. by application of the method of inductive generalization hypotheses were drawn, based on observations and experiments. Experimental physics thus had both analytical and synthetical roles: a few phenomena are analysed in order to derive the laws governing them. These are synthesised and used as an explanatory basis for other phenomena. This can be seen in Newton's combination or synthesis of the theories of Copernicus, Kepler and Galileo into a single system (to provide a coherent picture of motion and gravitation). In this way Newton laid the foundation for part of the theory of relativity. The other sources for the theory were provided by the phenomena of electricity and light. Thus long before the theory of relativity was even thought about, it foundations had been laid. The theory of relativity, therefore, had its roots in the rigid and "predictable" system of Newtonian mechanics; a system that was considered far from relative. Electrical and optical phenomena thus forced physics to go beyond the views of Copernicus, Galileo and Newton.

Even from the development of scientific theory from Copernicus, to Galileo and Newton it is evident that progress is usually achieved through conflict between the thoughts (or systems) between two successive generations. Usually a "matter of fact" of one age is derived from a revolution in thinking of a previous age. According to Reichenbach (1970, p.30) "A school knowledge acquired under the influence of one's environment (and) is believed and proclaimed with the certainty of everyday experience. Thus possible criticism to which even the greatest theories should be continuously submitted, is forgotten; thus we lose sight of the limitations holding for the deepest insights; and thus man forgets in his absorbing concern with the particulars to re-examine the foundations of the whole structure of knowledge".

Mechanics had been (after Newton) accepted as the ultimate foundation of knowledge. Thus the attempt was made to comprehend light on the basis of ideas derived from astronomy and mechanics. But mechanics could not provide a suitable explanation for optical (light) and electrical phenomena. On the contrary these phenomena could be used to explain mechanics.

Olaf Roemer's determination of the velocity of light in 1676 introduced a new physical concept. Up until that time no one had thought that light requires time to propogate. This is not perceived by immediate experience - because of the velocity of light. Roemer's discovery was obtained not from direct measurements of the velocity of light but from studies in astronomy. Already at this relatively early stage in science is evident the need for interdisciplinary dependence. Based on his mechanics, Newton explained light as the emission of particles so tiny that they could pass through gases. This physical interpretation of light held the world for a century.

The influence of Renaissance science thus had far-reaching consequences in determining the direction of philosophical thought in the Seventeenth Century. The studies of Galileo and those of Newton, showed that although God was regarded as having created the world, reference to him was not integral to the study of nature. The Renaissance scientist considered Nature as a "divine original", and was interested in expression of the structure of the world and of its dynamic nature by mathematical statement. In this way, it was possible to express the functional relationships between natural phenomena.

The original question asked by the Greek philosophers: "What is the essence of a thing?" now change to: "How does the thing function or behave?" or the nature of its relation to other things. The shift of emphasis from "essence" to "functional relationships" resulted in a complete change in subsequent scientific thought. The Greeks had sought to establish or attain essential knowledge of the Universe to that men might have some basis for an authentic relationship with the Universe and with one another. In the Middle Ages the Bible had provided this knowledge. With the development of science, the authority of the Bible was subjected to question. This resulted in the Bible slowly losing its authority to the reason of scientific thought.

The development of the physical science with consequent emphasis on the inductive and the empirical study of nature resulted in contrasting views between "theologically-minded metaphysicians" and philosophical scientists: the former laid emphasis on "final causality" and the latter on "efficient causality" as revealed in mathematically determinable motion" (Copleston, F. 1963, p.20) The latter mechanistic view of the world resulted in an intensifying of empirical studies in natural phenomena. The mechanistic approach of the scientist raised questions as to whether man should fall wholly within the mechanistic system, resulting in the emergence of contrasting views. Extension of the scientffic conception of the world to include man only in this material universe would result in a loss of human freedom as mental processes viewed against a mechanistic background would be interpreted in terms of mechanical laws. Man would thus be denied his spiritual aspect with which he transcends mechanical causality.

The implications of such a view are that man loses his "freedom" and with it, his "Will". If man's mental processes are interpreted as mechanical laws then he has no reason and consequently no choice. Man would thus become an amoral being for choice is the basis of ethics. With the loss of responsibility, ethics and society can have no meaning.

With the mechanical and mathematical approach there is also a change in the nature of causality. Since it bears no more relation to Aristotle's original question, it assumes a functional character. The teleological aspect of causality is now expressed by mathematically-expressed functional relationships of observation, description and accurate measurements. Mathematics becomes all-important in such an operational approach: for, if the relationships of natural phenomena could be expressed mathematically, they could be used to advantage, in the service of man.

However, the belief that the structure of the world can be expressed in mathematical terms - as Galileo supposes - is consequent on the presupposition that all elements or entities in the Universe are real and in harmony - a view originating in the doctrines (monistic) of the Ionian thinkers. But unlike their investigations which were directed at the essence of matter, mathematical investigations could only express the relationships between the diversity of natural phenomena - which it expresses as "laws" which relate to "How?" and not "What?". Since mathematics expresses natural phenomena as "Laws" it presupposes that there is a basic unity in the experienced diversity of nature. Thus the scientific investigation of the physical universe and its expression in mathematical form is dependent on a metaphysical concept: that of the Unity of Nature.

Galileo, however, felt that absolute mathematical qualities (figure, rest, magnitude, motion) or **primary** qualities constituted the basis of reality. A consequence of this view was the development of a mathematical physics and eventually a "mechanical physics". According to Weisheipl, "The essential feature of this mechanical philosophy was the rejection of phusis or nature, as an explanatory principle in physical science. With this rejection also went potency and act, substance, formal and final causality, and even the ontological reality of true causality. In their place, the Seventeenth Century philosophers substituted qualtified matter (corpuscular, atomic or continuous), mechanical agencies (impulse, attractants, repellents, adhesive forces and various energies and local motion." (Weisheipl, J.A. in Durbin, P.R. 1968, p.41). This gave to physics its mathematical basis and constituted the "new science" discovered by Galileo and developed by Newton.

Although Galileo regarded the "Book of Nature" as being written in mathematical language he had no illusions that such a method could reveal the essence of reality. Like Zabarella, "following the Greeks" he regarded logic "not as a science but purely as an instrument" (Randall, J.H. in Durbin, P.R. 1968, p.46). Logic and mathematics were only useful in so far as they could systematize observational facts and determine their validity. Zabarella, and with him the whole new science, insisted that experience must be at first carefully analyzed to discover the principle or cause of the observed effects, from which facts could be deducted. Only in this way (by application of analytical and synthetical methods) could new truths be discovered. This application of these methods necessitated the application of empirical techniques to experience. Experiments, however, are set under artificial or assumed conditions and are arranged by man. The truths of these experiments are valid only in so far as the limitations of both the experimental conditions and the experimenter are realized.

Galileo's analysis of the concept of causality is significant in that it leads to a realization that resorting to God as a creator or director explains nothing. It serves only to evade the question that has through the ages guided philosophical thought towards a rational understanding of the Universe. Galileo, therefore, on the realization that his method could not provide any conclusive answer to the question asked by Aristotle, resorted to a mechanical explanation of the Universe on the basis of mathematics, by which he also explained the mechanical law of motion or the "theory of dynamics", in contrast to the "static views" of motion of the Greeks.

In Newton's mechanical view of the Universe, all bodies, be they planets, terrestrial bodies or atoms, are subject to the causal laws of mechanics operative in space and time. Since these concepts are metrical, nature could be expressed in terms of mathematics. Such as expression of nature is grounded in the assumption of the Universe being in space and time. This constitutes the metaphysical aspect of Newton's mechanical causality: space becomes the basis of the extension of bodies and time that of motion.

Newton had considered space and time as "absolute (regarded as God's sense organs)". For Kant, however, space and time are synthetical apriori, being necessary for perception or the experience of the Universe. His concern was not with whether knowledge was possible, but with **how** it was possible. For Seventeenth and Eighteenth Century science, based on perception or experience, knowledge was inferential and the reality of the world was considered as being composed of "imperceptible particles or corpuscles", (Brittain, G.G. (Jr.) 1978, p.8) possessing spatial properties only. Colour, taste, etc., were considered as sense-subjective and therefore, not constitutive of reality. Consequently, there was a "gap between the world as it presents itself to our senses and untutored intelligence, and the world as it actually is, in the light of scientific investigation. If physics is taken to describe the world as it actually is, then it would appear, possibly with some additional assumptions, that its epistemological security can be guaranteed only if this gap is bridged or closed" (Brittain, G.G. (Jr)

1978, p.8). According to Kant such an epistemological gap did not exist; being not concerned with the justification of physics but with the establishment of its "objectivity". Kant's viewing of space and time as the necessary presuppositions for perception (synthetical apriori) makes objective observation possible. Natural phenomena thus become meaningful.

Newton, however, did not view space and time in the same way as Kant. His viewing them as mathematical entities made even God mathematical in character. As far as he was concerned, he framed "no hypotheses". The term "hypothesis", he felt, should be applied to whatever is not deductible by phenomena. Experimental philosophy could not accommodate anything not deductible from phenomena be they occult or mechanical, physical or metaphysical.

He therefore considered physics as concerned with "solid objects composed of atoms". This also implied the principles of "cause and effect", mass and energy conservation and static relations between space and time. Thus fixed mechanical laws governed the Universe, which were the basis of its predictability. Everything in the Universe was now explained in terms of "established natural laws". This meant that the motion of planets and stars was predictable, light could be "explained in terms of mechanical waves of ether; Heat was regarded as a massless fluid called caloric. Elasticity and magnetism were deemed to possess fluidic properties and their motion could be explained by taking recourse to the dynamics of fluids" (Rauche, G.A. unpublished). This view greatly influenced Nineteenth Century physics. The view of the Greek atomists that matter is composed of atoms was supported by numerous viewpoints, involving both instrumentalist and realistic interpretations. Dalton (in Gardner, M.R. 1979) proposed his atomic theory (1803-1808) based on the assumptions that matter is composed of indivisible atoms, that all the atoms of a given element are identical and that the atoms of different elements are distinguished by their weights. This theory was supported by the laws of definite and of equivalent proportions and implied the law of multiple proportions. The kinetic theory of gases and the theory of Brownian movement all pointed to the acceptance of the atomic theory on a realistic interpretation.

3.5 The biological implications of "Universal Mechanism"

The diversity and the origin of life-forms had been the subject of much speculations from ancient times. Aristotle's studies showed in his system of classification, that there was a hierarchic order in the animal world. The mechanisms that produced these divergent forms could not be ascertained, however.

Christianity explained this quite easily by the theory of Creation. Among others, the anatomical works of Vesalius and Harvey questioned this theory and showed that it was unacceptable as given in the Bible. In the background of the emerging scientific theories, the mechanistic view of the world seemed to provide more acceptable answers. Galileo's mechanistic view of the world, expanded by Newton and based on "atomism and mathematics" was used to explain all natural phenomena. As atoms formed the "basic stuff" of the Universe, it was felt that all natural phenomena should be grounded in atomism and explained on a mechanical basis. It was generally felt that all higher types were eventually derived from "formless stuff".

Methodical studies in comparative anatomy showed that there was "something resembling" a basic plan or system in different groups of animals. The different groups also seemed to be related to one another by the occurrence of vestigeal structures, (such as appendix, etc.) in different groups of animals. This showed relationships between different groups of animals leading to the view of a common origin for all life-forms from a basic prototype. The great variety of species was explained in terms of mechanical processes: by the "lengthening of some parts and the suppression and development of others". Consequently, there was a "graduated approximation" between different classes of animals. Beginning with man, therefore, his lineage could be traced down to primitive mosses and lichens and finally to raw matter - and the atom. The properties of matter itself were therefore responsible for the production of the whole complexity and diversity of nature. Viewed against the background of the then current physical processes responsible in the production of crystals, were accepted as being operative in the production of the various life-forms. In this way an explanation was given of a continuous and connected relationship of all natural phenomena.

Thus was man brought within the compass of those laws that governed the Universe. They were responsible for his emergence, and his subjugation. Such a view of the world was the basis for his relationship to the rest of nature that shared the world with him.

The mechanistic view of the Universe, however, did not consider a **purpose**. It was concerned with an investigation of nature in order to understand the laws that governed it. However, the **principle of purposiveness** is embodied, even in the mechanistic view, although it was not seen.

An investigation into the embryological development of life forms as well as the phyletic order leading to man, reveal the idea of purpose. Even if phyletic change is viewed as mechanical adaptation to environment, the idea of purpose cannot be ignored; it leads from man to the atom. The introduction of the principle of purposiveness into mechanics reveals the metaphysical nature, even of mechanics - for it shows that mechanics is guided by forces outside itself. The telelogical concept of purposiveness as it emerges from studies in biology is of moral significance as it releases man from the determinism of Universal mechanism (as expressed in the works of Aristotle, the Mediaeval thinkers for they affirm man's will and responsibility, Kant, etc.). Purpose thus constitutes the basis of man's striving for knowledge of truth. Thus is his influence and relationship to nature and society, affirmed. This purposiveness also reveals itself in evolutionary theory (later) which constitutes the basis of his ethical and socio-political relationships. This concept is also important in an evaluation of genetic theory which would also impose a form of determinism, and an understanding of humans on the basis of a mechanistic theory. Purposiveness also introduces the ideas of will and responsibility without which ethical and social relationships would be meaningless.

3.6 The Renaissance World

The period preceding 1600 A.D. had witnessed a slow revival of science. After this period, however, science began to take bigger strides. In 1645 the Royal Society was formed to consider philosophical investigations into "Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chymicks, and Natural Experiments; with the state of these studies and their cultivation at home and abroad" (Clodd, E. 1897. p.91). Although the society was condemned by Dr. South (a famous Divine) as an "irreligous body" its scientists continued their experiments adding to the stock of knowledge. In all these studies theology was precluded.

Although the earth's shape, movements, and relations to other heavenly bodies had long been studied, the theory of Creation in Genesis had served to arrest investigations on the earth, and also of its contents. Imprisoned by the Bible it was the last part of the inorganic universe to be freed by the investigations of scientific research. Such was the fate of man also, in the organic universe, till science compelled his release.

During the Renaissance, therefore, the miasmatic currents of intolerence emanating from the dogmatic attitude of the Mediaeval Church had begun to dissipate in the wake of a greater perception of the depth of understanding of natural phenomena provided by advances in geology and biology. Thus the ignorance or wilful blindness which are the breath of "rigid opinion" were slowly dying. There was a growing conception of the inter-relation between life-forms. The idea of a Cosmos supported by the Copernican theory was slowly being accepted. The advances in knowledge, contributed to and justified the freedom of the intellect (which had hitherto been imprisoned by the Church) which widened the conception of an "unbroken order".

Yet, that "sanctity with which time invests old ideas" was not broken and the influence of the Church still prevailed - but altered was its character: the conception of a widening intellect that could understand the world not on the authority of scripture alone but in terms of scientific "laws" which itself was created from observations of nature, overthrew theocentricism and developed into a growing anthropocentricism. Consequently, the conception of man's inclusion in the universal order was yet foreign, even to the minds of deepest insight. The idea of duality could still not be dispelled: supernature still over-ruled nature. It was not thought of as being part of nature. Animism therefore, still retained its essential character and was considered to be at the root of both good and evil.

The Renaissance, therefore, can be seen as a period in which there was a change in Western European thought with the intensification of the secular spirit. The Mediaeval emphasis on theology (concern with the nature of God) changed to an emphasis on the condition of man. Mediaeval Christianity had taught the enmity of "flesh" and "spirit" and the frailty of the intellect, as rational processes unless guided by "Christian inpiration", were useless in the perception of divine truth. Secular pursuits during the Renaissance, however, fostered in man the view that the intellect was capable of discovering truth. That which it could not discover, either did not exist, or was not worth discovering. Humanism was born of this secular attitude focussing interest not on God, but on man in general and on the individual. Thus individualism was also a product of the secular spirit. The human form was therefore, placed on a pedestal to inspire artist, writer, sculptor and man in every walk of life. Mediaeval monasticism, in the baptism of the individual ego, had completely submerged it into the group. Mediaeval Christianity was thus "collectivist": artists and writers often did not sign their names on their work, which contributed to the glory of God. The Mediaeval educated man was a specialist - theologian, administrator or church artist.

The humanistic and individualistic aspect of the Renaissance manifested themselves in all aspects of human life, abandoning the Mediaeval Christian restraint.

Although of the late Mediaeval Period the Divine Comedy of Dante (1265-1321) depicts vivid scenes (refer "Inferno") uncharacteristic of the Mediaeval Period. Boccaccio (1313-1375) in his Decameron also abandons all Christian restraints showing open revolt against the Mediaeval ideals.

In both private and social aspects, the development of scientific attitudes led to the concept of the non-moral state. Machiavelli, in the Prince emphasized the uselessness of Christian morals in the government. He felt that since all men were self-seeking, rulers, to be effective should be amoral and ruthless. Even conspiracy and treachery were not thought of as being immoral. Although his work was directed against foreign pillage of a divided Italy it also reflected the thought of an anthropocentrical secular age: the idea of the end justifies the means.

The secular spirit of the Renaissance shone through in its art. Although the themes were predominantly religious like that of the Mediaeval period, the figures were human and alive the expression depicting thought and feeling, like that of the twelve apostles in Leonardo da Vinci's (1452-1519) The Last Supper. Before Signorelli (+-1450-1523) Hell and the "soul-weighing" by St Michael had been treated realistically and scenes showing fantastic and horrible figures dragging the damned to Hell were common. In his **Fall of the Damned** (in Bazin, G. 1964, p.248: Fresco in Orvieto Cathedral, 1499-1505) his realization of man's inhumanity and cruelty is shown in his depiction not of any fantastic devil but of man with decaying flesh, yet filled with that violent energy that only humans are capable of in the "torture of their fellows". Michaelangelo's (1457-1564) devils however, are shown as humans deformed by their vices. Thus, from pre-Signorelli to Michaelangelo can be seen the humanization of the devil himself.

The figures in most of Michaelangelo's work in the Cistine Chapel are unclothed showing the respect and admiration that Renaissance man had for the human form; its beauty and majesty mirror the Greek conception of man. Like Leonardo da Vinci and others the art of this period depicts the Renaissance conception of "universal man". Yet, although the Renaissance artist showed man in all his beauty and power and strength, he did not glorify him to perfection. This was because of the realization of man's weakness in comparison with the Almighty: "the heroes of the Cistine Chapel are heavy with a strength which they know will never avail them in their struggle with the infinite. Thus unbalance gives rise to a despair which torments their bodies and darkens their faces" (Bazin, G. 1964, p.272). Tintoretto's work also shows humanity's attempt to be at "grips with vastness".

Renaissance art is pregnant with the realization that man could not accept authority as his Mediaeval forebears had done. Yet he realized his position in relation to the vastness of infinity. Developments in scientific knowledge had brought this to him. Copernicus had shown that the earth was not the centre of the Unvierse as Mediaeval man had believed. No more than a speck it was, in the vastness of an infinite universe.

Thus man came to realize through developments in scientific theory, and expressed in art, the fact that he was infinitesimal in comparison. Occupying such a position in relation to the Universe, man learnt his place in the Cosmos. This realization was the basis for his moral conduct. If he occupied so small a place, then his importance to the Cosmos was of like stature. His knowledge of the Cosmos was so little that he knew practically nothing with any certainty. Unlike Mediaeval man for whom the answer to all questions lay in the Bible, Renaissance man knew that he understood very little of the Universe. To develop a meaningful relationship with the Universe man had to gain some knowledge of its ways. This he was certain could be done through a scientific investigation - showing a confidence in his own faculties to understand the Cosmos. He placed implicit trust in his observational faculties and his reason, convinced that these would dispel his ignorance. Scientific developments had forced man to see himself in a different light - a blending of the mechanical, the biological and the religious universe.

3.7 Crisis of the mechanistic conception of Nature

Towards the close of the Eighteenth Century nature was viewed against a mechanistic and materialist background, originating in the Universal mechanism of Galileo and expanding into Newtonian mechanics. Attempts were made to isolate and to explain all natural processes in terms of "laws", and the principles used were verified by the conclusions based on them. This was likened to the geometricians' proofs of their propositions based on "certain and indispulable axioms" (Heisenberg, W. 1958 p.121). Thus principles could be viewed as axioms. And since nature was expressed in mathematical language (Galileo) based on "indisputable axioms", it was felt that the principles on which investigations into nature were conducted, constituted a true reflection of nature or of the processes of nature. Julien Offray De La Mettrie in his paper "Man as a Machine" says that "the human body is a watch" (in Heisenberg, W. 1958 p.135-136), made by nature's exquisite skill and technique. These views, among others, emphasised the mechanistic view of nature. But these views lacked the modesty of men such as Galileo, who realized that his investigations were made within the framework of "man-made hypotheses".

Among others, men such as Heinrich Hertz (Principles of Mechanics: 1876; in Heisenberg, W. 1958, p.152) realized that science could not produce a "world-view of nature as a whole or about the essence of things". The propositions of physics were expressive only of limited domains of nature. Eddington also expresses this view when he says, "We have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature" (quoted in Heisenberg, W. 1958, p.153). Unlike early Nineteenth Century philosophers who felt that their expressions of physical knowledge were assertive of nature as a whole, scientists and philosophers later realized that their propositions about physical knowledge were valid only within limited frameworks.

Dalton's atomic theory had provided a view or a vision of a unified homogenous universe governed by the unchangeable laws of a mechanical view of motion. Science was confident that the riddles of the universe, even that of life, would soon be solved and explained on a physical basis. It was thought that the physical reduction of nature to the immutable laws of physics sould form the basis of knowledge of the Universe. Physics was, therefore, attempting to understand nature by its reduction to its constituent parts. Metaphysics, however, was attempting to construct a rational concept of the Universe from experience of its constituent parts, so that the Universe might be understood in terms of a universal concept which could explain these parts. It seemed that the atomic theory of the Greek atomists and that of Dalton would converge onto a common point, the atom, so that both its physical and its metaphysical aspects could be explained.

However, Gay-Lussac's (1811) equal numbers rule, Berzelius' attraction theory and the Dulong and Petit Law (1819) among others all asked questions which Dalton's atomic theory could not answer to satisfaction. This pointed to the conclusion that there was something wrong with the assumptions on which Dalton had constructed his atomic theory, and that on this basis the atomic theory could not be interpreted on a realistic level: the atoms were just not what they had been thought to be. Dalton's atomic theory was based on Greek atomism. With this as a basis, experiments were being devised to test the implications. But the investigations seemed inadequate to determine the nature of these elusive particles.

Consequently, they still had to be considered as metaphysical entities defying the methods that sought to materialize them as particles.

Newton's particulate theory of light could not explain numerous optical phenomena. The mathematician, Huygens explained light as wave phenomena. As this theory posed problems in explanation of simple optical phenomena it was used only in explaining difficult optical effects. Consequently, so long as Newton's theory could be used to explain optical phenomena it is upheld. Additional experiments supported the wave theory, even though the results of some experiments were contrary to observation or experience. Newton's theory, for example, could not explain the fact that:

light + light = dark.

This phenomenon could be explained by the wave theory. Young (1801) had shown in diffraction experiments, that light consisted not of a stream of particles as Newton had taught but of a series of alternating light and dark waves alternating with each other.

The idea of light propogation as wave motion pointed to the logical conclusion that the wave motion required a medium, ether, for its propogation. Experiments to determine the presence of such a medium were to no avail (Reichenbach, H. 1970). The results of these experiments could be accounted for on the assumption that there was no ether! Thus science was in a rather peculiar situation: logic dictated that the conclusion following from the fact of wave motion was the existence of a medium. Experience (from experiments) showed that there was no such medium - reason was thus opposed to experience.

The contradiction from these experiments showed that ideas claiming absolute validity and even supported by logical argument, may not withstand deeper investigation. Such investigations lead not to the basis for the logical conclusions for concepts but to their origin. Common ideas "comprising the knowledge of nature such as substance, matter, wave or motion, have not sprung out of pure speculation, but out of primary experiences of daily life. And nothing is more dangerous than to forget their origin and to ascribe to them a necessary and unconditional existence. Quite on the contrary, it is important to comprehend that they have grown out of crude observations of nature, that they are hardly more than superficial generalizations concerning the world and that it has never been demonstrated that these ideas are applicable to a finer understanding of nature" (Reichenbach, H. 1970, p.41).

Although these ideas might not provide a "finer" or final understanding, they nevertheless do provide a basis for concepts without which no discussions about nature could be conducted. And it is from these discussions that the diverse aspects about nature are revealed. Were it not for these concepts, discussions about nature, which are the basis for that knowledge that man needs for the daily conduct of his life, would not have been possible.

It is, of consequence, an understanding of these concepts (for example, that of material substance), of their origin, and more important, of their purpose and use, that is the basis of knowledge. The understanding of one concept is related to that of another. Knowledge emerges from a realization of this relationship. This is adequately illustrated when the propogation of light is considered.

"Material substance" is inapplicable to the propagation of light. This has been shown experimentally: light does not behave as though it needs a medium for propagation, whether in the inter-atomic or astronomical realm. Thus "macroscopic" ideas are inapplicable in "microscopic" dimensions. Progress made in electrical theory showed that optics did require new fundamental principles.

Faraday's experiments showed that power and energy were related, not only to electrical current but also to electrical and magnetic fields in the atmosphere or in space. Since they lack the property of impenetrability these fields cannot be considered as "substance", as the idea of "fields" would give to materiality a new meaning. Thus the concept "fields" had to be regarded as separate from substance.

Basing his work on Faraday's experiments Maxwell reduced optics to electrical phenomena. Combining theoretically these experiments with those of Young, he unified electrical and magnetic forces and showed that light consisted of waves of electromagnetic radiation varying in wavelength. Mathematical formulations of the principles of electricity led to the conclusion that electrical vibrations spread through space. Light, it was assumed, was identical to these vibrations differing only in the very high rate of vibration, as compared to electricity. Stark's and Zeeman's effects also showed that light was an electrical phenomenon. Heinrich Hertz using electrical apparatus produced electrical vibrations, which though of lower frequency than light, had related properties. These radio waves were also propogated independent of any material medium. "They are waves in which electricity continually alternates between "positive" and "negative". Yet they are not dependent on the ups and downs of small material particles but move quite independently through space (Reichenbach, H. 1970, p.45).

These waves became widely used in telegraphy and radio. Thus a discovery made purely in search of understanding natural phenomena was taken over by technology yielding enormous industrial benefit, never realized by the discoverer himself!

The world of classical mechanical physics was itself shaken by Max Planck's quantum theory and shattered by the splitting of the atom. With the collapse of the atomistic world structure and uniformity of cosmic processes which had served as the basis for the predictability of natural events disappeared, to be replaced by constantly changing events. This takes man back to the Greek world, but on a microscopic level, to ask again that question that the Greeks had asked over two millenia ago: "What is the essence of Matter?"

The classical mechanical view of relationships based on static cause and effect principles could no longer be found. Events could, therefore, no longer be predicted with certainty.

3.7.1. Contemporary physics

In the deterministic view of classical mechanical physics the world was in time and space and comparable to machine, "which, once set in motion continues to run governed by immutable laws" (Heisenberg, W. 1952, p.22). It was irrelevent to classical physics that this view was a product of the human mind. this resulted in a divided understanding of Nature, based on the understanding of "immutable laws". Science, convinced of the objectivity of its method and its consequent validity, felt that it was applicable to all of experience. Classical physics thus formed the centre of the scientific concept of the universe. This was considered a rational concept since it was based on the axioms of mathematics (which could be analysed on a rational basis). Such an analysis, however, cannot be supported rationally, as it affords understanding of only certain particular aspects of experience.

Through atomic events, nature has shown that the concepts of classical physics, although complete in themselves, are applicable neither to all aspects of nature nor to all aspects of experience. In this way atomic physics attempts to form a complete self-contained system which leaves classical physics untouched - in that classical physics despairs of success in the complete explanation of natural phenomena.

Unlike tthe classical investigator of nature, the atomic physicist has come to realize that the mathematical formulations which purport to express the behaviour of atoms, express only man's knowledge or man's interpretation of this behaviour. Perhaps, like the Ionian philosopher, men such as Bohr, see man not only as an observer, but also as a part of nature.

Contemporary physics, like Greek atomism, also conceives matter to be fundamentally particulate; the particles however, are sub-atomic and display definite patterns of behaviour. Therefore, modern physics also attempts to trace "all perceptible qualities of substances to dynamics of atoms" (Heisenberg, W. 1952, p.54). But when traced back to the fundamental particle, it is found that the qualities of substances are not found in the atom or in the elementary particle. The Greeks explained the qualities of substances by ascribing these to variable atomic arrangements in space.

Modern physics also attempts to explain the different qualities of physical events in relation to varied forms of genetic theory. To the Greeks geometrical configurations were the bassis of the qualitative variety of physical phenomena. Modern physics, according to Heisenberg (Heisenberg, W. 1952) presents the diversity of phenomena in the variety of mathematical forms. He ses the atom as being similar in form to the -1 of mathematics which does not exist among ordinary numbers, "yet the most important mathematical propositions only achieve their simplest form on the introduction of this square root as a new symbol. Its justification thus rests in the propositions themselves" (Heisenberg, W. 1952, p.56). Contemporary physics thus shows that, in the same way, atoms cannot be considered as material objects. "Atom" is used as a concept which makes it possible to formulate mathematically, the laws which form the basis of physical and chemical processes. Heisenberg, thus sees the "atom" as a metaphysical "entity" which forms a basis for a unified picture of nature and also for the "purposeful and directive" forces of mathematica formulations. Thus, it is not geometric forms which are permanent, but the laws governing movement. The new venture is thus characterised by much more modesty than classical physics in realization of its limitations. Consequently, it leaves open the question of the ultimate essence of "matter" or "energy".

3.7.2. Atomic Physics

Dalton's atomic theory held the classical view of the atom. Based on the deterministic view of classical mechanical physics, processes were considered as being continuous and predictable. This view was permanently changed, however, with the new atomic physics.

In 1897 Thompson discovered the electron. Planck, in 1900, showed that light or electromagnetic radiation from these electrons was emitted or absorbed not in continuous stream but in discrete amounts (quanta). The "Photoelectric effect" showed that "photons" and "particle effect" could be understood if "light were made up of quanta having energy specified according to Plancks prescription" (Polkinghorne, J.C. 1981, p.5).

Diffraction experiments of Young (1801) had shown that light consisted not of a stream of particles as Newton had taught but of a series of alternating light and dark waves interacting with each other. Maxwell had interpreted this experiment theoretically. He unified the electric magnetic forces and showed that light consisted of waves of electromagnetic radiation varying in wavelength.

Consequently, the only certainty that could be known in physics was this wave-nature of light. Thus, there was a wave-particle duality. Louis de Broglie (1924) found that electrons which had been thought of as particles, also displayed interference patterns. Thus description of nature required a new rational framework. Such a framework was provided by Dirac in 1928 when he combined the wave and particle theories, without a paradox, in the quantum field theory. A combination of quantum mechanics and relativity theory thus provided a framework for explanation of much of atomic behaviour. Thus, the understanding of changes in the current analysis of matter required a new microphysical model for the age-old atomistic tradition could not accomodate the emerging conceptual revolution.

The "atom" of Lord Rutherford was split in 1939 by Otoo Hahn and Strassman releasing its immense store of energy and also numerous subatomic particles which could themselves be split or changed. Thus the neutron (Chadwick, 1932), the neutrino and numerous other subatomic particles wer discovered, some being neutral and having zero mass (neutrino). Einstein explained the existence of the neutrino by the relativity theory. The similar behviour displayed by photons and neutrons led to their being considered as two modes of a single object, the nucleon or a multiplet (a collection of particles having common properties and behaving identically for some of the interactions in nature).

This concept introduces again the idea of an underlying substance whose change is dependent on the type of force to which it is subjected. The photon which has been viewed as the basis for electromagnetic force can also exist as a "particle" (it displays "particle effect"). It would seem, therefore, that the photon is a concept in which these different effects can be unified and utilized meaningfully. Consequently, the idea of force which is responsible for both the stability and the disintegration (radiation) of the particles of the microworld can be viewed as a cause, or as an efficient cause, and as much be placed on a metaphysical basis: and with it its mediators, the neutrino and the photon.

3.7.3 Atomism in crisis!

The entire history of particle physics has been characterised by the development and adherence to view that substance is made up of atoms and that the basic constituents of these atoms are "elementary particles" (Weinberg, S. 1974). However, the absence of clear criteria for definition of the "elementary particle" leads to problems, (Schrader-Frechette, 1977) as it has been found that particles which have been defined as "elementary" are really unstable (Cline, D.B.,Mann, A.K. and Rubbia, C. 1976). This again leads to the question: "What is the fundamental particle?" "If 'fundamental particle' is a species name for entities sharing common characters, then it is unclear why some entities are particles and others not, and why allegedly elementary particles share no common characteristics, except that all particles of each type are said to be qualitatively identical." (Schrader-Frechette, 1977, p.415). The language of quantum mechanics, however, is one of interaction and processes and not of attributes and properties (Jammer, M. 1966). Consequently, it is the "theoretical primacy" of relations that is important for high energy physics.

Observability, is also a problem in high energy physics. Information concerning the "particles" is obtained from scattering experiments and particle decays. Methods for detection of these processes are inadequate with the result that the properties of these "short-lived" particles are often left to conjecture. It seems therefore, that unobserved virtual elementary particles are postulated in order to "balance the books" of conservation laws, to the point of applicability of the uncertainty relations, and constitute matter. These "particles" are therefore, used only to explain the properties of the proton-neutron system.

Studies on atomic structure are often done on excitation state separation, but "excited states" are not referred to as elementary particles. The idea of multiplets also questions whether particles are fundamental. Recently, Quarks have been postulated as being the fundamental particles of matter. But there have not been found to occur freely. Nambu (1976) feels that quarks are permanently confined within nucleous. As they have fractional changes, they cannot be detected by their charge, for particles in nature have unit charge or integral multiples of the unit charge. But even if quarks did exist independently, the nature of the charges holding them together is problematic (Heisenberg, kW. 1976).

Their permanent confinement (Nambu, Y. 1976) and problematic detection seem to point to quarks being no more than postulations. That this is so emerges from the fact that quarks are an indirect result of the Group Theory (SU3) of mathematics. Ne'eman had found that experimental work on elementary particles showed that groups of these particles bore relations similar to mathematical Group Theory. According to Segre "The abstract mathematical results of (SU3) may be obtained by postulating the existence of subunits, called "Quarks" by Gell-man" (Segre, 1976). Although the quark hypothesis is the basis for the explanation of a wide range of phenomena besides (SU3) "Free quarks have never been seen" (Segre, 1976).

That quarks are fundamental particles is also expressed by Glashow (1975): "In one group are the u (upward) and d (downward) quarks and the electron and electron neutrino. These four particles are the only ones needed to construct the world; they are sufficient to build all atoms and molecules and even to keep the sun and stars shining (Glashow, 1975, p.50). Consequently, there is no need for other particles!

Thus quarks, which seem to be the "building blocks" of the world have a basis only in the group theory of mathematics. The quark is a concept even used to support the Group kTheory. Its being a mathematical concept and used in physics as a "fundamental particle" reveals the direct relationship between "particles" and mathematical concepts: in physics it is regarded as a particle, in mathematics, as a concept. And as a concept, it constitutes the metaphysical basis of the ultimate fundamental particle of physics.

Marxists, however, do not see the dual nature of the electron and problematic and argue that it is the "idealistic" functional approach of Western thinkers that makes thee mathematical description an abstraction from concrete experience. The resultant is not an analysis of the nature of the atom. It is a piece-meal mechanical analysis and description of atomic events. They (the Marxists) see the electron as dynamic and self-propelling matter.

The method of "dialectical materialism" (for the Marxists) has been responsible for that evolution that has produced man's mind, the 'highest state of matter". It leads also to the ultimate identity of nature, man and society, thus resolving all logical contradiction. According to Rauche, (unpublished) when this principle of identity is fulfilled, man leads an authentic existence, i.e., one in agreement with nature. "Dialectical materialism" thus satisfies both the epistemiological and ontological needs of the Marxist.

Consequently, on the basis of their (the Marxists') "understanding" of the dual nature of the electron, the Marxists draw the conclusion that there is an objective dialectical law in nature. But it is also probable that their construction of this "objective law" is a product of their reactions to the historical conditions in which they found themselves during the industrial revolution of the Nineteenth Century. Consequently, the objective, self-propelling matter of the dialectical materialists, is a speculative metaphysical concept and reveals the metaphysical nature of their physics.

In contrast to the supposed objective nature of the Marxist dialectical natural laws, modern physics has a subjective aspect. This is evident in the use of the man-made experimental apparatus used in the aquisition of scientific knowledge. It is also seen in the use of mathematical equations to reflect the relationships of the atomic events which thus become an abstraction from experience, fusing subject and object.

Experimental apparatus can only measure what is measurable and what it has been designed to measure. This rests on the assumption that there is nothing beyond or besides the measurable, and it is felt that whatever can be measured constitutes the whole of the "object". But, inherent in the apparatus are the limitations of man's ability. Therefore, there are aspects of an object that are unmeasurable experimentally. The expression of nature in mathematical terms, constitutes only what his apparatus allows man to express mathematically.

3.8 Discussion

The discovery of quantum physics and the splitting of the atom changed the world view bequeathed us by Newton. Thus at the contemporary frontier of science the What? - question has again come to force in the Uncertainty Principle (Heisenberg, kW. 1963). Just as the imperfect world of objects had reflected for Plato, the rational world of the Forms, so the world of nuclear or sub-atomic physics, is, for Heisenberg, a reflection of the form in mathematical symmetry. For Plato the love for knowledge, has through physics broken down the cosmos beyond its most elementary particle, to find there the form of symmetry in mathematical equations. The form of the mathematical equation is now seen as the basis for a new cause and effect relation that could rise to restore the basic homogeniety of the world. The basis of the world once more is the form (of mathematics), reminiscent of the Form of Plato, establishing yet again the metaphysical in physics. The mathematical form, however, lacks the ontological significance of the Form of Plato.

The mathematical form is the reflection of the world as constructed in man's mind. It is found to be deficient in explanation of those experiences of the Universe that cannot be expressed in mathematical equations. From these mathematical equations, Heisenberg finds the basis for a "new stability", which consequently rises out of the limitations of the scientific enterprise. Through these limitations, the metaphysical in physics provides a basis for the moral dimension of scientific theory. It also introduces the idea of evolution into physics, which continues into biology. But even here the metaphysical element cannot be denied its prominence and is needed to cross the physics - biology border. Biology, therefore, unlike chemistry, is not "physics writ large".

Physics, therefore, cnanot yet discard its metaphysical basis if it is to survive the **What?** - question. Man realizes his limitations through the metaphysical in physics, which constitute the basis for new relationships between man and his environment. Heisenberg expresses this relationship in an address delivered to the students of Gottingen University on the Thirteenth of July, 1946, entitled **Science and International understanding**: "Take from your scientific work as serious and incorruptible method of thought and help to spread it, because no understanding is possible without it; and revere those things beyond physics that really matter" (Heisenberg, W. 1952, p.120). A similar view is expressed by Tobias (1971) when he talks about the evolution of the mind with its "intellect" and "compassion". That which really matters, therefore, is the metaphysical element in physics which brought man out of the atomic particle. Endowed with its energy he realizes that the basis of his moral conduct comes from the physical world of which he is a part, and to which he is subject.

Atomic physics thus shows that reductionism cannot produce a true picture of reality., for anything whole is more than just the sum of its constituent parts. This is amply illustrated in biology where attempts are made to reduce and to express biological characteristics in terms of genes (biological atom- Rauche, G.A. unpublished). Just as studies in atomic physics ended in uncertainty relations, so it has been with the gene where studies in behaviour, anatomy and embryology have failed to demonstrate gene-structure/behaviour correspondence.

Under such circumstances the gene, like the atom, becomes a model on which certain features of biology and life in general, might be understood. Thus biological theory, like any other scientific theory, becomes a model through which phenomena might be understood and must not be seen to have direct correspondence with reality. The uncertainty principle (of Heisenberg)applicable to atomic physics can thus be applied to the " biological atom ".

Thus even though the status of knowledge becomes problematic, the social and ethical aspects of science become more apparent. And influenced by the humanistic attitudes arising from anthropocentricism scientific theory was interpreted in different ways under the prevailing histotical conditions.

3.8.1 Social aspects of scientific theory

The Baconian ideal of science as a gradual accumulation of knowledge through a co-operative venture consistutes a basis for the moral conduct of scientisits: co-operation being fundamental to the development and accumulation of knowledge. For Bacon, however, this knowledge was for the benefit of society. According to Kuhn (Kuhn, T.S. 1962) the search for absolute truth is beyond the scope of scientific investigation which was guided by a community of scientists sharing a common paradigm. Many scientists also feel that science should be directed only towards the solution of social problems. Science should therefore be planned to supply man with whatever "commodities" he needed. Such a view is linked to the problem of defining what is good for man, bringing in personal, economic and political view-points.

In such a climate science becomes utilitarian and investment in scientific projects is dependent on the priority of social and political requirements - often from a national point of view. This increases the investment of science to the solution of technological problems. Science thus becomes "mission-orientated". Consequently, the satisfaction of human needs, social, political and economic become important in the direction of scientific development. The practice of contemporary science is thus made possible through financial support from government and industrial complexes which support only certain types of research. These government and industrial projects are to a large extent unthinkingly accepted by the public which does not realize that it is assisting in financial support for the political, economic or social ideals of someone in government. The public, however, believes that science is objectively pursuing the **truth** which is important to its (i.e., the public's) existence. Science, consequently, has assumed an almost "religious significance". Believing science to be an objective and impersonal enterprise, its conclusions and directions are accepted, almost uncritically, by the public at large. The scientific community, therefore, becomes the basis of the value systems, each regarded as being as good as the other - leading to intolerance of opposing viewpoints.

Following the "Baconian ideal of dominion over nature", kowledge is identified with power. This directly affects ethics, leading to intolerance and aggression. The paradigm view of science and the community aspect (scientific community) of scientific activity (Kuhn, T.S. 1970; Lakartos, I. and Musgrave, A.(ed.) 1979) with its "research programmes" all show the influence of social and political factors in scientific activity. Consequently, scientific activity reflects value judgements, projects being selected in accordance with these judgements.

The ideological use of science (science used to enforce or justify certain ideologies) has affected social life to a large extent. The unstable state of contemporary international affairs is largely due to the developments in science and in related technology. Differences in religious, social and political ideals based on different interpretations of religious scripture and scientific theory largely constitute the basis of the qualitative changes evident in national and international relations, with accompanying increased development in "science-related military-industrial complex" (Richards, S. 1983). On such a basis "right" and "truth" are often supported by military, "social, economic and political power sustaining (that) the truth claim", resulting in "the deformation of reality and the threats to human beings through confinement within fixed categories" (Singh, R. 1986, p.1). The consequent accelerated development in nuclear arms is justified by the different nations on the grounds of a "balance of power" in order to prevent global war. Little heed is paid to the fact that the human constitution of truth, even on a scientific basis is a reflection of the **Zeitgeist**. The constitution of truth is, therefore, limited by the particular "historical conditions" and the interpretation of the theory under such conditions.

From a material point of view, science and technology have raised expectations of a higher standard of living. As a result of this relations have become strained between different groups in a country and between developed (technologically) and underdeveloped countries. This is largely due to the "disproportionate allocation and consumption of resources". Resources are concentrated in the production of "luxury goods and military equipment for the affluent few", which protect this affluence with military support and social engineering. The affluent world has also imposed technological values on the underdeveloped countries resulting in requisite expertise being concentrated in ever fewer hands. Even though these (underdeveloped) countries might have democratic governments, "fundamental democratic principles" - popular participation and control - are being undermined. Power remains and is militarily protected, in the hands of an affluent few. Historically, these conditons can be traced to their origins in early colonial policies and to political and social engineering based on social Darwinism.

After the Second World War, governmental use of science for the war effort has tremendously increased. Although, during the pre-war years, science was relatively free from governmental influence, the war years convinced many scientists that they had to work for government in order to develop the military power needed to stem the threats of other governments who would destroy their religious, social and political ideals. Scientists thus were compelled to work for their governments if they wished to preserve their ideals. Thus government spending for scientific expertise increased and so either bought or increased scientific responsibility and obligation to government.

The development of the hydrogen bomb raised the profoundest moral dilemmas for scientists. Dependence of science on the state jeopardized the scientific imperatives of universalism and internationalism: these were incompatible with the ideals of the state. The scientist had become an instrument of the state. The individual scientist was thus faced with the dilemma on the one hand of loyalty to the "co-operative spirit of science" and on the other "to the competitive needs of nationalism". The scientist, suspicious of opposing nationalism, turned to the needs of his own.

The development of the hydrogen bomb also introduced a new dimension in international relations. Due to the tremendous risks it entailed for the survival of man, The Panel ("U.S. Atomic Energy Commission, chaired by J.R. Oppenheimer: War time director of Manhattan Project's main laboratory; see Richards, S. 1983, p.169) opposed development. The decision showed that it was universal rather than narrow nationalistic concerns that were important. However, the government overruled the Panels' decision causing a division among the ranks of the scientists themselves. Those who dissented showed that the "spirit of co-operation fostered by science was a matter of personal experience: a sense of international community transcended the fear and aggrandizement which they saw as the springs of competitive nationalism" (Richards, S. 1983, p.170). Consequently, this incident also showed that universal concerns were not as important to scientists as the pursuance of their personal views and concerns.

Social interests, therefore, do have an influence on science: it (science) must "fit in" with other world views since it is also part of culture. This is in contrast to the view that science is egalitarian as a consequence of its objectivity. Structurally, science is a meritocracy and the structure of the scientific body is characterized by inequality and stratification, like any political system. A relatively small group of scientists forms an elite which introduces increasingly difficult rules to keep others out, though they themselves might not have had to surmount the same rules they mete out to others. The scientific world thus becomes polarized. Women and non-white groups have thus historically been considered to be naturally unable, because of their physiology and psychology (biological), to match the achievements of the male white group (Sayers, J. 1982). Although group and racial discrimination had a large part to play in this situation, science contributed to no small extent. Tests from which conclusions were drawn, although considered objective and scientific, were designed by white groups for white situations - defeating the view of the universality of science.

Traditional values and cultural and ideological pressures have long served to keep women in certain roles (Sayers, J. 1982). Their biology was given as a reason for their confinement to certain particular roles which did not make the demands on them to which males were subjected. Women occupied protected roles.

Development of scientific theory under different historical conditions, however, has fostered a more open attitude towards women leading to their acceptance in roles which were in the past reserved for males.

The development of scientific theory and the rapid advances in technology have resulted in the value of science and technology being viewed in the light of their social, economic and financial aspects. Ethics has, therefore, been left to religion, literature, etc., leading to a separation of science from religion, etc. This has led also to the separation of the scientific from other communities, resulting in their mutual incomprehension and distrust. The "arts" and religion are thus seen as "subjective" views of the world, incapable of producing a true picture of reality.

The roots of this division lie in the separation of science from philosophy and of the understanding of science as "objective", attitudes which began in the late Mediaeval Period. It is, therefore, important to see the force of "imaginative experience"; that it plays as important a role in science as it does in literature and the arts. It is often felt that this can be achieved by exposing young scientists to the world of literature and the "arts" to enhance their awareness of a world concerned with ethical sensibilities. But inherent in such a view is still the idea that science and the arts do indeed occupy different worlds. It is because of such a view that many turn to religion in an effort to find peace and for moral premises to guide their lives outside the world of science. Such views, however, are still one-sided as they are based on incorrect premises.

It is, therefore, important to see that like religion and the "arts", scientific theory also has its origins in experience of the world. And like religion and the "arts" it is also developed by humans to answer or to deal with questions concerning the world: about its origins and structure and about man's place in the world or his relationship to the world. In an effort to answer such questions, scientific theory cannot but be concerned also with ethical premises.

To the Marxists, scientific theory constitutes not only an interpretation of the world but also the basis of a desire to change the world or to guide the evolution of man and society to, what is thought to be, its logical conclusion. Science is, therefore, seen not as a "distinct subsystem" of society, but as one aspect of the process of social development. Their view that science is concerned with the material world (like other views of this nature) sees material, and not social and religious values as important in social development. This view arose in the latter part of the Nineteenth Century, probably because of increased industrialization which necessitated social forms of production - creating a class of workers. For Marxists, therefore, scientific and technological innovations are promoted by historical and economic circumstances. Scientific theory is thus dependent for its development on social forces under particular historical circumstances. Pure and applied science cannot, therefore, be meaningfully separated (or theory and practice can have no meaningful separation because of their mutual dependence and reciprocal influence), as, it is in its application that the value of knowledge resides.

Marxists thus accuse the "profit motive" of capitalism as prohibiting the application of science for the good of society. They claim that not capitalism and democracy but a socialist science only, can promote the good of society. However, even though science is a source of innovation, it is also a force for social control. Thus both the Soviet and Western political schemes see science as utilitarian: science is thus used to satisfy the ideological needs of state and the technological needs of industry. In such a constitution science is used for the domination both of nature and humanity - for the furtherance of political, economic and social ideologies. The skills of production workers are thus developed in specialized directions, determined by the machines they have to operate: they almost become part of the machine itself. Education is thus directed towards technology so that the individual is little more than a skillful worker designed for a particular machine: he becomes preoccupied with not much more than "working conditions, security and pay". The end products of such fragmented labour provide little satisfaction for the worker, who looks at progress only in material terms.

Bacon had thought that "man's estate" could be improved by science. But "human progress" is now measured in terms of "technical progress". Nature's domination by science and the control of humanity by the power of science have replaced the Marxian vision of a harmony between humanity and nature. Social harmony and equilibrium are now measured in terms of state stability achieved by propaganda and military control of society. Both Soviet and Capitalist society operate through management and the division of labour, in the scientific tradition, in order to increase economic productivity. Scientific rationality has thus both "justified and absolved" even destructive and oppressive features of the scientific enterprise in the intersts of what is termed "a higher standard of living" -measured in no more than material terms.

However, both Marxists and capitalists still argue that even though science might have been misguided in its exploitative (both of nature and of humanity) venture, it must eventually produce a true and beneficial "science for the people". Such views find support in evolutionary theory. They advocate the eventual emergence of the harmonious society through the present difficulties of political and social evolution, achieved through the scientific enterprise by "the people" themselves. It is evident, however, that political expediency is at the basis of such an interpretation of scientific theory. Thus if politics can be interpreted in terms of evolution and evolution in terms of politics, then evolution can be seen to be no less man-made than politics. It provides a way of interpreting both nature and human institutions in terms of "progress".

Since "progress" is measured in economic and material terms, optimum material comfort in a classless society is the goal of political evolution. Capitalism also uses politics in the same light, but uses "democracy" instead of a classless society. Both systems, however,produce a classed society having both privileged and underprivileged classes.

Scientific investigation of the world or, the scientific method has as yet been unable to provide a unified and fundamental understanding of the world. Scientific theory provides only certain particular perspectives in understanding the world, relying as it does on the "piece-meal" nature of empirical science - based on "facts", "objectivity" and "reason". A single comprehensive answer thus cannot be provided to such questions as "The purpose of life!", which humans often ask. The "essential unity" of the "mind" is thus broken by the scientific approach in its separation of knowledge from values. Science is thus often seen as an accumulation of factual knowledge about the world although it has always been acknowledged that "acts of knowing and of being are inseparably linked" (Richards, S. 1983, p.188). In its "progress" science reduces values to "commercial imperatives" and specialization makes people "one dimensional" experts. It is therefore necessary to unite knowledge and values - if scientific theory has to have any meaning in a socio-ethical context.

The absolute and unchanging authority of revealed religious doctrines is constantly challenged by the evolving scientific world view. Galileo's observational data had been seen as a threat to the Bible and Aristotelian cosmology. Some two hundred years later the Darwinian hypothesis raised controversies concerning Creation and the origin of species; man in particular.

Since science uncovered natural causes for "wordly effects", the need to postulate supernatural causes declined together with the authority of religion; and God was "brought in" only to "fill the gaps".

This problem was solved in different ways. Fundamentalist theologians built around them an impenetrable wall of "scriptural literalism". Others saw in evolutionary theory a "divine natural law of progress", evolution being viewed as a God-directed force. Any new scientific evidence was seen as supportive of this position.

In an effort to reconcile science and religion to some extent, their methods and subject matter were construed as belonging to "different worlds". This introduced the idea of different levels of truth. "Explanation" was also given different meanings which were considered "complementary" not "contradictory". Although science explains different organisms through evolutionary theory with life emerging ultimately from inanimate matter, it says nothing of **Existence**, the explanation of which is left to religion.

The "**Big Bang**" theory of the origin of the universe also takes for granted the "source and status" of matter and the power to explode. Science can say nothing more about this: it depends on a metaphysical explanation.

It is argued, however, that creation is for science the temporal relation between cause and effect. For religion, creation concerns the "meaning of existence" (which is bound to redemption) and the relations between God and the world. Science, therefore, cannot penetrate Revelation. Existentialists see God operative in a sphere of "selfhood" (subjective involvement) while science operates in a "sphere of nature" (objective detachment).

However, contemporary views see scientific observations as being "theory-laden" since scientists are committed to particular paradigms (Kuhn, T.S. 1970). Although the paradigm, the falsification (Popper, K. 1959) and the research programme (Lakartos, I. and Musgrave, A. 1970) views of science do not provide an adequate view of scientific theory and its development, although they do show the social aspect of the development of scientific theory. The gap between "objective science" and "subjective religion" is thus closed to a considerable extent. The use of models in both science and religion (Barbour, I.G. 1970) also show the similarities between science and religion as systems explanatory of experience of reality. Consequently, science is no longer described in terms of infallible fact, but in terms of observations and models. Science is thus seen as proceeding not by the accumulation of facts, but by the "creative involvement of the imagination, which interprets empirical experience according to preconceived ideals in much the same way as it does with religious experience" (Richards, S. 1983, p.192). Both the scientific and religious communities are also committed to honesty, co-operation and universalism and envisage a comprehensive world view, based on a totality of experience.

3.8.2 Ethical aspects of scientific theory

Although scientific theories are not characterised by absolute objectivity, impersonal criteria and universality, being products of particular "historical conditions" and entering into "critical relationships with each other", (Rauche, G.A. 1986) they do provide some basis for the moral conduct of their practitioners and also for society at large. The formation, development and inter-relationships of scientific theories show that "the individual must act always for the common good, for he himself has benefitted from the communal efforts of his predecessors, as Newton himself acknowledged in his famous remark 'If I have seen farther, it is by standing on the shoulders of giants.'" (in Richards, S. 1983, p.104). Nationalism or ethnocentralism might be operative in the use of scientific theory for the benefit of particular groups. Scientific theory itself, as history would show is transnational, and transcultural. No scientific theory stands on its own. Nor has any scientific theory developed within a particular group exclusively. Each theory is built on and depends on several predecessors which have provided both the theoretical basis and been directive in the development of any particualr scientific theory: each scientific theory has provided the impetus for another.

Besides the ethical dimensions of scientific theory that arise out of the interdependence and interrelatedness of scientific theories, scientific ethics, also arises from the community aspect of scientific practice. This regulates the behaviour of scientists among themselves by the observance of certain ethical norms, for example, the acknowledgement of the help and use of the work of other scientists, the truthful reporting of results, etc.

The impact of the Second World War showed that science could not be separated from society for what happened in the world of science had a direct bearing on society. Thus there could be a clash between the interests of science and the interests of society. It is this interaction between science and society that is of the profoundest importance in contemporary times. Since scientific practice is funded to a large extent by government, eventually by society, science is obligated to society. The social aspect of scientific theory also affirms the relation of science to society, the scientific society and also society at large. It is often the case that the actions of government and society are not in agreement with each other or these actions might be guided by ethnocentralism and nationalism. Such actions raise dilemmas as far as scientific responsibility is concerned. In such cases it is, perhaps, important for the scientist to see that although not absolutely so, he, in his work attempts to uphold the criteria of objectiveness, impersonalness, and universality. The multicultural and multinational nature of the origins of scientific theory and practice point to its transcultural and transnationalness. "Scientific reality" is expressed in a universal language, mathematics. Rules of biological nomenclature including the use of Latin and Greek, are drawn up by choice and agreement at international level (International Union of Biological Scientists). Although there are different scientific communities at disciplinary and national level, their mutual need for a comprehensive picture of reality, in which scientific theories "enter into a critical relationship with each other" (Rauche, G.A. 1986) also point to the multidisciplinary and multinational nature of the scientific enterprise. The social and ethical aspects of scientific theory also arise from these aspects of science. The scientific community, in its attempts to be rational and democratic favours individual freedom through mutual trust. This also constitutes the basis of scientific responsibility.

In such a view, scientific knowledge seems the model on which an ethical basis for society might be built. It becomes the responsiblity of the scientist from his experience of reality at the multidisciplinary, multicultural and multinational level, in the development of his theory, to communicate to society the contingentness of experience and the transdisciplinary, transcultural and transnational nature of the scientific construction of reality. In this context, the question posed by Richards concerning the ethical issues between science and society and the loyalty of the scientist on the one hand to society and on the other to the scientific community, becomes significantly relevant:

> "Should he pursue the "truth" as dictated by science, no matter where it may lead, no matter what the consequences for society, or are there circumstances where his responsibilities as citizen must transcend his obligations as scientist?" (Richards, S. 1983, p.137).

"Is there something unique about the scientific enterprise which makes it a desirable model to be copied by society itself? Or would a purely scientific society drain out the warmth and beauty that might ideally be at the very heart of human experience?" (Richards, S. 1983, p.137).

Scientists following the Cartesian ideal see science as "truth institutionalized". They thus tend to emulate the scientific community which they see as being "rational", "disinterested" and "democratic", retaining individual freedom on the basis of mutual trust. Science thus seems a model on which an ethical basis for society might be built. The scientific method thus seems worthy and reputable, its results possessing a special and unquestionable value. Scientific results thus become idealized images of truth or reality, becoming a source of authority, and ethics, a "function of science". Thus, the empiricist traditon feels that "an objective truth lies, as it were, 'out there' waiting to be revealed by the rules of scientific method" (Richards, S. 1983, p.138).

The social aspect of scientific theory, however, shows that scientific theory rises out of the needs and conditions of particular historical periods, and as such, is constituted from human experience. Reality thus becomes a construct from experience, a guide to human action. According to Monod (Monod, J. 1971) objective truth and ethics (theory of human values) far from being in conflict, are linked to each other through action (knowledge and ethics are linked through action). In such a view, objectivity is the basis and condition of true knowledge. But this in itself involves an ethical choice making objectivity the "axiomatic condition of authenticity for all discourse and action" (Monod, J. 1971). Monod's view is that "objective knowledge" will guide the evolution of the modern world, once it is accepted and understood, for it is this knowledge that has "created" the modern world. This view constitutes an authentication of the present scientific method as the only way of obtaining authentic knowledge of the world, so that man might live an authentic existence. However, the subjective elements in scientific theory and the fact that objectivity is a construct by agreement, question Monod's view of scientific objectivity. They also open to question the view that the study of evolution would reveal the patterns that constitute the "natural basis" for the direction in which man must develop society in order to achieve the best possible world. It is felt that since human community is part of the natural world, "evolutionary progress" directed by man is "good" for this community. Inherent in these views is the idea that evolution is perfection-directed, thus making evolution a value in itself. However, the views of Herbert Spencer, T.H. Huxley, Waddington and Julian Huxley show, among others, that evolution can be interpreted in ways that would negate the views of Monod.

Since neither religion nor scientific theory can provide an authentic picture of reality as each puts the reality of the other to question, a synthesis or an investigation of both in the light of a common background might seem legitimate. Religion has changed under changing (historical) conditions of life so that different denominations within any practice or religion look at that religion from different perspectives. Also, although converts might follow the general principles of their adopted religions, traces of their original beliefs are always evident in the practice of custom and ritual. Scriptural literalism is thus never the only basis of religious practice. The practice of religion and the interpretation of scripture are also dependent on the changing conditions of life. And in the changing of these conditions, scientific theory has played no small a role.

The development of scientific theory also has been dependent on the changing conditions of life. It has also been, to a large extent, dependent on religion's interpretation of reality, and has had to resort to the metaphysical in order to formulate a coherent and comprehensive picture of reality. Consequently, both religion and science have evolved in that in their change they have incorporated the new with the old and have interpreted the old in the light of the new.

Consequently, evolutionary theory might provide the grounds on which religion could be understood on a secular basis. Evolution, as a comprehensive theory, sees the world in a state of constant change, as an interacting whole. It is thus in a constant "state of becoming", of "being and becoming". Evolution can thus be seen as a cosmic process with the emergence of forms of different levels of organization, to suit different conditions of life. Thus evolution can be seen as the change of "matter to life, of life to consciousness and from consciousness to society, in one vast continuum". With this change emerges ever greater awareness which constitutes the basis of freedom. And with this freedom, chance and indeterminacy have an important role to play, for they allow voluntary (choice) and selective reactions (action) to the vast potentialities of the world.

Since experience of the world is the basis both of religion and science and since religion has long been looked upon as the basis of ethics, it becomes important to determine whether, in the absence of some religious experience which the individual might interpret as a relevation of God, He does indeed exist. This is important as the holy the world over maintain that such experience is the source of infinite peace, and can even change lives. However, neither can the mystic prove God's existence nor can the sceptic repute it since such experience transcends the level of rationality (the "rational mind"). At this level, however, where the mystic lays claim to absolute knowledge, the scientist cannot, for he relies on rational argument: the three most important arguments being the cosmological (relying on cause and effect), the ontological and the teleological (the argument from design).

On the cosmological argument which relies on the principles of cause and effect, it is interesting to note that in atomic physics, the notions of cause and effect are of "uncertain status". However, to understand the meaning of creation it is important to understand the meaning of explanation in this context (for explanation might not include actuality or reality). Scientific evidence seems to have a closer impact on the teleological argument: (biological evolution being seen as a striving or drive to perfection). Science also accepts the world as an order consequent on design. Haeckel, for instance, saw a unity or an order in nature (Haeckel, E. 1899; 1910; Degrood, D.H. 1965). Many scientists find in this observation "support for their pre-existing belief in God" (Richards, S. 1983). Other scientists, however, support atheism, emphasizing the "wastage and suffering of the natural world". However, on such a view is evident the attribution of certain qualities to God, which constitute the absolutization and perfection of certain human attributes. And since "wastage and suffering" do not conform to the qualities attributed to God, His non-existence is concluded as a consequence. This view, however, does not take into account the fact that these qualities have been attributed to God by man!

Even though the Nineteenth Century Darwinian hypothesis undermined the teleological argument, it could be said that natural selection represents the mechanism used by God. However, the uncertainty of genetic interactions - not following directly the Laws of Mendel - introduces the Uncertainty Principle into biology, like that of Werner Heisenberg, in atomic physics.

Since the teleological argument leads to Deism, it embraces the cosmological argument where God becomes the first cause. Consequently, "faith" is the only other explanation that can be used to uphold the belief in God. Scientists also work with preconceptions that cannot be "proved" on a rational basis. The metaphysical aspects of scientific theory show that an "intuitive leap", for example, has to be resorted to in "formulating a scientific view of the world" (Richards, S. 1983). Logic also has an "internal consistency" and premises have to be accepted as true or correct, before inferences can be made as to their validity. Science also has to have faith in the ability of human reason. These "fundamental acts of faith" are necessary for, daily living, and the formulation of scientific hypotheses. It is these "acts of faith" that seem to give purpose and meaning to life and are experienced despite and not because of rational arguments concerning God's existence. Faith is thus operative at a level beyond reason. Like revelation it transcends the rational faculties of the mind - and dispells "psychological insecurities".

Thus although science is operative on the rational level and no amount of scientific evidence has power to persuade beyond this level, the formulation of scientific theory concerning reality cannot proceed without an "act of faith": faith in the rational faculty of the mind; faith in the data of experience; faith that the mind can penetrate to a reality beyond its rational capacity and faith in the rational faculty of others for it is through such faith that one can compare and modify one's construction of reality in relation to that of others, so that it attains greater authenticity. It is the realization of one's position in relation to that of others that constitutes the real ground of ethics and demonstrates the social nature of scientific theory. It is this realization that rules out the relativity of different views for it allows the evaluation and synthesis of one's view in relation to those of others. This leads to an understanding and tolerance of the views of others, in science, in religion, in every walk of life. Thus, the "Other" (Singh, R. 1986) is indispensable in the constitution of one's reality or "truth". From this obligation to the "Other" emerges the idea of one"s responsibility to the "Other": for the authentic construction of reality, truth in the construction of one's own reality (theory) is imperative.

In such a view of scientific theory a narrow two-dimensional logic (with "right" or "wrong") is insufficient for the construction of theories towards reality. A multidimensional logic is necessary. The history of science has also shown that theories (of reality) are neither "right" nor "wrong": they are the products of particular historical conditions, which depend on the state of scientific knowledge of any particular period. And these theories constitute the necessary basis for the origin and development of other theories.

PART II

THE EMERGENCE OF BIOLOGICAL EVOLUTIONARY THEORY

AND ITS SOCIO-ETHICAL IMPLICATIONS

CHAPTER 4

EVOLUTIONARY THEORY

4.1 Pre-Darwinian evolutionary theory

Alongside theories concerning the physical universe theories developed involving its biological aspects also. And like the former, the latter theories take root in Grecian soil. They are dependent to a large extent on the epistemological views of the period, concerning the Cosmos. For the basic substance of the Universe would also constitute the basis of the biological world. Anaximander had proposed the origin of life from water vapour. His evolutionary approach to biology is evident in his view of man's "fish-like" origins and of the inorganic origins of life. This showed a continuity between the organic and the inorganic world and consequently the relatedness of all life-forms. The Atomists also provided a physical basis for life (fire atoms). Aristotle provided a metaphysical basis for the theory of evolution with the view that all entities in the cosmos strive for perfection. Lucretius endorsed the views of the atomists and also showed that it was through physical struggle with the environment that man was able to learn from and about the environment and so emerge from primitive savagery.

During the Mediaeval Period evolutionary ideas are evident in the views of Augustine. Faith constituted the foundation of the desire to reach God or perfection (striving and teleology). Since this desire was dependent on free Will, it represented the individual's striving to perfection; to reach goals beyond the compass of contemporary experience. Abelard and John of Salisbury endorsed Augustine's views, asserting the importance of individual experience for the aquisition of knowledge and the development of the individual towards knowledge of God or to perfection. St Albert's interest in both the physical and biological sciences shows his view of the interdependence of the physical and biological worlds: encompassing the idea of evolution in the relationship between habitat and adaptation.

However, since the Bible (in Genesis) accounted for all life-forms, the seeds of evolutionary theory sown in Greek soil were not allowed to grow freely under the weight and authority of Scripture. It is ironic however, that men of the church themselves preserved evolutionary thinking (Augustine, Abelard, John of Salisbury, St Albert, etc.) - so long as it led to God. They also recognised the value of experience as the basis of knowledge. For experience showed the relationship between change and adaptation and the importance of environment as the basis for adaptation -showing the need for interrelationships.

Although the biological speculations of these times had not been systematised into theories, the hierarchical taxonomic system of Aristotle had already embodied the idea of the relationship of the different groups of animals through their graded complexity. The development of biological theory is closely related to the development of philosophy and its emancipation from theology, during the late Mediaeval Period, with subsequent emergence of scientific theory. Although scientific theory served to explain the physical aspects of Nature, the explanation of the living world was left to theology: to the explanations of Scripture.

The development and the final emergence of scientific method (from philosophy), resulted in many challenges to the authority of Scripture. Avicenna had already begun (during the Mediaeval period) to explain the formation of the earth's crust and other geomorphological phenomena in mechanical terms (refer Afnan, S.M. 1958. pp. 220-222). The geological work of Buffon (1751) also showed the evolutionary nature of change in the physical environment and the agents responsible for these changes. Like Buffon, Erasmus Darwin (1731-1802) saw in the gradations in anatomy between different species a challenge to the authority of Scripture concerning the separate creation of species. He viewed differences in the light of selective breeding and adaptive radiation. From this he concluded the common origin of all life forms and presaged the accidental (not teleological) nature of change in animals and their natural habitat. To Lamarck is attributed the view that change in both the organic and inorganic world is a result of Law and not miraculous intervention or accident. He laid the foundations for a theory of descent -an independent scientific theory -which constituted the philosophical foundation of Biology. Dependent on Law he saw life as a physical phenomenon in which mechanical, physical and chemical causes, inherent in the nature of matter itself, were active: forces which determine an organism's growth by its needs, determine the growth of organs in proportion to their use and transmit the new developments to their offspring. And since he had a physical view of evolution, the transmission of these developments was probably by particles. Lamarck's views, therefore, contradicted those of the Bible: whereas the Bible accounted for the legless condition of the snake, for example, on moral grounds, Lamarck showed that its adaptation to its habitat caused it to lose its legs. Others who lent support to the theory of evolution were Meckel (1811) and von Baer, who showed that the "lower" forms, as transitory stages, were present in the embryology of the "higher" forms of animals.

Von Mohl also showed that the basic material, protoplasm, of both plants and animals, was the same. All these views were in direct conflict with the idea of Creation. Robert Chambers, in Vestiges of Creation (Chambers, R., 1844. In

Clodd, E. 1897) tried to preserve the idea of Creation, and attributed the movements of the solar system to uniform laws which were the expressions of divine power. The development of animals and their different forms was attributed to an "inherent impulse imparted by the Almighty both to advance them from their several grades and to modify their structure as circumstances required," (In Clodd, E. 1897 p.110). This view of Chambers' was interpreted by the Church to mean that the direct intervention of the Creator was replaced by the "action of secondary causes," (or Natural Laws). Chambers had tried to find a "compromise" between evolution and Creation, but this was not acceptable to the Church, as it undermined the direct intervention of the Creator.

Not only the Church, however, opposed evolution. Amongst its antagonists were scientists of the stature of Lyell and Cuvier. Creation was sufficient (it was felt!) explanation for much of the observed phenomena till the beginning of the Eighteenth Century; so long as the world was considered as static and unchanging and created in about 4004 B.C. The hierachic organization of plants and animals was considered the "ladder of perfection" (or God's plan). Nature and her diverse phenomena were therefore, accommodated within a "literal interpretation of the Bible". Lyell's work, in geology, however, showed that physical forces were responsible for the sculpturing of the surface of the earth. Different geological strata also revealed distinct fossil fauna. This was explained in terms of a number of special creations. And where general laws were required to account for phenomena, it was postulated that such laws had been instituted by the Creator (Divine intervention). In the maintenance of this static world view dependent on Creation, philosophy also played a role. The first half of the Nineteenth Century was dominated by typological thinking or "essentialism" (Popper, K.R. 1945). Based on Platonism (eidos) and entrenched in Western thinking through Thomism it slowed down the acceptance of evolution. Reality and permanence were attributed only to ideas which were also discrete (discontinuous) from each other. Creationism, supported by essentialism led to the development of Lyell's static species concept. And it was this concept that was at the heart of the controversy: according to creationism it was fixed and commitable while, evolution meant that one species could give rise to another, thus introducing the idea of continuity into evolutionist thinking. Studies of the earth's surface convinced him that "vicissitudes" had shaped the earth's crust, which also ensured that no species could survive continually. Owing to "microcatastrophisms" (at different places on the earth's surface at different times), old species had to be completely and continuously replaced by new creations. Lyell considered species as "fixed morphological entities" created at specific times to suit the changing conditions on the earth's surface.

Consequently, Lyell had a "steady-state" concept of the world - "Uniformitarianism" - the "perpetual intervention hypothesis" which meant in effect that the same forces and causes that had shaped the earth's surface in the past were still effective. Lyell, however, applied this concept only to the inanimate world. Others, applied the concept to the animal world as well - so that the forces that changed the earth's surface were effective agents in the animal world also.

The general feeling among many of the naturalists of this time was that their task was to prove the existence of God. They felt that although many plants and animals had been present on earth before man, they had been endowed with the qualities they possessed because God had forseen that these qualities would be necessary in the service of man. This led to the idea of design and predestination: all of creation was in the service of man. In this way the relationships of animals, plants and man was explained. This natural theology pervaded much of the scientific work of this period (Mayr, E. 1972).

4.2 Socio-ethical aspects of evolutionary theory

Despite the mass of evidence that seemed to weigh against creationism (Lyell's geological theories, and those of Lamarck and Erasmus Darwin) it remained a dominant doctrine till about 1830 at the height of the Industrial Revolution. Thomism (with its idea of class distinction in the state) coupled with creationism (with its ideas of the acceptance of God's creations and of their immutability) and the species concept (of Lyell) could have contributed to urging the working class or the labourer to accept his position in society for it had been ordained by God. Even the changes that occurred were brought about by God. It was, therefore, the moral duty of man to accept his position in society. Thus, at the height of the Industrial Revolution while the Middle Class was getting richer, "the poor working man was exploited unmercifully and the goodness and wisdom of the Creator was emphasized constantly to smooth guilty consciences. It became a moral obligation of the scientist to find additional proofs for the wisdom and constant attention of the Creator (Mayr, E. 1972. p. 983). Most of the scientists themselves were from the Middle Class. Many were naturalists who felt that their "task is ... complete as soon as they (we) have proved His existence." (Agassiz, L. 1857, Essay on Classification. In Mayr, E. 1972).

The relationship between animals and plants was also explained together with the harmony of nature as the basis for the justification of belief in God's design and predestination. Lyell saw animal and plant extinction in the light of the "static species concept": that these species had been created for certain specific conditions and places. Extinction was seen as the animals and plants having completed their "allotted term" on Earth. New species were thus seen as new creations (by God) to suit the changing conditions. This was all part of God's plan. The entire world of nature was a reflection of the harmony of God's plan or design. Harmony could only be maintained if this design were accepted on faith. The Bible provided the basis for this acceptance:

> 26: "And God said, let us make man in our image, after our likeness: and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle and over all the earth, and over every creeping thing that creepth upon the earth ---"
>
> (Genesis, 1:26.)

The Bible itself was the justification of Lyell's views. The idea of design with predestination provided a justification for the status quo exorting man to accept His "allotted term" and place on earth. On such an interpretation, man, backed by "scientific evidence" could find justification and foundation for his moral condition. Creation showed that everything on earth had a place and that the harmony of God's design could only be maintained if it were accepted - on faith. The Bible also stated that God had given man "dominion" "over all the earth". This was interpreted to mean that man was answerable only to God for his actions, for from Him had he received his estate. And since God had created everything for man, this was interpreted as justification for whatever attitude man adopted towards his fellow-creatures; or, for his exploitation of Nature.

Scientific theory interpreted in the light of Creation, also provided a basis for the maintenance of the social structure of the time. It justified the hierarchy of social organization and the acceptance by the different classes of their estate and place in society - for so had it been ordained by God! Both science and religion, therefore, provided justification for the social order, and for the beginnings of class exploitation. They also provided a basis for the exploitation of Nature, to the service of man. Such views were further intensified by the Darwinian hypothesis, as it seemed to place these views on a firmer scientific basis.

4.3 The Darwinian Hypothesis

Evolution had been a theme for both philosophical and scientific study long before Charles Darwin. A phenomenal amount of facts had been amassed on the subject, but none before him brought these facts within the compass of a single theory. This was largely because they were looking at the individual not the population as the evolving subject.

Buffon, Lamarck, and his own ancestor, Erasmus Darwin, had contributed much to the development of the field. About the most important contribution, however, came from geology in the form of the works of Lyell. His works showed the unimaginable antiquity of the earth and the role of natural forces in the sculpturing of her surface. It is ironic, however, that although Lyell could appreciate the action of these forces on the earth's surface, he did not consider them as agents of change as far as life -forms were concerned. Thus there was a vast amount of facts concerning the earth and the creatures on it. The fact of the antiquity of the earth was the fact that Darwin required on which to build his thesis: it was tenable on this fact alone! Coupled with this was his experience of the varied types of animals, (including man) and their behaviour, and plants in different parts of the world, during his voyage on the **Beagle**. A.R. Wallace had also had a similar experience in the East Indian Archipelago (Wallace, A.R. 1897). This helped reinforce Darwin's views and both his and Wallace's papers were read at a meeting of the Linnean Society (on the 1/7/1858) under the title:

On the tendency of species to form varieties and on the perpetuation of varieties and species by natural selection.

The following year, marshalling the facts from the diverse branches of science, especially geology, Darwin unified them into a single synthesis to, firstly, establish the fact of evolution and, secondly, to elucidate the mechanism of its operation. The result was

The origin of species by means of natural Selection (1859)

Darwin had drawn this conclusion from his observations that organisms produce a large number of offspring. This resulted in a "struggle for existence" with consequent "survival of the fittest." Wallace, who had also done much work in this field shared Darwin's views in every respect concerning the descent of man but could not agree on one aspect, "... that natural selection explains the origin of man's spiritual and intellectual nature," since it has its origin in the "unseen universe of spirit" (Wallace,A.D. 1897. In Clodd, E. 1897 p.133).

Since many other prominent men held views similar to this it became necessary for the Darwinian theory to show that psychism is savage animism "writ large," and that it can be accounted for by the "theory of continuity:" that basic human characteristics could be traced through non-human ancestors (apes) to the "lower" forms of life. This meant in effect the disposal of the doctrine of the immutability of species, on which "creationism" depended. Both instincts and corporeal structure show a gradual development from the more primitive to the advanced types and so "tend to corroborate the theory of natural selection." (Darwin, C. 1859 p.237). Darwin's theory thus favoured the theory of "blending inheritance" and "phyletic gradualism."

Darwin's "Origin" was received open-mindedly by Naturalists, but clerics condemned it as a "brutal philosophy," with no God. Some clerics, however, such as Archdeacon Wilson, were sympathetic to Darwin's views as they did not see Christian doctrine like orthodox Christians; but as a creation out of Christ's teachings, "... a philosophy of life to suit man's needs." (Clodd, E. 1897). Consequently, although the content remained unchanged, the interpretation of the Bible changed continuously with man's changing intellectual environment. Lyell (influenced by Creationism) could not accept the inclusion of man, in evolution, "body, soul and spirit, "as the outcome of natural selection.

Darwin's views had a profound effect on the Church, which has endured into modern times. It shook the very foundations of religion - thé dogma of Creation and with it the ethical precepts embodied in Christian doctrine. His views were interpreted to mean that there was no God. Such a negation of the whole religious system was not acceptable, for it implied that the belief in man's origins and in the ethical precepts in the Bible had no foundation. Those who accepted Darwin's thesis turned from the Bible, for they felt that the views expressed in it were not in accord with scientific theory. The appearance of the "Descent of Man" (Darwin, C. 1871) further strengthened Darwin's theory for geology brought to light fossils that seemed like transitory stages in development towards the human.

Although Darwin himself did not directly apply his thesis to society, it had a tremendous impact on society in various spheres. It had a direct impact on the question of destiny and human relationships, which had an impact on ethics and society. In the light of Darwinian theory it seemed that the supernatural had no place in (the theory of) evolution. The belief in a single everlasting truth was also undermined, destroying the grounds for man's belief in the 'traditional dogmas of man's fall and redemption; of human sin and divine forgiveness." Darwin himself held the view that the increasing evidence bearing on evolution shows that "... the more we know of the fixed laws of nature, the more incredible do miracles become."

(Darwin, C. 1871: in Autobiography of Charles Darwin by F. Darwin, 1942 p.40).

Darwinism, thus, touched human interests in all its manifold spheres. Although the Copernican, Galileian, and Newtonian theories had revolutionized thinking of the universe, and contributed much to the dissolution of the theocentric world view, they were concerned more with the inanimate world and the forces of nature. Man was still a "special creation." His relation to the rest of the animal world was no deeper than the fact that he too had been fashioned by the same God. Darwinism, however, obviated the need for the direct intervention of God. It placed man in the same mechanistic stream as the rest of the universe so that he was considered also a product of natural law (Natural selection) and subject to the general laws of the universe, of which he himself was the product. In the background of this mechanistic view, natural selection fitted in as another "law of nature". Everything concerning man was derived from the lower groups of animals. Even consciousness was derived from the beginnings of the nervous system in the lowest forms, to its highest form in the "self-consciousness of man." Man is, of consequence, continuous with the rest of the animal world, even his consciousness. In the "Synthetic Philosophy", Spencer, "dealing with all cosmic processes as purely mechanical problems, interprets the phenomena of life (excluding the quesiton of its origin), mind, and society, in terms of matter and motion." (In Clodd, E. 1897 p.172). Material and spiritual controversies were therefore considered to be a "mere war of words," as material or mechanical terms were sufficient to explain everything. Analogies were also drawn between individual and social organisms and between man (as an individual) and society in order to explain the relationship between the individual and society. It was felt that since man was derived from the lower" forms of animals, his behaviour in all its forms was explainable in terms of "animal" behaviour; from which it was thought to be derived.

T.H. Huxley's lecture on The relations of **man to the lower animals** (1860. In Huxley, T.H. 1911) attempts to push the **Origin of Species** to its "logical" conclusions: that everything human, even the highest faculties of man, could be traced through the ape to the lower animals. His reliance on what he called "philosophical faith" is evident in his conviction of the fundamental unity of non-living and living, through the evolution of protoplasm from non-living matter. He thus gave a physical basis to life.

Huxley's conclusions, viewed as "gross materialism" by theologians led to their view that scientific conclusions were hopelessly at variance with Biblical teachings. Reverend, J.A. Zahn, however, felt that the only logical conclusion of the animal origin of man would be to modify the traditional view of the origin of Adam: to look at Adam from the biological and not only the Biblical point of view. For, just as the Council of Churches was interpreting Revelation, so was science interpreting the facts of experience. This led to his conviction that, in the ultimate analysis, the phenomena of Nature and knowledge were only "facts of consciousness". Reality thus becomes a "construct of consciousness" dependent on experience.

Consequently, the views of Huxley, based on the "evidence" of Darwinism resulted in marked revision in theological thinking. Numerous passages in the Bible were now looked at from a symbolic point of view: "dust of the earth" could mean that man was made from pre-existing material. The term "breathing" suggested that the soul was God's direct creation. Thus, even if the body of man was "animal", his soul was God-created and divine and eternal. Some theologians believed that man, though created mortal, was endowed with a free-will to prevent his being an automation. Man was, therefore, himself responsible for his subjugation to death, like the lower animals - as the result of his fall at the temptation. Sin was construed as being transmitted by the "natural effect of heredity". It was thus man's responsibility to restore, (through belief of Christ) the eternal life he had forfeited. In this view is evident the relationship of free-will and moral responsibility. Since Darwinism showed that man differed from the lower animals only in degree, not in kind, free-will and responsibility would be absent in the Darwinian man, according to Wallace. In "Darwinism" (1897) he discusses the origin of the "mathematical faculty" (Wallace, A.R. 1897 p.464-467) and argues from the "Origin of the musical and artistic faculties" (Wallace, A.R., 1987 p.467-472) that these could not have developed under the Law of Natural Selection. Thus the intellectual and moral faculties are unique to man and for their origin and explanation, one must seek for an "...adequate cause in the universe of spirit." (Wallace, A.R., 1897 p.478). Wallace also held the view that natural selection ceases to be operative in man when social and sympathetic feelings and moral and intellectual faculties become developed. At this stage, his mental faculties and moral nature combine to select and accumulate through reaction with adverse circumstances those features which would be suited to the increase and spread "... of the better and higher specimens of our race ... the lower and more brutal would give way and successively die out, and that rapid advancement of mental faculty would occur which has raised the lowest races of man so far above the brutes although differing so little from some of them in structure, and in conjugation with scarsely heritable modifications of form has developed the wonderful intellect of the European races." (Wallace, A.R. 1871 p.316-317). He was also of the view that the well-developed brains of "savages" are disproportionate to their needs.

Thomas Huxley did not agree with such views and felt that the knowledge a "savage" needs to survive and his language are even more complex than a European could understand or master. Their way of life is adapted to the dictates of their environment. They, therefore, represent, not a "fall" from the "primeval purity of Eden" but a condition out of which other races have emerged. Races the world over have similar stages in their developmental history. The differences encountered are due only to their mode of adaptation to their specific environments. Adaptations or advancements in physical or material aspects have their parallels in intellectual and spiritual advance. Anthropological studies show advancements from animism, through mythology to the higher conception of deity; a progress marked by "bewildering guesses to assuring certainties". They also showed that the doctrine of Redemption, one of the central doctrines of Christianity, had its origins in ancient religions long before the birth of Christ. Its origin in non-Christian religions, led to its being questioned.

Consequently, the comparative method, developed to a higher degree in biology (Comparative anatomy, comparative embryology, etc.) was extended to the product of man's intellectual and spiritual nature. Although the method as applied by biology and anthropology "starts with the assumption of differences in things, ...it equally starts with the assumption of resemblances, and in every case it has brought out the fact that the differences are superficial and the resemblances are fundamental." (Clodd, E. 1897 p.231). Darwin's investigations, together with the discoveries of geology and anthropology and in other branches of science, led to a slow but steady relinquishing of the Bible as the basis for man's ethical conduct. Those initiated in the knowledge uncovered by scientific discovery often saw in scientific theory a literal interpretation of truth as they had been accustomed to accepting the precepts of the Bible. Science seemed to present concrete evidence to support its theories - which were accepted as truth.

Interest in the Bible as a source of knowledge began to wane. Huxley, however, advocated the resumption of Biblical studies for he saw in it invaluable literature on the passed "History of civilized man". Huxley saw in the Bible the evidence of man's "gradual ethical and spiritual development." Darwinism thus greatly influenced Huxley and Spencer. There was a transfer of the foundation of

Ethics from a "theological to a social" basis. But while theological ethics urges man to contemplate the supernatural, social ethics looks to earth and concerns, not what is due by man to God (worship, rituals, thanksgivings, etc.) but what is due by man to his fellow-man, and viewed in evolutionary perspective, to his fellow creatures. Ethical foundations thus shift from belief in the supernatural to "social instincts" (which were believed to have come from the animal world or non-human world - genetically inherited). In this sense sin is not a falling away from God, but an anti-social act.

Darwinism, to a large extent, in the hands of Thomas Huxley, constituted not a readjustment but a revolution in ethics. Theology lost some of its appeal to human obligation to God with the result that secular interests became the incentive to social action. The physical, mental, and moral aspects of deeds should thus form the foundation for injunction to action: thus resting on a stable basis, on change itself, and not on a changing theology. The dogmatic aspects of Christian theology are therefore being "shelved" and attention is being given to the social aspects of Christ's teachings. Some theological views are thus slowly falling in line with evolutionist thought.

In Huxley's view evolution is both cosmical and ethical. Cosmic evolution has produced the universe with its contents, living and non-living. Nature, however, is selfish and in the "struggle" only the "fittest" survive. But man sets limits to this struggle in that, in social progress, selfishness is checked by the recognition of common rights so that men might live together in harmony. The instincts of emotion and affection shared with the lower social animals constitute the basis of the "Ethical evolution" which at a higher level leads to the development of family, society, tribal and national life. These ties are of the utmost importance for the stability of national life since their weakening leads to a "struggle for existence". In this way, ethics becomes an integral part of cosmic evolution (Huxley, T.H. 1911)

The views of Schurman (Schurman, J.G. 1888) are very similar to those of Thomas Huxley. He sees in the Darwinian doctrine that the life forms on earth are the result of "gradual changes in pre-existing and similar forms", (Schurmann, J.G. 1888 p.42) the Greek view that everything is in a state of **Becoming**; so asserting the "essential unity of existence." Darwinism is thus similar to Greek evolutionism in that it accepts the Greek belief that man is of immeasurable antiquity; that there is in the life of nature a progressive movement, with the "survival of the fittest" and that since all things are at bottom the same, new species of animals could arise from free-preexisting groups. And since change is the essence of cosmic processes they are all directed to stability and harmony in nature. Viewed in this light Darwinism has metaphysical implications: according to Schumann, "Every system of ethics is affiliated to a metaphysics expressed or understood; and every system of metaphysics carried with it a definite ethics." (Schurmann, J.G. 1888 p.114).

According to Darwinism, habits are ensured through the repetition of serviceable actions which are acted upon by natural selection. The "production" of these actions are assumed to be accidental and are due to heritable causes innate in the organism. But the assumption that the causes of variation are unknown and accidental is problematic since repetition and perpetuation of chance variations cannot occur in subsequent generations. Also, natural selection does not "form" or "produce" structures; it can only select what is already present. Natural selection thus seems to presuppose "design" since development seems to occur along certain "pre-determined lines of modifications," and only "weeds out" the inferior competing forms. Natural selection therefore seems to be teleological. According to Schurmann (Schurmann, J.G. 1888 p.113-114). Darwinism is independent of a mechanistic philosophy which in fact is a precondition for the ethical examination of Darwinism for it obviates the generation of an utilitarian ethics.

However, Darwinian natural selection assumes a utility on which to act and biological utilitarianism may be egoistic or communistic. The human, therefore, has developed with useful modifications for individual or social benefit advantageous over others. The sympathetic feelings in man, fidelity, trustworthiness, truthfulness, obedience, etc. are features useful for social survival. These features are thus self-preserving and self-perpetuating and are evident in the transition from the simian to man. By the accumulation of these useful modifications in the "struggle for survival" biology assumes an ethical nature: utility, therefore, governs him in conduct and has led to the generation of species in which it is manifest (leading to a utilitarian ethics). According to Schurmann "In the evolutiono-utilitarian theory of morals, the process which nature has blindly followed in the development of life comes to a consciousness of itself, and is recognized as the norm of human conduct." (Schurmann, J.G. 1888 p.123). Moral rules thus become the adaptations to the social life, which after many trials has proved to be of service to groups of humans in their struggle for survival. Thus moral life as produced through natural selection is the ability to live harmoniously in that society that was necessary for the "origin of a species of moral beings." Like the teachings of Christ and the Spencerian view morality is the sum of those acts that are concerned with the well-being of society. Although it might seem that evolution is a mechanical process and "mechanical evolution" cannot talk of the end or the ground of morality, it is yet assumed that morality had a mechanical origin; just as intelligence has been generated in unintelligent beings in the course of reaction between organism and environment. In this way also, through their experience, an "accumulation of modifications" in amoral and unintelligent animals produced a behaviour or system of Conduct among individuals so that they came together in a society and were thus able to establish a "victorious existence." The emergence of intelligence is seen as the consciousness of the relationships already established between the organism and the environment; the recognition of that utility that has promoted the emergence and evolution of man. The evolution of man (selfconscious and moral man) is thus referable to "physical causation."

Since the organism's actions or its behaviour is useful in the "struggle for existence" it cannot be random, as it is indicative of purpose. The moral nature of man thus becomes merged with (or inherent in) the "mechanism of Nature." Purpose, however, shows intelligence and can be referred to the Greek concept of the Cosmos. It would seem that morality has a "mechanical origin" yet conscience drives man so that he considers it his "duty" to obey the moral laws. Spencer, however, feels that moral obligation is entrenched in fear, e.g. of social ostracism or hell. Conscience and duty thus show that society exists on a moral basis.

Evolutionists, however, attempted to explain the idea of duty or obligation to the moral consciousness in terms of "race-accumulated experiences of utility." (Schurmann, J.G. 1888, p.148). But even though circumstances are changed, no experience or experiental theory has been able to explain the origin of the "ought". Natural selection is only selective but is not aware of the nature or essence of what it selects. It uses morality, but takes no account of its content and meaning and is thus indeterminate with regard to the constitution or production of the material on which it is operative. Darwinism thus makes morality something purely relative to man's circumstances. Schurmann (Schurmann, J.G. 1888) argues that evolutionary ethics has no support from evolutionary science for it does no more than combine utilitarianism with speculative metaphysics and "discovers the ground of mind and conscience in an antecedent physical or nervous mechanism" (Schurmann, J.G. p.160). Thus it lacks support from evolutionary science.

4.3.1 Ethical speculations of Darwin

As Darwin himself recognized, the greatest obstacle to his theory of natural selection was the "high standard of man's intellectual powers and moral disposition." He wanted to show that mental faculties differ not in kind, but only degree from that of the lower animals. Consequently, man's superior intellect has its correlate in his moral attainments. Just as there are gradations in anatomical development between animals on the evolutionary scale, so with mental developments.

However, whereas the basis for sociality in animals (apes, bees, ants, etc.) is instinctual, the sympathetic impulses in man are grounded in experience and reason which are guides to conduct. Being social, man is largely influenced and limited by the wishes and opinions of his fellow-man. The sympathetic impulses, selected (natural selection) for the good of the community could be the origin of moral sense or conscience. The persistence and continued selection of these impulses over others presents them in the form of a moral law. Man's ability to regret his actions is attributed by Darwin to his superior mental powers which allow reflection, and so comparison with the past. From this comparison the "ought" emerges which "seems merely to imply the consciousness of a rule of conduct, however, it may have originated." (Schurman, J.G. 1888 p.175).

According to Darwin, "the moral sense or conscience is by far the most important ... it is summed up in that short but imperious word 'ought', so full of high significance" (Darwin, C. 1901 p.148). Schurmann contends (Schurmann, J.G. 1888 p.188) that Darwin's inconsistent use of "conscience" in The Descent of Man (Chapter 4) is problematic since he provides no definition. Consequently, its origin cannot be determined. Schurmann feels that Darwin is tracing not the origin of conscience (in Chapter 4 of The Descent of Man) but of remorse (Schurmann, J.G. 1888. p.191) and assumes the continual presence and persistence of social instincts. But according to Darwin's theory of Natural selection, the only "omnipresent impulse is the egoistic one of self-preservation." He therefore compares a "whole class with some of the individuals" and arrives at the primacy of the social instincts, which are non-moral: and from the non-moral, Darwin arrives at the moral. But many agree with Darwin for his conclusions, "express a fact of their own experience. But they overlook the all-important difference that they are already moral beings, and that the highly intelligent animal Darwin speaks of is not. Why then should this non-moral intelligence experience remorse? (Schurman, J.G. 1888 p.194). But even though "ethical science" might show that the family and family morality might have had a "historical growth", it does not lessen the value of morality in a civilization that has absorbed it.

Like Schurman, Wallace also disagreed with the Darwinian view that "moral, intellectual and spiritual (faculties) have been derived from their rudiments in the lower animals, in the same manner and by the action of the same general laws as his physical structure has been derived." (Wallace, A.R. 1897 p.461). In The Descent of Man (Chapter III) Darwin discusses the basic rudiments of intelligence and morals and traces their origin to the lower animals - even to the extent that the deep love and submission a dog shows his master being the rudiment of religion! And in Chapter IV he discusses the faculties of savages saying that they are little more advanced than those of the higher animals (Darwin, C. 1901 p.46) and inferior to those reached in the civilized races. However, Darwin himself seems to contradict this argument as he does say that he was "incessantly struck whilst living with the Fuegians on board the Beagle, with their many little traits of character showing how similar their minds were to ours" (Darwin, C. 1901 p.276). The Fuegians, therefore, had the same faculties as the "civilized races." Their expression (i.e. of the 'faculties') is dependent, however, on the environment. The Fuegian "delights to torture his enemies, offers up bloody sacrifices, practices infanticide without remorse, treats his wives like slaves, knows no decency, and is haunted by the grossest superstitions" (Darwin, C. 1901 p.946) probably because of the savage environment in which he lives.

Both the Origin of Species and the Descent of Man do show the physical adaptations to the environment and the emergence of different forms through these adaptations. But the mental faculties are much more dependent on the environment for their expression. Natural Selection therefore, could not be alone responsible for the development of man's mental faculties (intelligence, etc.). Wallace feels that to support his theory, Darwin had also to show that these faculties (mental) have come from lower animals. According to Wallace, "Because man's physical structure has been developed from an animal form by natural selection, it does not necessarily follow that his mental nature, even though developed pari passu with it has been developed by the same causes only." (Wallace, A.R. 1897 p.463). His view is that the ability to develop mathematics, music, art, etc. is not derived through natural selection largely because it exists in only small proportions of people. Wallace argues that man has a spiritual aspect also for it is only on the acceptance of such a view that the "agony" that martyrs have borne, (e.g.), is explainable. For Wallace, the whole purpose of evolution was the "development of the human spirit in association with the human body" (Wallace, A.R. 1897 p.477). For it is struggle and effort that strengthens and perfects the noblest faculties of man and enables in him the qualities of justice, mercy, humanity, etc. And it is the environment that to a large extent, plays its part in this development and has resulted in the "wonderful intellect of the European races." Wallace thus sees the development of man and of the different races of man on a "spiritual level."

Schmidt however, had already in 1883, probably influenced by Darwinism and the Principles of Mendelian inheritance (of 1860), seen the development of races on a purely physical basis: "The psychical capacities of each individual bear the family type, and are determined by the laws of hereditary. For it is simply untrue that, independent of colour and descent, each man, under conditions otherwise alike, may attain a like pitch of mental development". (Schmidt, O. 1883 p.296). He is of the view that even though some individuals of other races have "reached" abilities of the European, they are on the whole "...behind the average individuals of the advanced races," and believes in there being "inferior human races," (Schmidt, O. 1883 p.297). This he attributes to the theory of descent and Natural Selection.

However, European (colonial) expansionism seems to have been at the basis of these views. Their contact with other races made them feel superior since these, (the other races), to them, did not seem to have reached the level of civilization that they (the Europeans) felt they had reached. They did not take into account that many of the races they encountered, e.g. in the East, had already reached the zenith of their civilization and were now on the decline. They saw evolution proceeding unidirectionally. This influenced the way they treated these races (i.e. in the colonies).

4.3.2 The influence of Darwinism

Evolution had been unacceptable to the Eighteenth Century naturalists, largely because, to them, it implied the "Scala naturae" (ladder of perfection). Lyell's studies had shown that besides the appearance of mammals before birds, rather diverse types all occurred in the fossil record at the same time, and therefore, he thought, refuted the theory of evolution. Darwin, however,, did not postulate a "drive to perfection": he merely postulated change, which was the basis for the appearance of new species. Essentialism, coupled with creationism had been the "stumbling block" as far as the species concept was concerned. The solution to this problem was, to a large extent, important to the understanding and acceptance of the evolutionary theory: for on the interpretation of this concept lay the understanding of the relationship between the past and the present - of the animal world with man, having implications for both social and ethical theory. It showed that man is related organically to the non-human animals and that he had appeared in a time long before that postulated by creation. Adding to the discoveries and conclusions of the physical sciences, it destroyed the anthropocentric concept of the Universe and so caused a major upheaval in man's thinking. Although it constituted a major revolution in man's thinking, it was long in gaining acceptance. This could probably be related to the fact that evolutionism had had a long history and what Darwin did was only to present a more precise formulation of the theory and supply the biological facts essential to such a formulation. His work does constitute a revolution in the sense that "... not simply the acceptance of one new theory was involved, as in some other scientific revolutions, but an entirely new conceptual world consisting of numerous separate concepts and beliefs and not only were scientific theories involved, but also a whole set of metascientific credos" (Mayr, E. 1972 p.987).

Darwin's work not only relied on but also gave scientific support to the geological and other scientific theories concerning the vast antiquity of the earth. This had kaleidoscopic implications. It also led to the refutation of catastrophism and the victory of the evolutionists (Lamarck, etc.) over the progressionists and over Lyell's "steady-state" theory. Darwin also showed that evolution did not consist in a steady "upward advance" but in adaptation to the constantly changing environment - a view unpopular with many non-biologists and with the schools of evolutionary anthropology of Bergson and de Chardin.

Evolutionists, (Lyell, etc.) and anti-evolutionists had both allowed for divine intervention. Darwin's theory, however, showed that divine intervention was superfluous in evolution. It seemed to separate God from the world replacing a planned theology by the "haphazard processes" of "Natural Selection". Religion thus needed a new basis and God a new concept. The fact of anthropocentricism placed man in the some evolutionary stream as other animals. Darwin's theory thus had a greater relevance outside science than inside the physical sciences. Although physical science theories had both social and ethical implications, the Darwinian revolution showed man in a different perspective than that of the Church.

Many held that it degraded man by linking him to the apes, and so destroying all distinction between the physical and the moral. It was felt that Darwin had destroyed the basis of ethics that resided in the Bible; so affecting man's personal beliefs, and raising questions anew in religion and ethics. Many scientists accepted the theory only in part. Darwin's theory thus "meant the replacement of one entire Weltanschauung by another and it involved all aspects of life including religion, philosophy and humanism.

4.3.3 Social Darwinism

Darwinism greatly affected the religious outlook on the world. It pushed God farther into the background, so that religion greatly lost its significance as a way of life. Some, however, saw in Darwinian theory the conclusion that God did not exist. This had a tremendous influence, for where religion had previously provided a basis for ethics, Darwinism was substituted. In some instances it was even used to complement the religious outlook on ethics. The changed outlook provided a justification; or an added justification for the attitudes of one group towards another. Instead of looking at different cultures or people in the light of cultural relativism, Darwinian evolutionism provided the basis for looking at culture as developing along unidirectional lines; and not as adaptive to particular times and places. In this outlook, technology played a paramount role.

The roots of social evolutionism are embedded in the Age of Enlightenment where the Classical doctrine of the Chain of Being constituted the basis of the view that there was a close relationship between the concepts of sociocultural and organic evolution. This became a "major intellectual assumption." The development of humanity was thus viewed as progressing along a single "unidirectional course". Cultural evolution was closely linked to social evolution, and involved transformations in technology, social institutions, religious beliefs, value-systems, etc.

After the "Origin of Species" (Darwin, C. 1857) biological evolution (Kuhn, T.S. 1962) became the paradigm for the study of social evolution; the paradigm, however, was slightly modified by the sociologists. Like biologists they saw existing human culture and institutions as having descended from animal antecedents by "gradual modifications". To many this also implied that cultural traits are transmitted through heredity (even though it has been shown that culture is acquired).

In their assumption of a unilineal development of culture and society, sociologists and cultural anthropologists felt that all cultures passed through similar stages in their development: "savagery, barbarism and civilization". In this view was also prevalent the idea of the "ladder of perfection" that had dominated early evolutionist thinking (Dobzhansky, T. 1962). Based on these assumptions (unilinear development and "ladder of perfection"), no satisfactory answer could be provided for this type of evolutionary change: it was therefore declared a "property of human nature."

Growing populations and complex economic arrangements that followed the movement away from simple food-gathering economies had eventually led to greater disparities in wealth. Consequently, the development of social status, depended to a large extent on wealth. This is seen clearly during the Industrial Revolution when, in the Nineteenth Century cities of Europe and America, the extremes of poverty and wealth existed side by side. This accumulation of wealth had also led, earlier, to the "carving up" of the world into colonial empires, where most other groups became subject to European rule. These "subject races" had to be"... uplifted and perhaps even civilized; the pedagogic method was to put the subjects to work for their white masters. If some of the latter felt a need to put their consciences at rest, a church hymn solved the problem:

> The rich man in his castle, the poor man at his gate,
> God made them high and lowly; He ordered their estate"
> (Dobzhansky, T. 1962 p.119).

Darwinian evolutionism was used to complement the religious reason and so "scientifically" justify their views. It was tacitly assumed that Darwin had not only discovered the laws of biological evolution but also that of society as well. Thus it was the phraseology, more than the essence of Darwinism that was put to use by social Darwinists. The "struggle", in the "struggle for life" was taken to mean "contention" and consequently "aggressive assertion" - to the benefit of individuals or portions of society: "to the victor, the spoils" become the ruling idiom. The "Natural" of "natural selection" was taken to mean pre-manmade changes in the environment. Technology was taken as the measure of advance from primitive (less technical) to advanced (more technical) societies. "Natural selection" was considered as a law that governs advance. Therefore, whatever advance there was technologically was considered "natural" and so, justified.

Social Darwinists did not really consider the "subtleties or qualifications of Darwin's theory. They equated affluence and occupation of the seats of the mighty with biological fitness, and common laissez faire, cut-throat competition and rivalry with Natural Selection." (Dobzhansky, T. 1962 p.11). Thus success in business or war was taken as the "measure" of a person's worth - which was considered as a measure of biological fitness. Natural selection can therefore be seen as the bastion of American Capitalism. Some American ideologists (e.g. Summer, [1840-1910]. Dobzhansky, T. 1962) even felt that the terms "strong" and "weak" were meaningless unless "strong" was equivalent to "industrious" and "frugal" and "weak" to "idle and extravagant". Consequently, millionaires were the products of the action of natural selection on the whole body of men to select those who could "meet the requirements of certain work to be done. John, D. Rockefeller (Sr.) himself agreed that "The growth of a large business is merely the survival of the fittest. It is merely the working out of a law of nature and a law of God." (In Dobzhansky, T. 1962). Such views seemed to glorify "rugged individualism", and the effects of such thought are evident in politics, business, etc. Ultimately, this type of "understanding' of scientific theory led to the belief that struggle and competition are the demands of progress - between individuals, social classes, nations, states and races.

Success, in terms of material wealth which formed the basis of progression, in terms of technology, and survival in terms of aggression, easily fostered the idea of the existence of a biological master race, the nordics. This is evident in Hitler's attempt to subjugate the rest of the world for the "Master Race" or the Aryans. His attempt to secure the world for the "master race" can be seen in his aggressive policy of elimination of "inferior" races. The effects of such views are also evident in his social policy, for in this way, he felt that he could develop and populate the world with the "master race". The eugenics policy of Nazi Germany was also based on

Darwinian and genetic theory, but, interpreted to accommodate social and political ideals. Consequently, marriages (artificial selection) were allowed only between those who could prove themselves "Aryan" which was considered a "pure race". It was felt that "defects" would not be able to infiltrate the development and spread of "pure strains" as natural selection would constantly eliminate them.

The English view was slightly different. They felt that it was God's will (Dobzhansky, T. 1962) that the English and the Teutonic races had been prepared for a thousand years (based and justified on Darwinian theory) to conquer the "inferior races" of the world, to administer them and to develop them culturally along Western or English standards. Thus the subjugation of the "inferior races" would be to their benefit, (i.e., to the benefit of the subjugated).

In the background of commerce and technology and based on the comparative method, European and particularly English culture was held up as a standard towards which all other cultures should progress. And if others did not wish to "progress" towards this standard, it was because they were ignorant; they therefore, had to be taught, by force. Religion also played a role in the "educating" and "uplifting" process. Since the religion of the "higher race" was ipso facto better than that of the "inferior races" it should be spread among the latter. Their, mostly "polytheistic" religions accompanied by "blasphemous" and "barbaric" rites, provided no way for them to be "saved" -in the Christian sense. They, therefore, had to be converted. This led to numerous other social and ethical consequences.

The education systems used (or imposed) in conquered lands were also a reflection of the view that the conquered peoples were inferior. It was argued that the conquered peoples would not be able to "match up" to the education of the conquerer: since they were considered inferior, their intelligence also must be inferior! And indeed, early "intelligence tests", based on Western education, did "prove" this! Consequently, education was mostly confined to the development of technical skills which would be useful in industry - and would eventually be to the profit of the occupying nations.

The "superior-inferior" view, coupled with the need for skilled technical labour, also led to the segregation of education. For it was argued that mixed education would result in the "inferior races" being an impediment to the education of the "superior races", or that the former would not be able to "match up" to the latter.

Thus, the benefits that the superior conquerers wished to bestow on the "inferior" conquered, were reduced to exploitation of subject peoples and destruction of their culture (either by eliminating them to a large extent, as in America and Australia, or by virtually forcing a new culture on to them). This was often replaced by the culture and government of the conquering races.

In the interests of economy, much of the natural resources of colonies had also been exploited, resulting in the disappearance of animal and plant life. Where indigenous people have killed (animals) only for food, the colonial masters have killed for sport and the acquisition of trophies to "prove" their supremacy. Indigenous peoples in many parts of the world have therefore dwindled considerably in numbers and are treated as "endangered species" to "develop" in reserves where their habits and cultural artifacts have become objects of tourist curiosity and anthropological study which sees them as primitive.

Much strife and uncertainty has also "developed" indigenous peoples because of the infiltration of their religion by religions and systems of thought foreign to them. The younger generations, being educated in schools provided by the foreigners have often found it easier to adopt foreign religions and think of their own religions and systems of thought as outdated and even primitive. The adoption of new religious thought has also resulted in changed values with subsequent friction between older and younger generations. This has led to much confusion in younger generations. Many customs which had formed the basis of certain value systems, have consequently been abandoned with resultant loss of those value systems: their ethics therefore has also changed considerably.

Religious infiltration has also resulted in "new strains" of religion being set up consisting of a "mixture" of traditional (indigenous) customs and beliefs being changed and adopted into the "new" religion. Thus, in order to bring personal peace and avoid uncertainty and fear, a complete break from traditional faiths has been avoided. In this way religions have carried into them and with them, customs which can be traced to origins foreign to certain religions. These origins are often forgotten in claims for the "true religion", when these are expounded as the basis for systems which could bring peace and understanding.

Religion, education and medicine have often been used by colonial powers to justify their presence in conquered territory. They felt that their "superior" culture was beneficial to the indigenous people. But while humanitarians were supposedly civilizing the people, their land, which had been claimed in the name of the conquering government, was often sold to individual enterprise which stripped the land of its natural resources. The indigenous people thus became landless and were reduced to a labour force, their worth being defined in terms of the amount of work they could do. But this has also concentrated the labour force into a single powerful unit. Basic value systems, or ethical systems have in this way been changed, leading to changes in social structure and in government. These new systems, however, which were thought to be "superior", with a basis in scientific theory, have still not been able to provide peace and stability. This is largely because the "new" systems are unsuitable. This is borne out by upheavals in former colonial countries, now turned "republic" - especially, in what have been termed "third world countries".

Technological advance was thus considered as the basis to progress. Those societies or people who were more dependent on technology, a technology that also brought them greater wealth, considered themselves as advanced. And since they were more advanced technologically, European society saw itself as being destined for the enlightenment of mankind. In such thinking was also embodied the idea of the superiority of Western concepts. These have consequently been foisted on "primitive" peoples to educate them and so alleviate their miseries and lead them to freedom (in the religious sense). Thus, while the "primitive" people were exhorted to look heavenward to happiness and freedom, their "teachers" enjoyed the fruits of their labour (i.e., the labour of the "primitive people") on earth. This has to a large extent contributed to much of the discontent in the developing "Third World countries".

4.4 Discussion

Darwin's theory, coupled with the lines of thought that emerged from the Eighteenth Century, formed the basis of the European view that progress was a "mechanistic compulsion" inherent in the "nature of things." Enlightenment thought, however, was focussed on the "... discoveries and possibilities of science and technology ... proceeding along a progressive path. This evolutionist thrust into the future ... was not grounded in the critique, but in the optimistic acceptance of evolving industrial Capitalism. Progress was seen as inevitable; social ills and disorder were simply attributed to inadequate technology." (Diamond, S.and Belasco, B. 1980. In Rossi,I.(ed.) 1980. p.543). "Social engineering" was therefore important in order to maintain order in society - the development and maintenance of particular classes for certain particular purposes (which goes back to Plato's Republic), evident in the colonial social and education policies.

Although it has been shown that cultural evolution is not dependent on any biological component, and consequently has no (biological) "necessary connection" with biological racism, social scientists among others, seem to have disregarded the context (whether deliberately or not) in which Darwin enunciated his thesis. The consequences of such disregard are evident even in the present. When Darwin spoke of Natural Selection he was concerned with natural processes where "natural" was used as an antonym of "artificial", (in artificial selection). The "struggle for existence" and the "survival of the fittest" were concerned with "differential reproduction of carriers of different genetic endowments owing to their adaptedness or shortcomings in a given environment". (Dobzhansky, T. 1962 p.11). The "fittest" in the "struggle for survival" was not a victor from any aggressive act; but more likely a "prolific parent".

The biological approach to man was dominated prior to 1940 by many varieties of social Darwinism. During the War and post-war years, however, popularity in the field declined because of its identification with Nazism and other racist policies. Despite this it has survived, but has assumed a different form and basis. The war years did increase the awareness of the use of "counterfeit biology" and to the dangers of the use of scientific theory - without a proper understanding of the basis and tenets of the theory. Some dangers of the use of social Darwinism and the use of genetic theory are evident in the "negative eugenics" policy (Tobias, P.V. 1969) of Nazi Germany.

Studies in hominid evolution show that the emergence of the hominid stock and its progressive changes from Australopithecus through Homo habilis and Homo erectus to Homo sapiens is correlated with the progressive increase in the number and quality of cultural artifacts and also the increase in cranial capacity. From the stage of Homo habilis "the human line is culture-bound and culture dependent" (Tobias, P.V. 1979 p.90). The Homo erectus stage is marked by the global spread of man from his cradle in East Africa (Leakey, R.E. and Lewin, R. 1977; Tobias, P.V. 1973). Artifacts found with his fossils (Tobias, P.V. 1969) show the beginnings of ritual and its correlates, symbolism and ideology. "The era of ritual evolution that he had pioneered was about to give way to the epoch of artistic, linguistic, and spiritual evolution that has been the hallmark of modern man" (Tobias, P.V. 1979 p.91); over a period of some three million years. With the emergence of symbolism and ideology ("The Second Transcendence" - Dobzhansky, T. et. al. 1977), the rate of cultural evolution increased towards domestication, agriculture, religion, writing, medicine, language, etc. From this stage on, man's development was rapid and directed for it no more depended on chance (mutations). The trend towards technology and social organization increased. The pattern, however, was not unidirectional, but like the non-human evolutionary patterns, mosaic, or similar to "adaptive radiation". In such a view, "progress" is problematic, and "civilization" assumes a meaning different from that which is embodied in "unidirectional views".

It was felt (Diamond, S. and Belasco,B., 1980. In Rossi, I. (ed.) 1980) that culture depended on "mental differentials ... which were quantitative not qualitative variations." This view, also held that the "chain of common experiences" is correlated with the "mental evolution" of society. According to David and Belasco (1980), Tylor's and Morgan's views also lead to ethnocentricism and racism. It was assumed that all cultures follow a common course. Culture is also seen as an extrabiologic phenomenon,(Diamond,S.and Belasco,S.1980. In Rossi,I.(ed.) 1980) but dependent on organic evolution of the brain and its capacity for symbolism. Cultural evolution thus emerges as a self-generating process which is "continuous, cumulative and progressive", making culture an extension of Natural history.

Ethnocentric theories are characterised by "evolutionary determinism" and embody "mechanical materialist concepts".

"They reduce symbolic intervention to an exclusively material imperative -technology, population pressure, environment, etc. ... and there is no dialectic evident between human and human, human and nature and human and culture" (Diamond, S. and Belasco, B. 1980. In Rossi,I. (ed.) 1980) p.561). Thus the historical aspect of culture is not emphasized; the human constitution of history is ignored.

Opposed to these deterministic views is the concept of dialectical evolution (Karl Marx) embodying interactions as constitutive of a "social totality". Culture and society are thus understood as concrete, not abstract phenomena. Change is seen as an historical process where human relations, including nature, play a vital role, together with cultural or historical inheritance. Thinking and acting thus become a single process where human experience and action "react intentionally in unexpected ways". Cultural evolution must therefore be seen in the light of "human purpose and volition" determined in certain particular environments or situations. In this perspective, evolution is not moving towards determined goals. This indeterminism gives to "success" and "progress" a different meaning from that which they assume in Western civilization. In the deterministic view Western civilization is assumed to be the peak of progressive development: as a beacon towards which all other social evolution must progress.

Western civilization, although constructed by man, is viewed as a "reality" and seen as being unavoidable since it is based on man's view of the evolutionary process; modelled on biological evolution: that it cannot be controlled. And if evolution is viewed as being progressive, it lends support to "imperialism that diffuses by socio-economic and political conquest, mirror images of the domestic experience of alienated Europeans" (Diamond, S. and Belasco,B.1980. In Rossi,I. (ed.) 1980. p.565). In "primitive" societies, the individual progresses through experiences in society which is also changed by his development. There is thus a "dialectical" unity of people and their total environment.

The unidirectional view is not an authentic picture of cultural development as culture spreads, diffuses and develops in various ways. Different cultures do not exist in isolation but mutually affect and influence each other through conquest, commerce, etc. Different comtemporaneous cultures or societal organizations (e.g., tribal organization) are seen as being in different stages of development towards civilization (where European culture, technology, etc., of the time, was taken to represent civilization) or, evolving towards civilization at different rates. This view provided an easy foundation for biological racism of the late Nineteenth and early Twentieth Centuries" "some people are by nature incapable of progressing beyond tribal savagery, (tribal organization and ways of life of indigenous people of the European colonies), while others are superior and develop civilizations" (In Dobzhansky, T. 1962 p.9). Dobzhansky, however, did not agree with such views for he found no necessary connection between biological and cultural evolution. Such views do not consider the fact that all civilizations have also passed through different stages in their development (to their present condition). Tribal organization must not be seen as the "inability" to progress further, for this would mean that the tribe cannot develop further. It must be seen rather as an organization that is sufficient for the needs of a particular group of people at a particular time: sufficient for their social, economic and political needs, etc., for certain particular "historical conditions". History has shown that an organization will change under changing circumstances. Thus it is not any mental capacity, etc., but also prevailing historical conditions that determine change.

Since man is also a product of biological evolution, it is felt that his behaviour is also derived from non-human animals - that aggression, etc., can be traced to these animals. Ethnology and sociobiology are attempts to link human and non-human behaviour through genetic theory. An investigation of genetic theory, however, shows that it cannot provide adequate support for ethnology and sociobiology.

CHAPTER 5

SOCIOBIOLOGICAL THEORY

5.1 Introduction

Sociological or anthropological accounts of ethics deal only with human behaviour and seek the origin and explanation of such behaviour in ancient custom and tradition. Sociobiologists however, attempt to find the roots of behaviour and of customs and traditions themselves, in animal behaviour. Based on biological theory, sociobiologists give an account of behaviour in terms of the survival value of behaviour. Thus individual behaviour was felt to be directed towards individual survival. This view was based not only on Darwinism ("survival of the fittest") but also on the "selfishness" of the Gene (Dawkins, R. 1976), a view which itself had origins in the Darwinian hypothesis.

Sociobiologists find the roots of ethical behaviour in altruism and kinship relations of animals. Sahlins (Sahlins, M. 1976) view is that, since kinship relations are different in different cultures, it could not be a natural basis for ethics. Singer's (Singer, P. 1981) view however, is that whatever form these relations might assume in different cultures, they could provide a basis for ethics, for men do not care for their own relatives only, but extend this feeling to others as well. They do begin however, by looking to the needs of their kin before that of others. This does result, often in strife, in multiracial societies where aiding or seeing to it that one's own race or ethnic group has the best before attending to the needs of others, meets strong resistence.

Social reformers often attempt to extend the family tendency to all society so that the needs of the community are attended to like the interests of the family. (Communist manifesto, Israeli Kibbutz system and some monastic settlements). Despite the view of social reformers who try to develop a social good by suppression of family life, family bias does provide the basis for assisting others. Reciprocal and group altruism is thus a strong feature of human social behaviour. This is evident in Hitler's use of group altruism to stir up nationalistic feelings and Stalin's use of the notion of "Mother Russia". Human ethical codes thus reflect group feelings leading to patriotism - which can be seen as "group selfishness", when extended to nationalism.

Thus Singer feels that "cultural and biological factors interact is something that should be borne in mind throughout our discussion of the biological basis of ethics. Biological and cultural explanations of human behaviour are not inconsistent unless, foolishly, we try to insist that one of these is the sole cause of a complex piece of behaviour" (Singer, P. 1981 p.52). Thus culture can change "genetically based tendencies".

Sociobiology must therefore be examined in the light of the Darwinian hypothesis, and the genetic theory. It must also be found to what extent these theories are determinative in human behaviour. The extent of cultural influence must also be examined in such behaviour or whether culture is an extension of animal behaviour. In such an evaluation the importance of the genetic theory of inheritance cannot be overestimated. For if human behaviour is genetically based and determined from animal behaviour, then the ideas of free will and responsibility so necessary to moral action or conduct, will be in question. Moral conduct is dependent on choice. It is therefore important to investigate the extent to which genetics is determinative in this choice.

5.2 Sociobiology

Sociobiology is the attempt to explain diverse social systems and human behaviour in terms of biological theory. Just as the Darwinian hypothesis attempts to explain the emergence and evolution of the human from non-human ancestors, sociobiology explains or derives human behaviour and social systems from these ancestors through natural selection. The genetic theory is considered as the basis of this derivation. Although man has changed much from his simian forebears, it is felt that he still shares many behavioural features with them, although in modified form. Trends in social organization, e.g., "behavioural scaling" which primates utilize for adjustment of "aggressive and sexual interactions", has in man become multidimensional. Sociobiology (Wilson, E.O. 1980: Sociobiology to sociology) is the search for the "human biogram" (Count, E.W. 1958; Tiger. L. and For, R. 1971) or the identification of behaviours through which society is manipulated by individuals so as to increase their "Darwinian fitness". The plasticity of this "biogram", (considered a phylogenetic vestige) is evident in the varied types of culture man has developed to dominate the environment, including the human and non-human inhabitants of this environment. No non-human social organization (even that of the insects) manifests this plasticity, which is probably due to the absence of interspecific competition. Using the "Insect Societies" (Wilson, E.O. 1971) as a basis Wilson attempts to develop a unified theory of sociobiology (Sade, D.S. 1975) integrating all fields of biology of a range of animals from bacteria to humans. Like Wynne-Edwards (Wynne-Edwards, V.C. 1963) and Barash (Barash, D. 1979) Wilson examines evolutionary rules that could have universal applicability for behaviour. Wilson's view is that evolution has produced societies. To understand societies and social behaviour, therefore, the processes by which natural selection, operating on genetic variants, could have brought about these societies, have to be investigated. Wilson defines society as a "Reciprocal communication of a co-operative nature, transcending mere sexual activity, is the essential intuitive criterion of a society" (Wilson, E.O. 1980 p.7). Society, therefore, constitutes more than just simple aggregative behaviour, territoreality or sexual behaviour, although these do seem to characterize social behaviour. A society is also characterized by a hierarchy, usually measured in terms of superiority in aggressive behaviour. Wilson explains the origin and rapid development of human society through the use of the "multiplier effect" (Wilson, E.O. 1980) which he asserts increases phylogenetically in correlation with intelligence. This view shows that Wilson sees evolution as proceeding in a single direction towards higher and more intelligent forms, culminating in humans.

According to evolutionary theory traits that are adaptive will be selected to the advantage of the population. Non-adaptive traits can, therefore, be seen as features that are inflexible in environments not usually encountered by a species. Environmental changes can also render previously adaptive traits, non-adaptive: for natural selection determines only those classes of traits that are of adaptive advantage to animals. Consequently, those traits will be selected; which would serve the animal in different environmental conditions. Ethologists, like Conrad Lorenz believe that behaviour and social structure can be studied as "organs", their structure and function being determined by genes. Wilson's view is that "Social evolution is the outcome of the genetic response of populations to ecological pressure within the constraints imposed by phylogenetic inertia" (Wilson, E.O. 1980 p.20). This is evident especially in the insect world where eusociality has originated some twelve times; but only once in an order outside the Hymenoptera, i.e. in the termites.

Wilson also (1980) sees reciprocal altruism, frequent in human behaviour, as being consistent with genetic theory, although it is not the general rule in infra-human behaviour. He attributes this to the fact that relationships and memory are not very enduring in animals. Anthropoids, however, do show it to varying degrees. Wilson thus feels that "a single strong thread does indeed run from the conduct of termite colonies and turkey brotherhoods to the social behaviour of man" (Wilson, E.O. 1980 p.63).

It has also been found that as the animal advances on the evolutionary scale it depends increasingly less on its genes. At the human level, behaviour is more dependent on tradition and culture. Through teaching and learning, specific forms of behaviour are passed from one generation to another. As tradition is enriched, its effectiveness is accelerated and is often initiated or altered by an individual. Its effect is cumulative and its spread rapid, often within a single generation. The uniqueness of tradition and its application to specific places and individuals results in its fast divergence in families, societies and populations. Culture, Wilson feels, differs from "animal tradition" "only in degree" (Wilson, E.O. 1980). Changes to the environment by humans has also resulted in changes in behaviour patterns of animals, especially primates. Studies of such shifts in behaviour patterns resulted in the belief that the genes responsible for these patterns could have been inherited from lower animals. In the pre-Pleistocene era two or more hominid species did exist together: **Australopithecus africanus** and **Homo habilis**. But only one of them survived the Pleistocene. This species, it seems possessed a plasticity that could accommodate numerous changing conditions. "The hypothesis to consider then, is that genes promoting flexibility in social behaviour are strongly selected at the individual level. But note that variation in social organisation is only a possible, not a necessary consequence of this process" (Wilson, E.O. 1980 p.273). The variation in social structure could be due to "... lack of competition from other species" (ecological release). Unlike animals that are "tightly packed" in the ecosystem leaving little room for experimentation, man is not subjected to the constraints of interspecific competition. He is, however, subject to cultural competition. And cultural traits can change within a single generation: "Culture is not inherited through genes, it is acquired by learning from other human beings .... In a sense, human genes have surrendered their primacy in human evolution to an entirely new non-biological or superorganic agent, culture. However, ... this agent is entirely dependent on the human genotype" (Dobzhansky, T. 1963). Certain features of human behaviour do have a high heritability. The predominance of these characteristics have been responsible for the predisposition of societies towards cultural differences.

Anthropological genetics have also attempted through phylogenetic analysis to compare man to other primate species in order to identify basic primate or genetic traits. Such analyses attempt a derivation of human from infra-human behaviour patterns. Ethologists such as Konrad Lorenz (**On Aggression**), Robert Ardrey (**The Social Contract**), Desmond Morris (**The Naked Ape**) and Lionel Tiger and Robert Fox (**The Imperial Animal**) have all in their works called attention to man as a biological species and have discussed his behaviour as adaptive to particular environments. They showed that the extreme behaviourist view of Man's mind as an "equipotent response machine was neither correct nor heuristic". Ethological handling of the problem, however, was also inefficient and misleading. "They selected one plausible hypothesis or another based on a review of a small sample of animal species, then advocated the explanation to the limit." (Wilson, E.O. 1980 p.275). Their work advocates a direct continuity between subhuman (especially primate) and human behaviour. And the same or similar reasons are attributed to human behaviour, which are attributed to behaviour in subhuman groups. This is taken to signify the presence of genes for particular types of behaviour.

Close examination of these views and of genetic theory shows that such genes are not forthcoming. Human behaviour, therefore, cannot be derived directly from animal behaviour. Although Wilson postulates "genes promoting plasticity" the genetic theory does not support the existence of such genes. If such genes did, in fact, exist, they would have to be derived from the animal world in which "genetic plasticity" would be problematic.

5.3 Methodology and links with other theories

In the first part of **Sociobiology** (Wilson, E.O. 1980) Wilson analyses post-Darwinian evolutionary theory and its relation to social evolution. The genetic structure of the population is used as the basis for the definition of the group or society and the individual. Genetic isolation and in-breeding raises the coefficient of relationship in the population. Thus through kin selection the evolution of altruistic behaviour is enhanced. The concept of "inclusive fitness" developed especially by Hamilton (Hamilton, W.D. 1963) is perhaps the central concept of Wilson's theory. Individual genetic fitness, therefore, is measured in terms of the survival and reproduction of individual and offspring, and also by "fitness" enhancement of relatives sharing these genes. Consequently, the development and evolution of co-operative or altruistic acts is facilitated - even though these would be detrimental to the individual's survival. Altruistic behaviour would consequently increase in the population of animals bearing similar hereditary traits. Altruism, and consequently, kin selection, is therefore central to Wilson's Sociobiology.

The second part of the book includes reviews of social mechanisms (group size, reproduction, time-energy budgets, social symbiosis), their evolution and adaptation to ecological pressures, and the optimization and use and development of the "caste" system of insect societies. Using models, he shows that the relatively stable tropical environment has the most numerous and specialized development of insect "caste" systems.

The third part of Sociobiology deals with the behavioural adaptations of social animals, including micro-organisms and man. Sociobiology thus becomes "... a systematic study of the biological basis of all aspects of social behaviour, particularly of animal societies, but also encompassing the social behaviour of early man and the organization of the more primitive contemporary human societies" (Waddington, C.H. 1975. In Chaplan, A.L. 1978 p.253).

In Wilson's view colonial invertebrates seem to constitute the most perfect societies. Having identical genes, colonial members exercise an "extreme degree of altruism". Individual freedom and interest is subordinated to the advantage of the colony whose members are specialized for specific tasks (e.g. colonial coelenterates). As in insect societies, there is morphological differentiation towards specialization and division of labour between castes - conducive to the altruistic behaviours that help maintain the colony. Sociobiology is therefore defined as "The systematic study of the biological basis of all social behaviour ... Its central precept is that the evolution of social behaviour can be fully comprehended only through an understanding first, of demography, which yields the vital information concerning population growth, and second, of the genetic structure of populations, which tell us what we need to know about effective population size in the genetic sense, to coefficients of relationships within the societies, and the amount of gene flow between them. The principal goal of a general theory of sociobiology should be an ability to predict features of social organization from a knowledge of the population parameters combined with information on the behavioural constraints imposed by the constitution of the species" (Wilson, E.O. 1980 p.4-5). Integrative neurophysiology could then become the framework within which "... whole patterns of animal behaviour could be explained, in the terms of functional and evolutionary biology." Lewontin seems to support such a view saying that "natural selection of the character states themselves is the essence of Darwinism. All else is molecular biology." (Lewontin, R.C. 1972 p.181-182).

The sociobiologist view that earlier stages in human evolution have borne behavioural determinants, sets constraints on human behaviour. Wilson's view is that recognition of these constraints makes the "approach to social behaviour realistic and effective." He even goes so far as to suggest that a foundation for ethics can be found in an understanding of the functioning of the neural systems of the brain, (Wilson, E.O. 1980): "The biologist, who is concerned with questions of physiology and evolutionary history, realizes that self knowledge is constrained and shaped by the emotional control centres in the hypothalamus and limbic systems of the brain." (Wilson, E.O. 1980).

With the development of the theory of Natural Selection (the modern synthesis, based on genetics) explanations of human characteristics are sought in animal behaviour, at a genetic level. Following this trend, Wilson (Wilson, E.O. 1975a pp.108-110) declares that ethical behaviour can be explained, like altruism in animals, on the basis of natural selection of inherited traits. Sociobiology, therefore, provides a new perspective on ethics: that ethics should be "biologized". Sociobiologists are of the view that the basis of ethics or moral behaviour can be found in kin selection and altruism. In the chapter on "Morality of the gene" (Wilson, E.O. 1980) Wilson says, "The biologist who is concerned with questions of physiology and evolutionary history, realizes that self knowledge is constrained and shaped by the emotional control centres in the hypothalamus and limbic systems of the brain. These centres flood our consciousness with all the emotions, hate, love, guilt, fear and others, that are consulted by ethical philosophers who wish to intuit the standards of good and evil. ... The hypothalamic limbic complex automatically denies (such) logical reduction by countering it with feelings of guilt and altruism. In this one way the philosopher's own emotional control centres are wiser than his solipsist consciousness, knowing that in evolutionary time the individual organism counts for almost nothing. In a Darwinist sense the organism does live for itself. Its primary function is not even to reproduce other organisms; it reproduces genes, and it serves as their temporary carrier. Each organism generated by sexual reproduction is a unique accidental subset of all the genes constituting the species. ... As more complex social behaviour is added to the genes' techniques for replicating themselves, altruism becomes increasingly prevalent and eventually (appeared) appears in exaggerated forms." (Wilson, E.O. 1978 p.3).

Wilson thus feels that ethical behaviour should be seen as biological adaptations and that the content of "beliefs" should be examined with reference to the "emotional control centre." Ethical claims then rest on "biological empirical claims" and are not only emotive responses. Wilson asserts that if this interpretation is correct then men do have innate rights that take root in the drives for survival and self esteem. Consequently, they do not have to be validated by "ad hoc theoretical constructions produced by society." Wilson thus seems to suggest that ethical constructs (since they are biological adaptations) are justified by biological claims, validating the derivation of human rights from sociobiological fact.

Dawkins (Dawkins, R. 1976 p.21) holds a view similar to that of Wilson: genetic constructionism is taken as an explanation for all aspects of human anatomy as well as behaviour. His view is that "Our genes swarm in huge colonies, safe inside gigantic lumbering robots, sealed off from the outside world, communicating with it by torturous indirect routes ... they created us body and mind; and their preservation is the ultimate rationale of our existence." (Dawkins, R. 1976 p.21).

Sociobiology can, in this perspective, be seen as an extension, on a genetic level, of "Social Darwinism". Genetically based or biologistic explanations are given for human behaviour and institutions. The close links with the Darwinian Hypothesis (of Natural Selection) is based on claims of a close relationship between the "social" (or what is interpreted as such) behaviour of animals and the nature of human social institutions and behaviour. Such a view sees human nature and institutions as determined by such characteristics as "territoriality", "indoctrinability", "reciprocal altruism", "aggression", etc., inherited from non-human ancestors. This would mean that, although modified or intensified to some degree , these characteristics are the same as those of animals, whence they have been inherited. Modern Euro-American culture sees these as basic qualities of human nature. Ignoring historical and ethnographic perspectives, this claim is founded on the evolutionary view that existent social institutions have superior adaptability. This would mean that existent human behaviour and institutions are as they should be (because of genetic determinism) and are appropriate for the existing conditions.

Such a view would tend to justify existing social institutions as the product and outcome of natural tendencies. Present behaviour patterns or moral conduct would also be justified as natural and a transitional stage in the development towards a better society. Thus existing social systems and codes of behaviour and relationships between different people should be maintained and accepted as natural processes have selected the present form as best suited to the circumstances. Emphasis on the determinist view of biological theory thus tend to justify the status quo. This is reflected in social and political policies and institutions and determines the relationships between people and between different groups of people.

5.4 The implications of sociobiology

Sociobiology has through its genetic and biological hypotheses influenced the development of social as well as political policies. Natural selection has been claimed as the primary agent for the development of social and political policies, (Allen, E. et al) resulting in a deterministic view of behaviour. Consequently, a genetic basis or explanation has been sought for such problems as crime, alcoholism and even for racial differences in intelligence. They also provide a genetic justification for the privilege of certain groups according to class, race or sex. They have, for example, provided a basis for America's "sterilization" and restrictive immigration laws (1910-1930).

Sociobiology has thus served to "reinvigorate" the old theories attempting to show that man's behaviour is due to evolution, in the same way as organic evolution: all behaviour would thus be explicable and understood in terms of biological theories. Sociobiology would therefore, in the light of modern genetic theory, reinforce Social Darwinism and support eugenic policies.

The determinist element in sociobiology sees the present state of society as the result of biological forces (genetic determinism, natural selection, etc.) and the biological nature of humans - over which no conscious control is possible. Present social and political conditions can therefore be justified on biological grounds as being selected naturally for the present conditions - which are also products of "biological imperatives." Past and present social institutions are thus legitimized and aggression, competition, the defence of national territory, individualism and the present hierarchical order of society are viewed as being inevitable. It has long been felt that "evolutionary imperatives" have determined human social behaviour. This has been seized upon and widely entertained not so much for its alleged correspondence with reality as for its more obvious socio-political value. In the background of modern social dynamics sociobiology seems to promote the acceptance of present situations as they appear the world over. For it would consider these situations as natural since the processes that led to these situations were genetically determined. Of consequence, they are the best situations for the present since they have been brought about by natural selection. It justifies the **status quo** which is further maintained by (in certain societies) discriminative legislation, social injustice and militarism. Discrimination is often on grounds of race, colour, creed, religious beliefs, etc. Sociobiology, therefore, not only accounts for but also promotes the present state of things.

The environmentalist view that culture is the basis of human behaviour also shows culture as directive in human behaviour. Adherents of this view use their position to erect barriers against social change in order to defend established social institutions. If people are plastic, then those with a claim to knowledge would feel justified in their claim to authority over others. This could lead to dictatorships. Thus if human nature (psychologically - as opposed to genetically) is a product of history and "given social relations" it could result in the removal of barriers to manipulation by the powerful. Both determinist and environmentalist attitudes thus lead to similar positions.

5.4.1 Socio-political implications of sociobiology

Sociobiology has implications for the question that has plagued man for over two and a half millenia: What is the nature of political man? Is man inherently good or evil? Or, is man political by nature? Unlike the view of Rousseau (The Social Contract) who saw man as solitary in the "natural" state, sociobiology would advocate that man is social and thus political. The question of man's inherent goodness or evil is also important from a religious point of view as the Bible sees man as having "fallen" and in need of "redemption".

Kropotkin (1903) along with other anarchists, asserts that man is inherently good and that humans are inherently good by nature. The state, therefore, is not necessary and evil. Hobbes (Leviathan), however, sees man as selfish and self-centred. A strong state is therefore needed to regulate society and curb the selfish tendencies of man. Marx and Owen see man as neither good nor evil. Human nature is, therefore, a "reflection of the objective conditions under which humans are raised and live", it is thus a reflection of society. According to Aristotle, man is by nature a political animal (Aristotle - Politics). Locke, however, felt that man learns to be political as reason demonstrates the necessity of political life. Locke (Two treaties of government) was of the view that people are by nature in different groups. Thus people should perform those duties and responsibilities for which they have been equipped by nature.

Human nature, however, had to be developed, in, for, and by the state. The nature of man has thus provided the foundation on which political theorists could develop their political philosophies. Competing political and social ideologies also find a basis in human nature, as classical conservatism assumes that people differ in intelligence and ability. For social order or stability to prevail, it is necessary to have a strong state or tradition to counteract the imperfections of human nature. However, it is unwise to change individuals through social engineering as the consequences of directed social change cannot be comprehended by man's rational capabilities.

In contrast to this view is Liberalism which feels that man desires freedom and to this end is rational. He can, therefore, using his rational faculties effect deliberate political change. The individual then becomes a manifestation of purpose or duty. This raises questions as to whether the rulers or the ruling group is servant or master: if servant, they would carry out the wishes of society; if master, they would direct society. It can only be assumed that they would know the correct course to pursue, in order to achieve the desired freedom. Basically, the course would be that directed by human nature. If the individual is conceptualized as "economic man", the application of a cost benefit calculus to maximize economic gain" would result in Capitalism.

Based in reciprocal altruism, if man is seen as being, or as capable of becoming essentially co-operative and nonaquisative, society can be seen as being essentially Socialist. In such a society man can happily and effectively share the means and the output of production. Socialism, however, assumes many forms but central to its thesis is the view that only through a "collective, social ownership of the means of production", can a morally justifiable foundation be laid on which a society can be built. The anarchist view, however, (Kropotkin, P. 1903) also based on altruism maintains that a political society is unnecessary, as man is inherently good and co-operative. Depending on the convictions, therefore, about the nature of political man, diverse ideological schools emerge.

From a sociobiological point of view, and since altruism has a genetic basis (Wilson, E.O. 1978) human nature is seen as being inherently good: for, consistent with genetic theory, reciprocal altruism is part of human nature (Wilson, E.O. 1980). And since it would be advantageous to human survival, it would be selected for, in evolution. The opposite, however, is also applicable: aggressiveness, since it can enhance reproductive success, can also be selected. Sociobiology, therefore, gives credence to divergent views, in support of a single phenomenon.

For sociobiologists, behaviour is a product of evolutionary adaptation and as such "is designed" (since it was selected for in evolution) for the maintenance of social stability. The emphasis on natural differences raises the consequent need for "subordination and superordination" in social and political science. Various insect castes are taken to represent social differentiation. And, even though primates are distinct from insect species, it has been hypothesized that their (primate and subsequently human) social organization displays a genetic basis for class distinction. Such distinctions have been used to justify the ideas of "ruler and subject", of "subordination" and also of a natural "division of labour". Reciprocal altruism can be seen as being advantageous in such a position. Wilson suggests that money and the free exchange of goods are also forms of reciprocal altruism, (Wilson, E.O. 1980). This leads Sahlins, M. 1976) to charge sociobiologists like Trivers (Trivers, R.L. 1971) and Wilson (1980) of advocating "possessive individualism". The fact that Australopithecus africanus, Homo habilis and also Homo sapiens spent much of their time in collective bands (Leakey, R.E. and Lewin, R. 1977, Tobias, P.V. 1973) like the lower primates, is taken by sociobiologists as a justification for the evolution of sociality in man. Socialists seize upon this fact as the justification for their advocacy of the "collective control of the means of production."

Viewed in sociobiological perspective, despite the effects of altruism, human tendencies are towards aggression and violence in both national and international affairs. This would seem to be the result of political socialization, analogous to the genetic determinant view of territoriality and group bonding and imprinting. This leads to the problem of whether the causes of, e.g. war, should be sought in human nature, the nature of states or in the structure of the international system.

Political and social institutions behave like organisms, adapting to changing environmental conditions. "Genetic selfishness" is counteracted by the development of social and political norms for altruism which is developed not through biological, but through social evolution. Processes analogous to natural selection are responsible for the development and evolution of socio-political institutions. Organic evolution has thus not kept pace with social, political and economic institutions. Thus, it is possible that man has no "genetic fit" with the social environment he has created for himself. Consequently, individual predispositions which are genetically influenced will be at variance with social norms and political structures for it is within these that the individual has to function. A balance, therefore, has to be restored and maintained between social and political structures and genetically influenced individual predispositions.

This argument of Peterson and Somit (Peterson, S.A. and Somit, A. 1978. In Caplan, (ed) 1978) would suggest a non-genetic basis for human altruism since it is "derived" from the conflict between individual predispositions and political structures. "Genetic selfishness" is thus controlled by political and social institutions. In its attempt to adapt to these institutions the individual effects changes in them, which in turn changes the individual: thus genetic control is not complete! This results in the process of continual change in the individual and the institution. Genetic theory would not allow such changes since mutations are basically the elements of change. And genetic mutations occur neither as quickly nor as frequently as changes in socio-political structures. A genetic basis for these changes is also unacceptable when viewed in the background of evolutionary theories such as "phyletic gradualism" or "saltatory evolution" which themselves are problematic when viewed in the background of genetic and evolutionary theory.

Individual reason and culture therefore, overrules genetic predisposition and guides the individual. Since there is a continual interaction between the individual and political and social institutions, a "genetic fit" cannot be achieved; also because the individual is not under complete genetic control as hypothesized for the non-human world. Consequently, both the individual and socio-political institutions continue to evolve, but in directions guided by forces within institutions themselves.

This would seem to support the view that culture is the primary determinant in the development of socio-political structure. Rawls, for example, in A Theory of Justice (1971) says, "In a just society the liberties of equal citizenship are taken as settled; the rights secured by justice are not subject to political bargaining or to the calculus of social interests" (cited in Caplan, (ed) 1978)

p.299). Individual rights, therefore, cannot be transgressed by anyone, including the state.
These premises lead to different prescriptions. The approach of Rawls would permit a rigid social control so that it might be possible to distribute equally the rewards of society. Nozick (Nozick, 1974) however, sees the control of the state only in a minimal capacity - state's function should be primarily one of protection of its citizens against force and fraud. The rewards of society should also be distributed equally. Unlike Rawls, Nozick accepts a meritocracy, unless the communities decide to experiment with egalitarianism. This, however, could lead to problems as it would require the constitution of a body to prescribe moral precepts. If social behaviour is "learned and transmitted by culture", social policies would be created by culture and thus decision-makers would validate the status quo. Such a view of social policy, consequent on the premises of environmentalism has been rejected by **The Study group of Science for the People** (S.S.G.S.P.).

Wilson (1980) therefore falls back on "human nature" with the human genotype imposing restraints upon "human nature". An understanding of their significance therefore, requires a reconstruction of the evolutionary history of the mind alongside cultural evolution. This also provokes the question: "To what extent should the censors and motivators in the emotive centres of the brain be obeyed? Given that these centres deeply and unconsciously affect our moral decisions, how faithfully must they be consulted once they have been defined and assayed as a biological process? The answer must confront what seems to be the true human dilemma." (Wilson, E.O. 1975 In Caplan A.L. 1978 p.301) They cannot be followed blindly. Their structure and genetic components are the products of millions of years of prehistory evolving in conditions that no longer exist. Even so, it is these processes that have guided human mental processes to the state where they are able to appreciate the necessity to choose consciously among the inherited emotional guides, if man is to decide how human he wishes to remain, in the ultimate biological sense. Wilson thus leaves man with a freedom of choice and yet reminds him of his biological position.

Consequent on this dilemma, a sense of reserve is advocated when proposals are made for social change - "based on utopian intuition". If biological interpretation is correct, then men possess innate rights. These are embedded in the drives for survival - which are independent of validational procedures like ad hoc theoretical constructions of society. If the creation of human rights is based on culture, as advocated by the environmentalist position, then, the withdrawal or removal of these rights can equally well be validated by culture.

Alper (Alper, E. 1976) agrees with the S.S.G.S.P. 1978) and with Wade (Wade, M. 1976) that Sociobiology is a political issue attempting to justify "biological determinism" as the basis of "human social existence". He however, feels that the efforts to biologize sociality are based not in biology, but in particular social and political perspectives. This is clearly evident when the S.S.G.S.P. takes issue with Sociobiology as being deterministic in providing a biological basis for sex roles in society, based on genetic theory. However, this bias exists in both agricultural and industrial societies and although Wilson (Wilson, E.O. 1980) lacks the proof for interpolation from insects or any other animal to man, he feels the position justified on the grounds that it has evolved to this state through natural selection. He therefore feels that society should not be "steered" (social engineering, eugenics, etc.) as the stresses and strains that society undergoes are the processes that give society its Darwinian edge. Thus, in a genetic sense, social control would not be able to adapt to changing circumstances - and this could be deleterious to its survival.

This view also regards society as an organism and sees the "Darwinian hypothesis" as the basis and guiding force of its evolution. Stress on the societal gene pool would therefore result in the survival of the best genes. Such a view would also justify those forces that are disruptive to society in whatever form. And the results of the disruption would, therefore, be looked upon as good and beneficial to society. Sociobiologists would see such positions as being natural and as the maximization of the genetic potential of the population. Their position that society should not be "steered" is contradictory as the "stresses and strains" of society are the results of society being "steered" by different economic and socio-political ideologies. Such views are also supportive of an ethics that is "self-centred", both at the individual and at societal level.

5.4.2 Ethical implications of sociobiology

Philosophers and scientists have long argued on the "relationship between empirical scientific knowledge and moral or value beliefs", or ethics. Science and ethics are generally separated with the result that the formulation of moral prescriptions on the basis of empirical science has not been acceptable. However, it is equally obvious that scientific findings directly influence the sorts of moral (or ethical) prescriptions held to be valid at any given moment. The notorious feuds at the beginning of ths century between those who believed ethics to be reducible to the empirical properties discovered by science and those who denied that any such reduction was possible, have produced a "schism between these two camps that few participants in either group seem willing to acknowledge, much less bridge." (Caplan, A.L. 1978 p.312).

Evolutionary theory (Darwinism) based in genetics concerns a drive for species survival. All else in behaviour, would thus, of necessity, be directed to this drive. Seen in the background of Darwin's theory, this would mean a "struggle for survival" with consequent "survival of the fittest". Darwin's theory concerned those genes that were best able to survive environmental changes. Dawkins (Dawkins, R. 1976) attributed this survival to the "selfishness" of the gene in its attempt to maximize its potential and so perpetuate itself. Behaviour among animals is considered from this viewpoint. And that behaivour is considered proper and appropriate, in the circumstances in which an animal finds itself, which results in the survival of that animal and consequently in the survival of its genes. Since genes are believed to be to a large extent both prescriptive and directive of behaviour, the animal is viewed only as a means to the survival or only as a vehicle in which the genes may realize their potential for survival and proliferation. This narrows the field for the search for ethics or for the basis of morality to those aspects of behaviour that are genetically controlled, or rather, all behaviour is seen in terms of genetic expression.

Sociobiology thus sees ethics as subservient to the preservation, proliferation and perpetuation of the gene. Natural selection and molecular genetics are thus combined to account for "self-oriented" behaviours by classical and individual selection, and altruism, by kin selection (to relatives) and by reciprocal selection (to non-relatives). The adaptive advantages of dominance, hierarchy, territoriality and other features of present animal behaviour are all accounted for on a genetic basis. This leads to a biological determinism which would constitute a justification of existing social institutions, as being adaptive. Human behaviour patterns could thus be viewed in the basis of adaptive radiation.

Already in the "Victorian social milieu" Spencer's evolutionary positivism served as a "sociological model". With evolutionism as the basis, Spencer contended that progress was an integral aspect of Nature. Humanity was assured of inexorable progress so long as its moral and consequently social precepts were founded on a scientific basis. This would result in a natural social order. Just as Newton had discovered the universal laws of natural causation which governed the physical universe, so, Spencer felt that evolutionism governed events in the biological universe. The scientific paradigm (Kuhn, T.S. 1962) of explanation could therefore constitute the basis of all knowledge. Biological, and consequently, human phenomena could thus be explained and understood in terms of scientific (cause and effect principles) theory: (Positivist view) a belief in the uniformity of nature. And since all parts of Nature are fundamentally similar, they should yield to similar analyses. "This assumption has profound effects on the epistemological status of humans: human situations can be seen as biological situations, human institutions, as biological instruments for survival." (Miller, L.G. 1976 In Caplan, A.L. 1978). Thus human conduct could be seen as biological regularities.

5.5 Sociobiology: an assessment

Sociobiology can be seen as an attempt to draw together the seemingly disparate behaviour patterns of birds, monkeys, insects, etc., in order to derive a common theory for the origin and maintenance of these behaviour patterns on an evolutionary basis: "to place all biological phenomena under a single rubric" (Miller, L.G. 1976. In Caplan, A.L. 1978). The sociobiologist aim is to develop a common set of parameters applicable to all the different groups of the animal world, including man. Bonner (Bonner, 1975) and Sade (Sade, 1975) express their enthusiasm for the view that the extension of sociobiology to sociology, and perhaps to the humanities will give to the latter disciplines the "precise quantifiable findings of population biology and evolutionary theory" (Caplan, A.L. 1978 p.306) although Wynne-Edwards (Wynne-Edwards, N.B. 1976) and Morrison (Morrison, R.S. 1975) endorse Wilson's evolutionary approach. The former is dubious whether the definitions of "society" can be conferred on biological systems such as ant or bee colonies. They both agree that vagueness and uncertainty cloud the corporation analysis of behaviour and its assessment as far as humans are concerned.

The sociobiologist attempt to derive society and ethics from altruism, kin selection, etc., is problematic since social communication and the "evolution of mentality" are also legitimate problems for the analysis of human behaviour (Waddington, C.H.1960). Altruism, kin and group selection, should be seen in the background of evolutionary theory (contemporary- Mayr, E. 1961, 1972; Dobzhansky, T. 1962, 1972; Simpson, G.G. 1963; Waddington, C.H. 1960) where evolution concerns "the product of organisms striving to maximize their contributions to the gene pool of future generations. The individual is the primary unit of evolutionary change", (Caplan, A.L. 1978 p.307); the gene pool is composed of individuals. Instances of altruistic behaviour include caste sterility, warning cries (which could be to the disadvantage of the individual giving the warning), adoption, food sharing, dominance hierarchy, etc. Reproductive and personal advantage are sacrificed in these instances for the benefit of other organisms. It is therefore difficult to reconcile the sociobiologist and genetic (Dawkins, R. 1976) theses that altruism serves reproductive and personal advantage, with the instances of altruistic behaviour.

Altruism, therefore, is the central problem of sociobiology. Wilson (Wilson, E.O. 1980) postulates altruistic genes in ants which results in castes, each modified for certain functions in the colony. Such modifications do not occur in vertebrates, much less so, in humans. The class or caste systems of humans are cultural inventions for socio-political purposes based on a division of labour. Distinctions of the system are also not as clear or as morphologically (or genetically) binding as in insect social systems. In a widespread species such as man, where there is much gene flow, selection will require much longer to effect changes in traits. It is also not known to what extent behaviour is under direct genetic control.

Wilson's extension of altruistic behaviour from animals to man; that it is adaptive, serving in the evolution of social behaviour both of animals and of man, is based on the assumption that such behaviour is present both in animals and in man and that even in man it is adaptive, has a genetic basis and is preserved and perpetuated by natural selection. To substantiate this claim Wilson tries to show that what is considered altruism in animals is moral behaviour in humans, or that these two concepts are so similar that they should not be separated.

However, moral behaviour is intentional whereas altruism, concerned only with consequences, i.e. with genetic fitness, is gene-directed. In humans, moral or altruistic behaviour is not concerned with fitness. Guided by intentionality, moral behaviour in humans is concerned with human relationships; towards living in harmony with other humans. It is also concerned with the treatment of all forms of life. Schweitzer's "respect of life", for example, will be an exception to Wilson's thesis. Although the practice of moral behaviour may assume different forms in different cultures, it is basically directed towards harmonious living, without concern only for the self. Its concern is for a way in which to understand and to accept society and so live in harmony in it, and not for personal fitness. Human "altruism" is not restricted to kinship or group selection; it is concerned with humanity at large. Situations are numerous, however, where human behaviour is motivated by personal or group gain. But this is directed not by any genetic influence but by emotion and reason.

Wilson's view is that altruism is gene-governed. Consequently, moral behaviour could not be derived from the same basis as altruism because it is largely culture - or reason - determined. Thus ethical behaviour is consciously directed and so forms a basis for moral action. Human altruism could have had its origin in the belief that altruism is beneficial to humans. Wilson does not give any priority to this view for he sees behaviour, and interprets moral beliefs as "... arising from the emotive centres of the hypothalamic limbic system" which is a product of natural selection (Wilson, E.O. 1980). But although the system could have evolved by natural selection each moral belief cannot be explained in terms of natural selection.

The sociobiology thesis is thus built on a number of assumptions interpreting human social behaviour on a genetic basis and expressed in biological terms. This view suggests that biological conclusions or solutions are applicable to human problems, although the biological basis for human behaviour cannot be determined conclusively in scientific terms. Thus the formulation of theories of human nature bear the political and social biases of sociobiologists.

Sociobiologists, according to their theory feel that the present system of social and political thinking is the best since it has evolved through natural selection. Thus these systems must be preserved. They maintain that biological theory shows an evolution towards this system. Thus the present trend to change systems of government and society are not justified - on a biological basis as it would upset the status quo which have reached their present forms through the natural processes of biological evolution.

Wilson also feels that ethics, aesthetics, politics, culture and religion, etc., are all in need of biolization, since his primary aim is to explain aspects of human behaviour: homosexuality, philanthropy, celibacy, slavery and martyrdom, all in terms of evolutionary theory. For his conviction is that their origins lie in the action of selection upon genes. It is easier to envisage, however, these aspects of behaviour together with warning cries, adoption, food-sharing, etc., being transmitted by culture. Religion, for example, can transmit the advantages of celibacy and philantropy to more people quicker than reproduction and the processes of (genetic) selection pressure on the organic traits and genetic components in human ancestors.

Darwinian processes are adaptive and natural selection operative in "sorting out" traits suited to the environment. Thus disadvantageous traits do not survive. According to sociobiologists (e.g. Wilson, E.O. 1980; Barash, D. 1979, etc.) human social structures are also adaptive and those not suitable share the same fate. This, however, does not imply a genetic control for altruism, for such traits are preserved and perpetuated in the tradition (stories, songs, etc.) of a people. Reciprocal altruism can thus be inculcated by learning.

Since sociobiology has grown out of the accumulation of studies on animal behaviour placed in the background of "theoretical ecology and population" and molecular genetics, it provides to some extent a theory to interpret and predict the social structure of a species. This is perhaps applicable (to some, or to a greater degree) to non-human social organizations. In such cases organization may be rigid intraspecifically, but not interspecifically where there is an immense variety of organizations. It is questionable whether a simplistic genetic explanation is sufficient of such behavioural plasticity; and human society as much more complex and plastic. Moreover, human society is not without ecological problems: consequently, it cannot be the best adapted. Wilson's thesis would tend to justify present social situations for it would see these as a product and result of the action of natural selection. Youth aggression, neglect of responsibility, political and religious (ideological) intolerance, would all then be acceptable as inevitable and normal. But such a situation is clearly unacceptable.

5.5.1 Methodological Investigations of Sociobiology

Wilson and other sociobiologists use the comparative method (like comparative anatomists) to "... develop general biological principles and to extrapolate conclusions from one group to another" (Bock, W.J. 1978. In Caplan, A.L. 1978 p.398). However, sociobiologists do not provide the theoretical principles of (biological) comparison for their synthesis. They do not account for the mechanisms of evolutionary change and for the basic principles and methods of comparative biology or how these might be applicable to sociobiology. Where anatomists are concerned with structures and organs and can easily trace through homology the relationships and derivation of organs and structures from one group to another, the sociobiologist deals with behaviour and behaviour patterns between groups. These studies are usually based on analogous behaviour patterns of different groups of animals.

Wilson's thesis is therefore also problematic on methodological grounds, (Burian, R.M. 1978. In Caplan, A.L. 1978). His language, in opposition to known pleiotropism, is genetically atomistic treating behaviour traits as being under the control of single genes. Sociobiologist implication is that there are specific genes for aggression, spite, etc., which breaks up into arbitrary units the totality of individual behaviour and social phenomena. Reification of these units is taken as the basis for the postulation of specific genes for each unit. These hypothetical genes serve only to further analogical explanations. The idea of gene-specificity has long been abandoned for it cannot be demonstrated conclusively, even at an anatomical level.

The sociobiologist argument that all behaviour is adaptive is a consequent of their view that society can be seen as an organism and its "specific units" of behaviour as organs - adapted for the good of society. At present, however, there is no consensus among geneticists whether adaptive or random processes constitute the basis of evolutionary processes. Huxley, (Huxley, J. 1948) avoids extreme selectionism in organic evolution by emphasizing allometry: organs may change as a result of their developmental links to others that are under selective pressure. Similar process could be operative in human social organization.

Selection also is not operative on single genes but on the phenotype; selection pressure affecting large assemblages of genes (Mayr, E. 1975. In Caplan, A.L. 1978). Absolute selective values thus cannot be assigned to a gene: its expression is dependent on its possible background. Consequently, sociobiology which assigns "fixed fitness" values to genes which are treated atomistically, encounters technical difficulties in relating, "current sociobiological calculational apparatus to a realistic genetics" (Burian, R.M. In Caplan, A.L. 1978 p.389). Universality of common behavioural traits and their continuity in different groups in the animal kingdom, especially between primates and humans, need not necessarily be genetic. Most are analogous: similarity of result does not indicate "identity of cause". This is aptly shown by adaptive radiation and convergent evolution.

The Sociobiology Study Group of Science for the people (S.S.G.S.P.) asserts the absence of any behavioural homology, on a genetic basis, between the primates and humans. It is possible that natural selection has operated on different genes. This has elicited convergent responses as adaptations to similar environments. Wilson's and other sociobiologist analyses can thus be seen as the "metaphorical impositions of human institutions on animals", (S.S.G.S.P. 1978. In Caplan, A.L. 1978) and then finding the human instance from the animal. In this way human behaviour and institutions seem to be natural, having their origins in non-human ancestors - even from groups that are not on a direct evolutionary line leading to humans.

As a neo-Darwinist evolutionary theory, sociobiology has been extended to include besides details of social organization, taxonomy and ecology. While evolutionists try to extend their views over biology, ethologists attempt an integration of animal and human behaviour. Wilson attempts to "... stretch convergence into identity", with the humanities and biology constituting the common foundation of sociobiology. However, a form of biological determinism is implicit in the sociobiological framework. Within this framework, the evolutionary history of the organisms concerned should form the basis of explanations emerging from genetic and ecological parameters, and the natural historical descriptions of organisms. However, sociobiological descriptions of the behaviour are based on "back metaphor" in which anthropomorphic descriptions are used to describe both animal and human behaviours. Xenophobia, for example, is used to describe all types of aggression against newcomers and aggression is applied to competition as well as fighting which usually results in the submission of one of the contestants without suffering any real injury or harm. The behaviour pattern, therefore, cannot be real aggression as applicable in the human context (War, etc.). Wilson thus seems to strain his descriptive apparatus in order to explain or accommodate behaviours and human institutions within genetic explanations: even cultural evolution is built in "genetic potential" in the brain!

Sociobiology is thus beset with numerous problems that restrict its value and its direct application to the study of human behaviour in its social and ethical aspects. Numerous conceptual problems also have to be solved as concepts used in the evaluation and description of human behaviour cannot be applied to animals. Also, explanations that might be applicable to animal behaviour are not appropriate in the human situation. One of the central problems is the use of consciousness in human behaviour. A genetic basis for human behaviour would be deterministic which is seen as instinct in animals, i.e., certain behaviour patterns are unavoidable. Human behaviour, however, is dependent on numerous factors: choice, duty consciousness, conscience, responsibility, etc.

Sahlins (Sahlins, M. 1976) is of the view that sociobiological explanations undermine the role of culture in human behaviour. The constitution of reality via language through empirical and rational argument, has emancipated culture and human behaviour from complete genetic domination. Methodological, ethical and technical difficulties also arise in attempts to study directly the biological basis of human behaviour. Usually other animals are studied and the results available are, with modification, applied to human behaviour. However, such applications are inconclusive, even if results from primatology are applied to man, since the conclusions drawn may be from inadequate evidence. Ethological studies, like sociobiological, are often subjective - biased as behaviour cannot be categorized into discrete entities. Even though reliability checks are made, hypotheses cannot always be readily tested. Consequently, the applicability of sociobiology directly or even restrictedly to human behaviour is greatly undermined.

Investigations also reveal that phenotypic expression (of the genotype) is to a great extent environment-dependent. Even though (an animal's) development might be completed, environmental influences can result in alterations in phenotypic expression, e.g. in the mechanisms of somatic or physiological adaptations. Phyletic evolution, the result of mutation and selection, is regarded as being "chance-based" or the accidental component of evolution. It is the result of the interaction between the environment and the phenotype (of individuals) where there is differential survival of the phenotypes. It is this that makes natural selection seem the "design aspect of evolution", creating the impression of a progressive development towards man: as though man is the inevitable result of these natural processes. However, natural selection does not predetermine the nature of the genetically-based variations; it only selects from the variations those that will survive in the environment. The phenotype (or individual) is therefore the product of the interaction between the environment and the genotype. Thus, even from a biological viewpoint it can be seen that the genotype does not completely determine behaviour. The mechanisms of evolution, mutation, natural selection, speciation, etc., are all problematic and make Wilson's views on sociobiology, (the derivation of human behaviour through comparative behaviour) even more problematic and uncertain. Phylo-analysis and comparison of different groups shows that behaviour patterns do not have a common origin, especially when vertebrate and invertebrate groups are concerned. The origin of social and colonial behaviour in vertebrates is not homologous to that of invertebrates. Even though comparisons can be made, lineages diverged very early in geological time. It is a matter of conjecture whether behaviour patterns of contemporary animals could have been the same in early geological time. Even if Wilson restricts his comparison to primates, an homology is difficult to obtain.

The use of kinship relations by sociobiologists in their discussions on altruism is couched in genetic language creating the impression that kinship relations are basically of a genetic nature. Human kinship relations are based on "arbitrary rules" (which is evident in the comparative anthropological studies of different peoples) of marriage, residence, and descent. They (kinship relations) are cultural, governing the co-operative relationships of the type unique to human societies, and are developed for specific purposes. Geneological relationships thus obtain arbitrary values from kinship relationships. Sociologists believe that these "categories are cultural manifestations of truer biological practices" (Sahlins, M. 1976).

Wilson himself seems to contradict his views (earlier) when discussing certain types of behaviour. He feels that since the capacity to learn is genetic, it does not matter whether aggression, for example, is innate or learned. But this is precisely what does matter: for genes cannot be responsible, if, as he says, "they have given away their sovereignity" (Wilson, E.O. 1980). Wilson's view that genetic sovereignity "underlies" variations between cultures is also problematic. Although chromosome numbers are species specific, genetic (molecular) variations do occur, which are the "raw materials" of natural selection. His impilication is that these constitute the basis of cultural variations also. Such a view, however, would not account for intra-cultural variations and the rate of cultural change for this is much faster than the operative rate of natural selection. Population genetics makes predictions about rates of change and biochemistry provides data on the "degree of genetic differentiation between human populations". The correlation between these two, however, is "too small to agree with the very rapid changes that have occurred in human cultures historically and the very large cultural differences observed among contemporary populations" (Caplan, A.L. 1978 p.288).

From a methodological viewpoint, the sociobiological argument is problematic. Closer examination of the Darwinian hypothesis and the genetic theory show that human behaviour and society, are much more complex than those theories can accommodate. Just as the effect of the environment is important for phenotypic expression, so is the effect of culture at a societal level; where culture can be seen as the environment necessary for the development of the individual. Sociobiologist theory, therefore, is dependent not on definite scientific laws but also on prevailing historical conditions or historical periods.

5.5.2 The role of culture

Alper is of the view that "...despite the sociobiologists' supposed disregard for social, historical anf political factors which shape human actions these factors are incorporated into the theory in the form of the behavioural traits suggested as fundamental to human society' (Alper, J. 1978. In Caplan, A.L.1978. p481). Wilson does say that human behaviour (in society) is characterised by "indoctrinability", "spite", "male dominance", deception and hypocrasy" and "xenophobia". He also asserts that these behaviour patterns have a genetic basis. But such a view is based on social, political and historical analyses. Viewed in this background the assumptions of sociobiology become apparent: that the predictable effects of genes are evident in human behaviour and that their relevance to human behaviour is the result of evolutionary pressure on non-human populations. Sociobiologists thus see contemporary "primitive" societies as the types of societies that could have given rise to modern societies. "Primitive" societies are also seen as having their origins in animal groupings. e.g., those of primates. Consequently data on studies on animal behaviour are applied to humans. Genetic constraints on animal behaviour are thus applied to human behaviour. But the failure to demonstrate a direct link between gene and behaviour in the individual or in an evolutionary view undermines the sociobiologist analysis of human behaviour.

The popularization of sociobiology has led to the view that its implications for human society are revolutionary. It has been felt that this new science with its new ideas why humans sometimes "behave like cavemen, will show the relevance of zoology and primatology to human behaviour. It is also felt that some dilemmas of present society can also be solved if they are "...quantifiably related to analogous phenomena in other animal species"- on the assumption that the "facts"of sociobiology are applicable to the explanation of human behaviourin accordance with evolutionary principles. Social behaviour is thus explained in terms of "adaptive significance" (Alper, J. 1978. In Caplan, A.L. 1978).

According to Durham (Durham, 1978. In Caplan, A.L. 1978) neo-Darwinist theory is of the view that genetic traits optimal to animals in their envivironment are preserved over generations. Individual level natural selection is responsible for phenotypic changes. Thus genotypes influencing phenotypic changes suited to prevailing environmental conditions are preserved.

In humans however the function of the genotype is to a large extent assumed by culture., which, constituting the non-genetic component of the phenotype, promotes and preserves in human populations, through literature, customs, traditions, art, etc.,features advantageous to both individual and population. It seems therefore that what was selected during human evolution "was an unusual capability for modifying phenotypes on the basis of learning and experience. Within limits culture enables us to alter and build onto aspects of morphology, physiology and behaviour without any corresponding change in genotype. This means of course that natural selection by itself is neither adequate nor appropriate for explaining the culturally acquired phenotypic traits of human beings," (Durham, W.H. 1978. In Caplan, A.L. 1978. p.429) This capability to what might be called "genetic plasticity"is not unique to humans. Statistical determinations show that all animals do not have the same behaviour all the time. There are always particular instances of deviation from "normal"behaviour-to suit the circumstances. This behavioural plasticity is apparent more in the primates and man than in the other groups of animals. This is taken to be an advance over other animal groups, and is seen as the (genetic) " Darwinian edge" that has culminated in man having the most unpredictable behaviour.

Culture is governed by non-biological processes and is characterised by variations within and between groups. These variations undergo a selective process very similar to natural selection. These could include " free energy, satisfaction, profit, population regulation, homeostasis and ease of replication and transmission of cultural instruction." It seems therefore that "genetic plasticity" was selected for as it permitted modifications through learning and experience and also for its survival value (Durham, W.H. 1978. In Caplan, A.L. 1978).Humans do not passively receive culture but also develop selective biases towards phenotypic aspects which past experience has shown to be advantageous. Such selective processes occur at both individual and group levels, and cultural selection becomes complimentary to natural selection. In this way more forms of human social behaviour develop than could be produced by mutations and "transgenerational changes" in presumed behaviour-gene frequency.

Sociobiologists therefore attempt to preserve the discrete gene-based behaviour hypothesis, by postulating "gene plasticity". This shows on the one hand, that sociobiology cannot explain human behaviour on a genetic basis, and on the other that culture being not gene-determined shows the inadequacy of present genetic theory as an explanation of heredity and also the uncertainty of the Darwinian hypothesis.

5.5.3 Value of sociobiological claims

An analysis of sociobiology shows that human social behaviour cannot be viewed only in the light of biological claims. Culture allows phenotypic modification without any "concomittant genetic change" (Durham, W.H. 1978. In Caplan, A.L. 1978. p.444). This however, does not negate the value of human biology in human evolution as genetic influence and constraints are important in human behaviour. Thus human biology and culture must be integrated in studies on human adaptations. The processes of selective retention must be examined in order to learn about cultural selective mechanisms within and between groups. This view adds a historical dimension to theories of adaptation.

Some sociobiologists (e.g. Trivers - refer Alper, J. et al. 1978. In Caplan, A.L. 1978) see sociobiology as setting up physical and social worlds to accommodate the biological and genetic components of human behaviour. Thus sociobiology sets up "sex role division of labour, competition and hierarchies" based on behaviour in e.g., insect colonies, and sees these behaviour patterns as being "genetically controlled". Alper (Alper, J. 1978. In Caplan, A.L. 1978) sees these aspects of behaviour as being changeable within limits. The way society is structured and inequalities and other fundamental questions dealt with depend on ethical principles. It is, however, the origin of these ethical principles which are in question. Sociobiology advocates an evolutionary approach to this question: "biologization" of ethics (Wilson, E.O. 1975). The striving for a free and equal society is one of the most important aspects of human behaviour. Sociobiology, however, shows the limitations of man for attainment of an egalitarian society since genetically influenced drives do not validate the claim for corresponding rights. Thus there is a greater need for relevance from genes to action. Caution must, therefore, be exercised in attempts to culturally control or plan society on a genetic basis (eugenics, selective breeding, etc.).

Altruism as discussed by Wilson (Wilson, E.O. 1980) is also not the same as ethical altruism since all instances of altruism do not fall under Wilson's theory. Some instances of moral behaviour might be explained in biological terms but this is not enough to establish normative claims about altruism. The explanation of facts in biological terms and the making of moral assertions are not identical activities. Thus altruism cannot be explained in moral terms without the use of further sociobiological premises. Sociobiologist altruistic behaviour does not encompass the concepts of Will and responsibility, - and these are necessary aspects of ethics or moral behaviour. "To show that ethics was merely a specialized branch of biology, one would need to establish a conceptual connection between the concepts of the two sorts of claims. A form of sociobiology attenuated enough to be plausible seems to be too weak to take ethics out of the hands of philosophers" (Mattern, R. 1978. In Caplan, A.L. 1978. p.470). Thus the "biolization of ethics cannot be established or claimed on contemporary genetic or biological theory.

It is also a "naturalistic fallacy" to claim that ethics is nothing but biology. It raises the question of whether ethical claims can be derived from factual ones. Both critics of sociobiology and sociobiologists have assumed that "normative conclusions follow directly from scientific premises". The S.S.G.S.P. sees in sociobiology a behavioural determinism contending that it constitutes a defence of the **status** quo, because of its social implications: that theories of sociobiology "operate as powerful forms of legitimation of past and present social institutions such as aggression, competition, domination of women by men, defence of national territory, individualism, and the appearance of status and wealthy hierarchy" (S.S.G.S.P. 1976. p.182)

Neither side of the dispute has addressed the problematic status of derivations of value claims from scientific ones. Although there might be a relevance of biological fact to justification of moral claims, the facts themselves are insufficient - as moral claims are also seen in a cultural context. Consequently, instead of genetic constraint the cultural context itself constitutes a sort of constraint. Without such constraints, it is possible that humans could decide the type of society they want and proceed to bring it about. This is possible only if human behaviour can be seen as completely malleable. The S.S.G.S.P. contends that only basic functions are genetically controlled while others, e.g., behaviours are learned. Against such views Wilson contends that he is not advocating a biological determinism. His intention is to show that the relevance of biology to social behaviour can be demonstrated through sociobiology. He warns that if human behaviour can be seen as completely malleable, it would allow for the imposition of "personal" systems and for the justification of social and economic arrangements. It can be argued against this however, that if human behaviour is genetically determined, the status quo is justified as unavoidable. But Wilson also states, "On the basis of objective evidence the truth appears to lie somewhere in between, closer to the environmentalist than to the genetic pole. That was my wholly empirical conclusion in Sociobiology: The new synthesis, and continues to be in later writings." (Wilson, E.O. 1976. In Caplan, A.L. 1978).

According to Wilson, the final chapter of **Sociobiology: The new synthesis** must be seen not as the conclusion drawn from previous chapters but as the beginning of studies into human behaviour with an assessment of the earlier chapters for their relevance to such behaviour. Even though he postulates genes for diagnostic human traits, it does not mean that there are specific genes for "spite", etc. "The tendency to develop such behaviour in a distinctly human form, is part of an immensely complex social repertory which is undoubtedly dependent on large numbers of genes" (Wilson, E.O. 1976. In Caplan, A.L. 1978. p.295). There are certain features of behaviour, e.g. facial expressions conveying basic emotions that are relatively inflexible and transcultural", and even similar to higher ceropithecoid primates. His aim is to place human behaviour in "clearer evolutionary perspective", but his critics read his statements, out of context and therefore see his work as a "genetic determinism". Consequently, they see his work as racist or as an attempt to justify the **status quo** in social and political issues. To suit their purposes critics (e.g. S.S.G.S.P. and Alper, J. **et al** 1978. In Caplan, A.L. 1978) select only those passages in **Sociobiology: The new synthesis** that seem to justify the **status quo**. Wilson warns against the reading of his work as **"What is, should be!"** Genetic biases cannot be used to justify practices in present or future societies. Even though certain practices could have been advantageous to Neolithic man, for example, the continuance of such practices might not be advantageous in contemporary society. Wilson thus says that "Genetic biases can be tresspassed, passions averted or redirected, and ethics altered; and the human genius for making constructs can continue to be applied for making healthier and freer societies" (Wilson, E.O. 1975. In Caplan, A.L. 1978. p.267)

Sociobiologists are, therefore, only providing possible answers, not asserting correctness of their claims. But even through the difference that exists between cultures, some genetic bonds do emerge, e.g. language, altruism, religion, etc. (Ruse, M. 1978. In Caplan, A.L. 1978). It is probable, however, that the "genetic bond" as far as language is concerned is not the ability for language but for the development and production of the organs and organ systems used in the articulation of language. It is easier to see "altruism" and "religion", however, as dependent on culture.

5.5.4 Links between biology and sociobiology

Gould (Gould, S.G. 1978. In Caplan, A.L. 1978) contends that Wilson's critics have failed to see the relevance of biology to human behaviour, as, human biological nature does impose constraints on behaviour. Wilson's view is that although human social and altruistic behaviour are genetically controlled, their subset of possible patterns, though restricted, are much different from those of ants, chimps and other social animals. Consequently, although Wilson endorses biological determinism, he does realize the importance of cultural influences. He feels that just as Darwinism reformulated biological science, it could reformulate behavioural science. It is probably on this assumption that he expresses the view that "genes" do "maintain a certain amount of influence in at least the behavioural qualities that underlie variations between cultures" (Wilson, E.O. 1978. In Caplan, A.L. 1978 p.345). However, since Wilson fails to produce evidence for direct genetic control of social behaviour, his view is merely speculative - for Darwinism needs genes to select!

Although Wilson does provide a thorough discussion of social behaviour in different animal groups, the final chapter of **Sociobiology: The new synthesis**, "**Sociobiology to society**" does not show any direct genetic link between non-human and human behaviour. It is an "extended speculation on the genetic basis of supposedly universal patterns of human behaviour" (Gould, S.G. 1978. In Caplan, A.L. 1978 p.344).

Gould's view is that man's large brain (with all the attributes that come with it) obviates the need for "coding" for any behaviour. He does not see the need for genes for specific behaviours for he sees behaviour not as "biologically determinist" but as "biological potential": behaviour is thus "biological" as the brain represents a subset of a range of possible behaviour patterns. Behaviour is thus determined by the social structures or by the creation of specific social structures that would permit certain specific behaviour patterns to flourish. Gould sees his criticism of Wilson, not as a "non biological environmentalist; it merely fits the concept of biological potentiality, with a brain capable of the full range of human behaviours and predisposed towards none, against the idea of biological determinism, with specific genes for specific behavioural traits" (Gould, S.G. 1978. In Caplan, A.L. 1978 p.349).

Gould's position, however, although he denies it, implies "environmental determinism". If the brain is capable of the "full range of human behaviours" it is the environment that is "selective" of any specific behaviour that is best suited to the particular situations. This would also imply that there is a set range of human behaviours: such a view is also determinist, although it is in this case the environment that dictates the selection of the "set" that is best suited to it.

Such a view, however, raises questions concerning the origin and transmission of the "set of behaviour patterns". It would also imply that all humans have identical or similar sets of behaviour patterns. Thus although Gould emphasizes the environmental and Wilson the genetic component of behaviour, they both begin in a biological determinism.

Gould's idea of "potential", however, is significant as it introduces the ideas of choice and responsibility in human behaviour and action. This seems to be linked to the "large brain" of humans. However, choice, as far as Gould is concerned would be passive, the expression of the behaviour pattern being dependent on the environment. In humans, however, behaviour patterns are to a large extent, a matter of conscious choice, i.e. the expression of the behaviour pattern is the result of deliberation. Advantages and disadvantages are weighed in the light of past events and possible future repercussions, before acting. There is also a certain desired goal to any action, that must "fit in" with other actions, past and subsequent. The eventual action is, therefore, dependent on "consciousness and will": the individual can exercise some control over the behaviour pattern chosen under any particular set of circumstances - or condition of the environment. The behaviour pattern expressed therefore, is the outcome of "free will" and "choice", introducing

the idea of "responsibility" into behaviour. Humans are thus responsible for their actions. Although genetic influences do restrain action to some extent, it is neither the genes nor the environment that dictate behaviour. These together do influence behaviour, but the final action, depends on the individual, showing freedom of choice.
Besides "choice" and "responsibility" human action also embodies "conscience", so that choice of action is questioned (by the individual) with reference to certain norms and values of the individual and of society. Human behaviour, consequently, cannot be seen only in terms of hereditarianism or environmentalism, but in both these perspectives in addition to tradition and consciousness in all their multidimensional aspects. The large brain of humans thus introduces a new perspective into behaviour.

Wilson's focus on "intuitionistic approaches to ethics" also narrows his view of ethics. Seen in the background of natural selection, Wilson sees natural human drives as "egoistic", like Dawkins (Dawkins, R. 1976), and not as beneficial to others. Darwin, however, had anticipated this natural drive and in his approach to ethics saw altruism not as egoistic, but as "... the most noble of all the attributes of man, leading him without a moment's hesitation to risk his life for that of a fellow creature; or after due deliberation, impelled singly by the deep feeling of right or duty, to sacrifice it in some great cause" (Darwin, C. 1871 p.148). Although Wilson's approach to ethics might be narrow, the significance of his views lies in the fact that he elucidates reference to natural features or to "genetically influenced attributes". Consequently, ethical theory is invested with a broader scope as it is not restricted to "empirical claims peculiar only to some members of the species".

The relevance of biological fact to ethical theory lies in their informing theorists of the constraints on ethical claims: humans can do no more than they are biologically capable of doing! Limitations can be both environmental and genetic. "Biological considerations are also relevant to ethics because they inform us of what is already accepted as valuable to humans, what they do not need to be persuaded to treat as important. But what we are naturally inclined to do need not be restricted to what our genes predispose us to do. If culture moulds and adds to natural attributes in profound ways, as it certainly seems to do, the whole set of features thus produced is the factual basis which may be relevant to moral claims" (Mattern, R. 1978. In Caplan, A.L. 1978 p.472). In claiming the relevance of biological claims only to ethical theory, psychological claims also have to be considered unless it is felt that psychological claims are reducible to biology.

Sociobiology: The new synthesis can thus be seen as a biological framework for understanding human behaviour, within which the possibility of a biological ethics cannot just be assumed. Since his framework lacks the factual basis for his claims, Wilson can claim only necessity, not sufficiency for the ethical theory he attempts to draw from animal behaviour. Ethics thus cannot completely be "biological". Sociobiology must be seen as a supplement, not a replacement for ethics. It provides a basis from which science can approach the origin and meaning of human values from which ethical and sociopolitical views emerge.

Although sociobiology might give a deterministic view of human behaviour, it does throw some light upon the relationship between animal and human behaviour. The closeness or distance of this relationship depends on the genetic theory of inheritance - whether the theory in its present state is supportive of Wilson's arguments. It also "offers the possibility" of understanding in a different light the utilization of concepts and research techniques of ethology and population genetics in investigations concerning interactions between behaviour of individuals and functional aspects of "such macro-structures as the state. Political scientists, for instance, could investigate socialized forms of, for example, "aggression" with a view to determining ways of coping with such social behaviours, that have been part of history itself.

Although Wilson's thesis implies a genetic origin for behaviour, he does not show how such behaviour is inherited. His use of analogous behaviour patterns undermines his views as such behaviour patterns could originate in different causes, and be transmitted by different genes. The sociobiologist views can only be accepted if it can be shown that behaviour patterns in different animals are the result of the inheritance of homologous genes. Sociobiology also does not show any gene behaviour correspondence.

Sociobiology can be seen to arise out of contemporary social and political systems - as an explanation of these systems. Sociobiologists try to find the cause of certain behaviour patterns and social systems at a genetic level and argue that these patterns have emerged and continue because of the efforts of the gene to perpetuate itself. That behaviour is adaptive and genetically determined shows that it has been selected (Darwinism) and thus is legitimate and unavoidable as it is the product of the natural biological process.

Wilson, however, changed his determinist approach when criticisms were levelled against his theory. He contended that his work was being misinterpreted. The problem probably arose out of the fact that the language used in Sociobiology: The new synthesis and the approach, are both determinist. Wilson's later view that, "Genetic biases can be trespassed, passions averted or redirected, and ethics altered; and the human genius for making constructs can continue to be applied for making healthier and freer societies" (Wilson, E.O. 1975. In Caplan, A.L. 1978 p.267) shows that he distances himself from the determinist approach in his later theory. It also shows his belief that humans can override their genetic determinants and can to a large extent construct their own way of life. The focus of human action, therefore, must be on responsibility for he must so construct the world that it provides a basis for his moral conduct. This view of Wilson also shows that besides being influenced by society, scientific theory, also influences society and constitutes a basis for ethics; for human behaviour depends on how the world is seen.

It is evident that problems arose with Wilson's sociobiological theory because he accepted Darwinism, ethology and the genetic theory as objective and "correct" biological theories - as a true reflection of reality or what actually happened in biology. Closer examination of sociobiology, however, showed that these theories too provided only certain views of the world; of the biological world and that they also rose out of certain historical situations.

For Wilson's theory to be acceptable it has to depend on contemporary genetic theory. Genetic theory must show that not only morphological but also behavioural characteristics must be gene-determined and transmitted. It is thus important to examine genetic theory to find whether it meets the requirements imposed on it by the sociobiologist and other biological theories. Examination of the genetic theory shows that it arose as a result of certain particular requirements of other biological theories to which it is closely related (Darwinism, natural selection, sociobiology, etc.). Concepts of the gene arose out of certain particular historical situations and along with the evolution of biological theory and society the concept of the gene has also evolved.

CHAPTER 6

GENETIC THEORY AND ITS IMPLICATIONS.

6.1 Introduction

Advances in molecular biology led to a re-examination of the eugenics policy of the pre-war and war years. The investigations revealed class and racial prejudices which, to a large extent, are rooted in social Darwinism: Darwin's views had been used to justify these prejudices. The essence of Darwinism was ignored or so interpreted as to accommodate social and political ideals. Darwinism thus constituted the basis of social engineering (refer Stoddard, L. 1925) directed to the development of a "super race", for such men as Stoddard and Hitler believed that "racial impoverishment" causes the decay of society and civilization. This was believed to result from the mixing of inferior genetic material, or the mixing of superior with inferior races, causing an impoverishment of the superior race and leading to social decay. It was felt that through selective breeding and the avoidance or destruction of inferior strains, a "pure race" could be produced and social decay avoided.

The atrocities of the war years, however, had led to the development of an almost violent reaction against social engineering and eugenics. The idea that intellectual progress of different "ethnic, national and social groups was indicative of genetic capabilities, fell into disrepute. All peoples were regarded as equals. The environmental view of progress developed, in which education, economics and social reform were emphasized as the basis for social development and progress. It was argued that all people should therefore be given equal opportunities in social development and political self-determination. However, social development and progress were still seen in the background of western standards. Political development was directed towards western political ideals. Even though social Darwinism and eugenics were frowned upon, evolutionist ideas yet prevailed and political progress or changes in political structure were seen as "self-determination", in the east towards "communism"' and in the west, towards "democracy".

The abandonment of the view that genetic endowment was determinative in the performance and achievements of different ethnic, national and social groups had consequences for both social and political development. Belief in progress through education and social reform was emphasized in the environmental view of progress. The environment, therefore, was to a large extent determinative in the development of the individual, and consequently, of social and political institutions, for it superseded genetic influence (Winchester, A.M. and Mertens, T.R. 1983). Anthropological studies of people of different religious convictions, of different races and political ideals also contributed to the realization of environmental influence on the views and behaviour of different peoples and that racist policies were based more on social and political ideals than on biological fact. Consequently, irrespective of genetic endowment people were socially and politically equals.

Such views thus constituted the basis of the call for equal opportunities and education for the different peoples, for example, under colonial rule. The result was the rise of ethnicism and nationalism which were largely contributive in the dismantling of colonialism in many parts of the world. However, with the withdrawal of colonial rule most of the countries were left to rule themselves through institutions that they had hitherto not known and in many cases which were not applicable in the situations in which the colonies had been left. This was due to the deprivation of the proper social and political education during colonial rule. Consequently, chaotic conditions arose in the vacated countries, which were often viewed as being the result of inherent primitiveness. However, the internal strife was also due to different groups in the population struggling to gain power, each feeling itself superior in some way to the others. Viewed in the light of the Darwinian hypothesis, this was seen as the "struggle for survival"; the victorious group emerging as the one best fitted to rule. In evolutionary perspective it was seen as inevitable -

the progress from tribalism, through colonialism, and military rule to democracy or a free society. The move towards democracy was not a consequence of evolution; of maximization of genetic heritage. It was the result of dissatisfaction (of the masses) with colonial or post-colonial rule - arising therefore, out of the historical situation in which the people found themselves. It was not because of an inexorable movement as described by evolutionists (e.g. of the Marxist school).

Scientific theory, however, did play a part in this change for Darwinism showed that differences were due to not any inherent inferiority but to adaptive radiation. Thus the influence of Darwinism depended largely on its interpretation, firstly, in terms of the prevailing historical situation, and secondly, in such a way as to justify the status quo or subsequent social development.

Darwinism, sociobiology and genetic theory are, therefore, closely linked. Darwinism and sociobiology do depend on a sound genetic theory. Such a theory must show that the gene is an entity that is inherited or a particle that passes from parent to offspring. It must also show that it solely is determinative in morphological and behavioural characteristics in humans and that it can change and so introduce variations depending on environmental conditions.

6.2 Genetic theory

Advances in molecular biology and a re-examination of the Mendelian principles of inheritance at the turn of the century (Burns, G.W., 1976) have resulted in advances in molecular genetics. The "negative eugenics" policy of the war years was re-examined in the light of molecular genetic developments. The nature and action of genetic material, the processes of recombination, transformation, transduction, the production of mutations, all led to the resumption of the "eugenics" policy on a new level. The ideals, however have not changed from those of the war years: they are still directed to the production of a "superman". It is hoped that the knowledge gained from genetic research would constitute the basis for the development and production of such a man. Although racist thought had permeated eugenics, the idea has a "sound core". The health of genetic material is the basis on which to build sound populations; important both to the individual and to society.

Genetic research has shown that segments of DNA can be joined to produce biologically active Recombinant DNA in vitro (Berg, P.D. et al 1974). Xenopus laevis ribosomal DNA has also been linked to DNA from bacterial plasmids. This recombinant plasmid has been shown to replicate stably in Escherichia coli where it synthesizes RNA complementary to Xenopus laevis ribosomal DNA. Drosophila chromosomal DNA segments have been incorporated into both plasmid and bacteriophage DNA yielding hybrid molecules that can infect and replicate in E. coli.

Beckwith, J. et al (1969 in Wade, N. 1974) isolated a pure gene from a bacterium: the isolation of the "biological atom" thought to constitute the basis of all "life processes". Techniques developed to determine the structure of a gene also show the possibility of gene transfer between unrelated organisms (Benzer, S. 1962; Cohen, S.N. 1975; Berns, M.W. 1974). Although these workers have, to some extent, managed to isolate genes, the structure-function relationships are as yet not completely determined (Shapiro, J. et al 1969; Agarwal, K.C. et al 1970). Benzer, S. (1962), Berns (1974) and Cohen (1975) have also shown that genes do have the ability to survive and reorganize the genes in host cells: foreign genes are able to destroy host genes and "take over" the host cell. Such experiments do have beneficial effects but they could also be used to destructive purpose. They do, however, open up numerous avenues of possibilities.

6.3 Possibilities of Genetic Manipulation

The work of Aaronson and Torado (1969. In Burns, G.W. 1972) showed the value of "genetic surgery" in the curing of such diseases as "sickle cell anemia", where SV40 DNA could be introduced into a cell and become "a permanent part of the host cell genome". Specific information could thus be inserted into and become a permanent part of both somatic and sex cells. The isolation (Shapiro, J. et al 1969) and synthesis (Agarwal, K.C. et al 1970) of bacterial genes has led to the possibility of "curing" some hereditary diseases: where there are germ cell abberations, these could be altered to prevent development of abberent forms. Developing embryos could thus be modified. Thus besides his ability to control his environment to some extent, man has also developed techniques that could be used to control and to direct his evolution. It is also felt that with proper understanding and control of the gene, human behaviour could be better understood and possibly altered.

6.4 Social implications of genetic theory

Molecular genetics has vast implications for society. Genetic surgery, the possibility of introducing genetic information into a host genome, could be used for medical and other beneficial purposes. It could be used to alter or to introduce certain genetic information into embryos in order to produce certain particular types of individuals for specific purposes. This could lead to selective breeding resulting in the production of certain castes fitted to the performance of particular tasks in society. Coupled indirectly with genetics (intelligence tests, etc.) selective procedures are at present carried out at educational institutions and through educational systems. Consequently, "genetic selection" is not the only type of selection that can be practised. It is, however, based on "aptitude" which is assumed to be genetically determined. Consequently, it was felt that subjects were genetically fitted only for the performance of certain tasks. And according to results of the tests subjects are assigned to certain educational curricula which equip them for only certain categories of occupation. However, such tests are often designed on the basis of certain educational curricula and in a particular social system. They are then used in different areas with different curricula or social systems. Consequently, the results are often biased, even on racial lines, Also in the design of the tests, little consideration is given to the effect of the environment.

Even though eugenics and the modern approach to education are both heavily reliant on genetic theory, it is evident that genetic theory is not completely supportive of their views. These views embody a "genetic determinism" although contemporary work in genetics weighs against this. Yet, old ideas remain and to a large extent guide scientific investigation. Genetic fitness is still used as a basis for justification of hereditary dominance of caste or group. Contemporary genetic theory is used as a basis for the dominance of the intelligentsia over other groups. Association of such groups (intelligentsia) with academic hosts and "prestige" jobs, identifies them as a select group to which others must look for guidance, and follow, to progress. The result is social stratification or hierarchy in which the elite group is the leader. By the formation of certain societies which specify particular conditions for membership, the structure and dominant position is maintained. As more people from other groups become eligible for membership the entrance conditions are raised and modified so as to maintain the **status quo**. This often results in the formation of other societies in opposition to former ones; an opposition which might assume various forms. On such bases many still argue for the "...evolutionary virtues of war, nationalism, race and class prejudices and conflict as agents of the biological progress of mankind" (Dobzhansky, T. 1962 p.13).

Society has often used and still finds in genetic theory a basis for the social dominance and segregation of race or ethnic group. Religious belief and technological achievements are often considered the criteria which delineate the Europeans as superior to the darker-skinned races. Religious superiority is claimed on the grounds of progress from mythological thinking, through polytheism to monotheism. It is felt that polytheism still prevails in most of the religions or religious beliefs of the darker-skinned races. Technological achievements are considered as proof of superior intelligence which is thought to be hereditary, and, of consequence, from a superior genetic constitution. And since they have "raised" others out of their primitive ways of thinking both religiously and technologically, they constitute a superior race. Consequently, to maintain the superiority of this race or the society this race has created, integration with other groups must be avoided. Integration both racially and ethnically is often frowned upon as it is often felt that customs and traditions which had been inherited over many generations, would be lost. Although the "inheritance" is cultural, the depth of conviction (for custom and tradition) is felt to be biological.

The formation and maintenance of societies is thus directed to the maintenance of the **status quo**, each holding the view that it is superior to, if not equal to the others. Yet it is equally a fallacy that all "... men are born equal", and biologically alike. Thus ethical, and social and political concepts are used openly in biology and also seek justification in biology. According to Dobzhansky, "equality" must be taken to mean "... that all humans are entitled to equal opportunity to develop their capacities to the fullest, not that these capacities are identical" (Dobzhansky, T.1962 p.14).

6.5 Implications of modern genetic research

Technological advances in molecular genetics have given rise to numerous and novel possibilities through chemical and molecular modifications in the genetic apparatus. Works such as Genetic Fix, Biological Time Bomb, Genetic Revolution, Fabricated Man, and Biocrats (in Suzuki, D.T. et al 1981) all warn of the dangers of modern genetic technology. Geneticists also fear that exposure to chemicals presently being manufactured could also be changing man's genetic make up. Consequently, even though the effects might not be apparent immediately, they could appear in time (Suzuki, D.T. 1981). This is of particular significance in an age in which man seems able to direct his future evolution. For he needs to take cognizance of what present conditions or how the present environment will be affected in future and the effects this might have on man's further evolution. Thus even if man were to direct his evolution, he would not be able to do this without consideration of the environment.

As early as 1933 techniques were developed, both electrical and mechanical, which could separate male from female determining sperm (Koltzoff, N.K. and Schroder, V.N. 1933; Lindahl, B.E. 1958). Coupled with the work of

Edwards, R.G. et al, (1970) the exerpiments showed the possibility of sperm selection and the production and the development of sex-determined embryos. The application of artificial insemination on humans showed that the sex of the child could be determined and that parents could choose the sex of the child they wanted. This could have serious implications for society as it could result in sex-ratio imbalances and necessitate a change in the structure of society or the reorganization of society.

Muller (1961) felt that man could enhance himself through eugenics provided "life as a whole" is seen as a process of continual change. The accomplishments of natural selection had far surpassed other types of progress. Application of this principle to society could be effected through "genetic improvement:. This could be effected in various ways by birth control, artificial insemination, etc., or through conscious artificial selection. However, such procedures were not feasible in a society yet undeveloped in values and limited in knowledge to make such a choice (Muller, H.G. 1961; Sonneborn, T.M. 1968). Such choice would involve a "...major change in social conditions and human attributes - namely, change from a capitalistic class stratified society to a socialistic society in which biological principles become common knowledge, birth control and artificial insemination are legal and positive selection and large scale genetic research on man are fostered." (Sonnebon, T.M. 1968, p.774). To this end Muller advocated that the theme in education should be evolution at all levels to show man his place in nature. Man could thus develop a greater cooperativeness and reorganize genetic and cultural togetherness.

Such views, however, like that of sociobiology, are based on the assumption that natural selection presupposes that genes determine productive fitness and hence adaptive success in future generations. It is also assumed that adaptations are always suited to the conditions and therefore, that adaptations are advantageous. This led to the thesis that if the structure and functional mode of the gene could be determined, it would be possible to direct evolutionary development in lines suitable to future generations. Thus the evolution of society could be directed by what is desired by society or by what is desired by particular groups. Consequently, human evolution could thus be directed by the needs and desires of any particular time or of any society.

6.6 Evaluation of the dangers of genetic theory

Gene transfer (Davis, B.D. 1970) and DNA hybridization (Singer, M. and Soll, D. 1973) could result in the formation of new kinds of "plasmids" whose nature could be unpredictable and hazardous. Experiments in cloning have been performed only up to the amphibian level. It is felt, however, that in time experiments could be performed up to the human level. But before such experiments are performed their possibilities for social and ethical import must be evaluated. The contemporary effects of such experiments might be plausible and even desirable, but their effects on future generations must also be considered. Such experiments could lead to an excessive conservative influence on the population and consequently also on cultural achievements. Society could thus be deprived of the richness that emerges out of new gene combinations. Cloning could also be problematic for clones might not all develop in the same way as development is often dependent to a large extent on parental influence and on the cultural climate, for literary, political and social development are largely dependent on experience.

Evolution has also shown that the success of a species depends not only on adaptation but also on genetic variety or on the potentiality for unrealized adaptations for the survival of a species in yet unencountered environments.

Homogenization of a population by cloning or by other means, could also produce a survival hazard as clones would only be adapted to certain particular environments and changes in the environment could be deleterious to the clones. Cloning could also be used for political ends where political indoctrination has failed, as a mechanism to regulate behaviour or to depress human potential. This is often effected largely through pharmaceutical, surgical and nutritional means. The results of scientific achievements have long been used by governments or by ruling groups to obtain political objectives. Supported by government, armies conduct "biological warfare" laboratories which are attempting to improve the lethality of viruses and bacteria, harmful to man. Such enterprises are clearly supportive of political objectives; and are directed, usually to the maintenance of the status quo: human thinking has always been found to be resistent to change of any type. Little thought is given to the fact that change is both imperative and adaptive.

6.7 Scientific responsibility

Recent advances in biogenetic research (Berg, P.D. et al., 1974; Agarwal, K.L. et al, 1970; Shapiro,J. et al., 1969; Benzer,S. 1962; Cohen,S.N. 1975) facilutate solutions to important theoretical and practical biological problems. However, they could also lead to the production of novel types of problems through the creation of new types of infectious DNA elements whose biological properties cannot completely be predicted in advance. These biohazards could have deleterious effects on the population. Unlike any other group of preceeding scientists, the biologist has seen the potentialities of his work as both beneficial and hazardous in biological and social contexts. Consequently, scientists attending the 1973 Gordon Research Conference on nucleic acids (Singer, M. and Soll, D. 1973) requested the National Academy of Sciences to ask for the deference of experiments on biogenetics till the biological properties of "cells" produced could be predicted with certainty. Experiments involving genetic manipulation of living cells and viruses have consequently been temporarily banned. This is the first time in the history of biology that scientists are willing to accept restriction on the freedom to research (Wade, N. 1974), other than those to do with human experimentation. The group recognized that adherence to its recommendation "... will entail postponement or possibly abandonment of certain types of scientifically worthwhile experiments ..." but says that its concern "... for the possible unfortunate consequences of indiscriminate application of these techniques motivates us to urge all scientists working in this area to join us in agreeing not to initiate experiments ... until attempts have been made to evaluate the hazards," (Wade, N. 1974 p.332), although these experiments could elucidate the structure and workings of animal chromosomes. Thus, the onus of how the results of scientific research might be used, falls on the scientist. He is the most qualified to know at least some of the potential dangers of his research. The publication of research results is therefore important in that it be done such that his work not be misunderstood. The scientist should thus publish both negative and positive aspects of his work and should he find it prudent, be allowed to withhold certain results of his work which could be misused. Davis,B.D. (1974) shows that "genetic engineering" in bacteria led to fears that such techniques could be used, not only to cure diseases, but also to alter human nature.

Any assessment of the problems connected with genetic research or engineering must consider that genetic traits are not always determined by a single gene, as it is, for example, in sickle-cell anemia. Genetic traits are usually determined by multiple genes, which include intelligence, dexterity, strength, etc. Such traits are socially more important as they show a range of variations with which they may be operative often depending on the "... sum of small contributions of many genes interacting with many environmental factors" (Davis, B.D. 1974 p.). The success of molecular genetics, so far, is confined to only single gene traits. The fact that genes have multiple effects which vary continuously (Davis, B.D. 1970) and also the fact that even if all the genes were known, traits could not still be determined for "... a set of relevant genes does not fixedly determine the corresponding trait". Both past and present environments are important in the determination of the genotype and its phenotypic expression. Most genes determine a range of potentialities for any trait. Consequently, actual phenotypic expression is dependent on a range of genetic possibilities and of environmental conditons.

Extension of the techniques of genetic manipulation to man will raise numerous sociological and moral issues. Therefore, since it cannot be predicted when a particular kind of manipulation may become feasible, and since moral standards and social needs change with time, it would be presumptuous to try to "... guide future generations by present wisdom" (Davis, B.D. 1974). However, the dependence of the future on the past is nowhere more apparent or important than in genetics. For it is genetic structure which is to a large extent determinative in the survival of a species. But as far as humans are concerned, they have to a large extent been emancipated from genetic fetters or their genetic systems function in a less determinative way than in the non-human world. It is therefore the duty of science to help guide society in its decisions as far as research is concerned so that harmful experiments can be avoided and research evaluated.

In this respect the responsibility to a large extent falls on the scientist to inform society of achievements and also of areas of failure or of doubt or of the potential problems of the results of research programmes. Many drugs, for example, although they have been "passed" for use, have later been found to have deleterious effects: such drugs as Thalidomide and L.S.D. ( ) which have been found to interfere with genetic systems.

Since the introduction of the steam engine it has been felt that "... society must adjust to new technologies" (Etzioni, A. 1968). New technologies, however, as was evident during the "Industrial Revolution" do not usually sustain prior values and institutions. The result is undesirable effects on society. However, scientists often argue that science is concerned with the search for "truth", and that the "applications of scientific findings are not determined by the scientists, but by society, politicians, corporations and the citizens" (Etzioni, A. 1968 p.1110). It is also argued that the course of science is unpredictable and therefore scientific findings could be used for good or bad purposes. Scientists often argue that external intervention in their work could retard the growth of knowledge and be detrimental to certain applications of scientific findings that are at present for the good of society (e.g. birth control). According to Etzioni, these arguments are given "... as if they themselves were empirically verified or logically true statements. Actually, these arguments merely represent a formula which enables the scientific community to protect itself from external intervention and control" (Etzioni, A. 1968 p.1110).

It is possible that science does thrive in societies where scientists are given less freedom than in models which imply that science must have total freedom in which to develop. But freedom of science is not always the ultimate value. It is often felt that society at large deserves the same protection that a human subject does from research. Thus the scientific community cannot be excused from the responsibility of asking what effects its endeavours have on the community. On the contrary, only an extension of the existing codes and mechanisms of self control will ultimately protect science from a societal backlash and external regulation. The intensification of the debate over the scientists' responsibilities with regard to the impact of their findings is by itself one way of exercising it, because it alerts more scientists to the fact that the areas they choose to study, the ways they communicate their findings, to each other and to the community, the alliances they form or avoid with corporate or governmental interests - all these affect the use to which their work is put" (Etzioni, A. 1968 p.1110). The careful supervision of technological inputs into society is therefore imperative. The attempts to build a bridge between scientists and society has also been problematic as the media is quick to exploit situations even before scientists could double-check their results and their implications. Regulatory systems must thus appreciate the difference between science and technology,(bearing in mind that technology is born of science).

Etzioni (1968) thus distinguishes between science and technology. Control of technology could thus free science and protect society. Societal and political preferences and needs could thus guide research and technology, so that financing could go more to research, than to technology; as it is at present with the development of armaments, etc. Etzioni (1968,,p.1111) also feels that society shoud have "... less concern with nature and more with society".

This view, however, is contradictory as it is the concern of society with itself that is at the root of the problems that do beset society: the protection and enforcement of political and social ideals. To maintain order and to maintain a way of thinking that is deemed to be God-given or in accord with nature, society is prepared to destroy other ways of thinking or of ideals that differ from its own.

Certain groups in society guided by feelings of superiority support scientific development in directions which would further support such views or in attempts to justify their beliefs. Superiority in technological achievements that have led to the economic and financial superiority of certain groups have led to feelings of superiority over other groups.

The rapid increase of knowledge in genetics has uncovered a host of problems. This knowledge coupled with developments in technology has presented society with new and sophisticated technological services. Their use widely, especially in medicine, has raised a number of ethical questions. According to Ladimer(Ladimer, I.1977.) it is important to translate values into social and scientific properties: towards genetic disease reduction, parental diagnoses, genetic surgery, etc. The expression of existing phenotypes could be improved and the gene pool protected by world policy to minimize exposure to mutagens. Artificial insemination and cloning (it is felt) could also assist in the creation of "genetically superior individuals".

Genetic counselling and the eugenics programme have also been used in a negative way. Screening and testing programmes for genetically transmitted conditions have often had negative psychological impact on subjects and society, who have learned, because of the way the screening and testing had been conducted and because of the way the results have been made available, to treat the carriers of genetically transmitted conditions in a negative way. In Virginia, America, testing programmes for sickle-cell-anemia has led to "stigmatization of (the) black school children" (Jemison, E.W. In Lipkin, M. and Rowley, P.T. 1977. p.75). Others have either lost their jobs and even been refused jobs because they are carriers of some genetic conditions (Desmoyers, A. In Lipkin, M. and Rowley, P.T. 1977). Screening programms have also been "discriminatory" in schools because in many cases they have been carried out only on certain groups of children (Brosseau, G.In Lipkin, M. and Rowley, P.T. 1977) .Such programmes have had adverse effects as the results have often been racially construed without regard to the origin of the condition (e.g. sickle-cell-anemia) which had adaptive significance. It has also been suggested that genetically based, black IQ was lower than that of whites (Desmoyers, A. In Lipkin, M. and Rowley, P.T. 1977), leading to racist campaigns against blacks. It has also been felt that the children of racially mixed parents are more prone to genetic defects. This has led to suggestions on research into the "hereditary basis of social behaviour" and of genetically transmitted diseases. It was thus hoped to show that the origin of social problems lay in social mixing. The primary aim however, had historical roots in the division between the races in the country and the view of white racial superiority, based on prejudice.

PART III

MAN'S CONTINGENT EXPERIENCE OF LIFE AS THE COMMON GROUND BETWEEN SCIENCE AND MORALITY

CHAPTER 7

CONTINGENT EXPERIENCE, SCIENCE AND MORALITY

7.1 Introduction

A historical investigation into science and morality, both shows that knowledge of the world or rather knowledge of the structure of the world is based on experience and the constitutive faculty of the mind. In science, experience (empirical) of the world constitutes the basis for the formulation of theories of the world: the way a particular scientist experiences the world contitutes the basis for his construction of the world. Consequently, each scientific theory concerning the world, or each world theory, is based on the particular experience of the scientist in that particualr historical situation in which he finds himself. It follows, therefore, that the different world theories enter into a "critical relationship" with each other.

World theories, besides providing knowledge of the world, that is, besides having epistemological, are also of ethical significance. Moral theories, therefore, also emerge from world theories or from the scientific constitution of the world, in any particular historical situation. And just as scientific theories (of the world) enter into a "critical relationship" with each other, so do moral theories. Scientific theories and moral theories are, therefore, constituted and reconstituted in the light of past and contemporary theories. Since these theories are inconclusive they are problematic in that they can provide neither certain knowledge (concerning the world) nor an authentic direction for moral action, so that man might live an "authentic existence". It is, however, the realization that the problematic nature of these theories lies in man's imperfection, which shows that he cannot in any particular historical situation provide a conclusive answer, that can point to a moral ground. According to Rauche, "This critical relationship points beyond each theory to a moral ground which lies outside it and which is common to all mankind and, in this sense, universal: man's contingent experience of reality. It is from this universal experience that all theories are constituted." (Rauche, G.A. 1985, p.251).

Scientific and moral theories arising from certain particular historical situations or conditions constitute a reflection of the problem situations or the conflict of each historical period. This in itself is evidence that no scientific or moral theory can be conclusive. Arising out of certain situations, they constitute an attempt to overcome the situation, and thus attain an "authentic existence", defined in terms of freedom and justice, which terms have themselves undergone changes in preceeding "historical conditions". These conditions thus constitute reality, experience of which results in the formulation of scientific and moral theories. Experience thus has both epistemological and ethical significance.

Since theories cannot provide any conclusive answer concerning reality, they point to an inherent limitation which represents the limitation of man. This limitation points to a moral ought which obliges man to enter into a critical relationship with his fellowman - if he wishes to maintain justice and freedom (Rauche, G.A. 1985). The historical nature of scientific theories (indeed, of all theories!) is indicative of the fact that they cannot produce ultimate answers in terms of reality. Their historical dimension restricts their application to situations that lie in the future. It is therefore with caution that man must tread the path that leads beyond the compass of his experience. For to go beyond this would be "self-transcendence". This would mean that man transcends his limitations in an act of absolutization of his theory - into an ideology. This is done at the expense of reference to his fellow-man, which results, often in a polarization, leading to conflict. In such an act man does not strengthen but forfeits his freedom. For freedom lies in the realization that even under changing historical conditions man depends on his fellowman for a rational constitution of reality based on experience. Freedom does not lie in religious or scientific dogmatism or in social or political ideology. Absolutization of any ideology would lead to domination of one group over another - which is so evident in past and even in contemporary history where scientific, religious, political, social, cultural, etc., ideologies lead to totalitarian practice. In such circumstances self-control, tolerance and respect are lost, leading to unrest and violence.

It must be recognized, therefore, that theories, and scientific theories are no exception, represent a **Weltanschauung** which is based on certain premises arising from certain particular historical conditions - man's contingent experience. Based on such premises, the **Weltanschauung** constitues a certain way of looking at the world in a particualr historical period. Seen in this light scientific theories constitute a certain framework in which to understand the world. Understanding the world is therefore directed in a certain way and is dependent on past experience. Knowledge gained or constituted from past experiences thus provides the basis on which contemporary theories of reality may be constructed.

The moral aspect of scientific theories also arises from the fact that no scientific theory stands by itself. Scientific theories are dependent on one another. Besides their mutual dependence within a single discipline, scientific theories of different disciplines are also dependent on one another. Thus theories in biology (especially evolutionary theories) are related to geology, physics, chemistry, etc. Biological "laws" may thus be expressed in terms of physics and chemistry. The mutual need of these theories for each other in order to increase their explanatory content, also shows the ethical aspect of scientific theories. It is on this account that Newton was able to say "If I have seen farther, it is becuase I have been standing on the shoulders of giants." Such a realization shows the mutual need and dependence of different scientists on one another. In this acknowledgement can be seen the basis for the conduct of scientific activity in the spirit of tolerance and humility for scientific theories provide only "truth perspectives".

The present "piecemeal" approach of science which ends in scientists turning specialists, results in their looking at the world through their various specialities. They feel, therefore, that reality can be understood by looking at the world in certain particular ways. But each speciality reveals only a certain aspect of reality. This is very evident in biology. Biological phenomena, viewed through different specialities do not provide a picture of an animal as a whole. An animal is viewed from an anatomical, a physiological, a psychological or a genetic background. Consequently, only certain aspects of an animal come to light. Thus an holistic approach is necessary to understand an animal, as a whole. This requires an integration of different disciplines, showing the mutual need of different disciplines, or of different specialists for each other. Man thus has need for his fellowman for his understanding of the world can only be fulfilled in society which provides a basis for a multidisciplinary approach. Mutual dependence and need again constitutes the basis for society. Although society is born of conflict, that is, the natural conflict that exists between different scientific theories, it also emerges from the need to resolve this conflict. This also constitutes the basis for tolerance, self-restraint and humility of man towards his fellowman.

Science can, therefore, be seen to have moral implications. This is born of the very nature of science and governs the relationships between different scientific disciplines and consequently, of different scientists. The "conflict-nature" of science emerges from the historical conditions under which specific scientific theories are developed - which conditions are largely determinative in the way a theory is developed and formulated. The empirical nature of scientific theory is thus evident in the critical relationship that exists between theories. Since morality emerges from this relationship under specific historical conditions, it can be said that morality is empirical. The formulation of moral theories change along with the formulation and reformulation of scientific theories or, with the constitution and reconstitution of reality, under specific "historical conditions". Consequently, man's attitude to his fellowman and to the world also emerges from the way in which he constitutes his world. Science, therefore, has moral implications, while morality can be said to be empirical. In this sense both scientific and moral theories are products of man's "contingent experience" of the world, or, from his knowledge of a changing reality.

Since it is man who constitutes his reality, the knowledge on which he formulates his theories concerning the world is also a product of knowledge from within himself or it might be said, an experience of the self. From a biological (evolutionary) point of view, human form and function (in all its manifold aspects) can also be seen as the formulation and reformulation of experience, in organic form emerging in particular geological periods - which are particular historical conditions. The gene (in whatever form understood) can, therefore, be considered as the organic manifestation of knowledge. Its particular structure can be seen as the product of its reaction to changing historical (geological) conditions. Although the change is not instantaneous, it does represent the interaction of gene and environment. That gene survives which is best suited to the particualr environment. In such a view extinction can be seen as "an act of alienation from reality" - at genetic level. Survival would thus represent "genetic plasticity" or the ability to live in harmony with the environment, that is also changing. There is, therefore, a dynamic interaction in the close relationship between organism and organism and between organism and environment. In such a system, or an ecosystem, it is the recognition and realization of position, function and limitation, in the ecosystem that maintains its harmony. "Position", "function" and "limitation" do not, however, represent or constitute any hierarchical system. They represent the equality of responsibility - that every organism in the system shares the responsibility for the maintenance of the system. Although both the organism and the environment are constantly changing, the dynamic relationship that exists between them ensures the maintenance of stability in the system. There is, therefore, a constant interplay between the gene and the stability (harmony) of the ecosystem - or between knowledge and stability (a dynamic stability). In this interplay the gene is both instrument (directive) and product (directed by the ecosystem - this, however, must be seen in the light of population genetics). In the relationship between gene and stability of ecosystem can be seen the "interplay between theory and practice" which arises from experience.

The ecosystem, of consequence, is of supreme importance for on its survival is dependent the harmony and survival of all that constitutes it. Such an ecosystem must be seen not only from the viewpoint of biological theory but also from the centre of a compass that defines man in his biological, anthropological and cultural aspects: where his biological aspects define his relations to the non-human world; his anthropological aspects define his specific human characteristics and his cultural aspects define all his creations as part of his needs for existence. Thus, although man's origins are rooted in the non-human world (through evolution) the genetic constraints that seem to be confining in this world (that is, the non-human) have to a significant extent disappeared in the human. This view sees man from a vantage point that is regarded as a culmination of evolution (biological evolution). But if evolution is seen as a continuous and continual process then, each stage in evolution can be seen as a transcendence; an attempt to cope with the specific conditions of life or to lead an "authentic existence:" "... even Darwinian evolution can be seen as a process of perpetual and increasing transcendence." (Skolimowski, H. 1981 p.67). Evolution can, therefore, be seen as an attempt to maintain harmony and for the maintenance of this harmony the versatility of the gene is the basis for the diversity of living forms that are needed (to maintain this harmony). The gene is also responsible for the constraint in each organism. For any organism in an ecosystem to exceed its constraints would upset its harmony, both in an individual and a collective sense.

Human biological constraints, unlike those of the non-human world,(consonant with evolutionary theory),are reduced to basic functions. Human action therefore, can be considered moral since they are restricted by no constraints, besides those of conscience and will. Human action therefore relies on freedom and places on the human an obligation: freedom, therefore, places on the human a moral ought.

7.2 The ecological imperative

During the Industrial Revolution and the period following it, the "struggle for survival" and the "survival of the fittest" meant competition, and those survived which were victors in the competition. In such a view the "ends justified the means". For it was victory that was all important and whatever means deemed necessary to secure victory were employed. Competition became the basis of moral action.

The situation, however, has changed after the Second World War. The destruction caused by the war, especially by the two atomic bombs, has revealed the awesome power that science has placed into the hands of man. The subsequent development of nuclear power shows that the potential for destruction has been increased many fold. Disaster situations in countries received aid world-wide and even during the Chernobyl disaster (Serrill, M.S. 1986.) The Soviet Union had to get help from the United States of America. These and numerous other instances show the need for co-operation and also the need for mutual aid. Present scientific development has shown that despite ideological differences the need for interdependence is steadily and rapidly growing. In the contemporary concern for survival against the military arsenals of the world, the threat of nuclear disaster, is evident the need for interdependence and mutual aid. Even in the upheavals of the present political climate the different nations of the world, despite their mistrust of one another, realize their mutual interdependence.

The ecological and conservation movements are born of this concern for the environment and ultimately for survival. Where evolution was once interpreted as the movement towards perfection and perfection meant the "survival of the fittest" (through competition, which included aggression, etc.), it is now interpreted to mean "mutual aid" (Kropotkin, P. 1903; Huxley, J. 1944; Waddington, C.H. 1967; etc.), "interdependence", "co-operation, etc. For it is only through such realization that the "harmony, stability, and delicate equilibrium of nature as a self-recycling energy system" (Richards, S. 1983. p.140) can be established and maintained. The realization of the need and dependence of different nations and of different groups within the nation on one another for a harmonious society, has both influenced and is influenced by ecological thinking as a model "for human society as the closely integrated richly interwoven and self-sufficient pattern derived from an idealized image of nature." (Richards, S. 1983 p.140).

Opponents of ecological thinking, however, stress that nature is wasteful and has many "imperfections". It is urged that these ("imperfections") can be eliminated by genetic interference. But this view is only based on pre-existing ideas of what is, or, will be best for society. Such prejudiced views determine the interpretation and application of scientific theory and emphasize those aspects only, that are to their advantage. This to a large extent, constitutes the basis of the thinking that mastery over nature should be sought rather than investigate nature's mystery to understand the workings of nature, as a whole.

Evolutionary theory shows that everything is in a state of continual change. And always, this change is directed to stability, or it might be said an "authentic existence".

This can easily be seen in embryological processes where different parts of an embryo function inter-relatedly to achieve stability in growth and with the environment. Evolution and genetic theory also elucidate this close interrelationship between animal and environment and embodies also the mechanisms needed to achieve this relationship that leads to stability.

The idea of altruism also emerges from evolutionary theory. Skolimoski (Skolimoski, H. 1981) regards altruism as an essential aspect, in fact, the **modus operandi** of evolution. Where sociobiologists explain altruism only in genetic terms, Skolimowski, (Skolimowski, H. 1981) contends that such explanations do not take into account that evolution is a process of transcendence. And as altruism is based on co-operation and sacrifice, so is evolution. Human life is, therefore, to a large extent filled with sacrifice; for it is not merely a means towards an **end**: in sacrifice, man fulfills himself as **human**. Thus sacrifice can be treated as an end in itself. According to Skolimowski (Skolimowski, H. 1981), this is in accord with the **Kantian imperative** that treats every human life as an **end** in itself. Human life, therefore, participates in sacredness, making man an ultimate value, in whom the workings of evolution may be acknowledged. This acknowledgement is also the basis of the premise that in the continuation of evolution man will transcend himself. Man is, therefore, both a means (an instrument) and also an end. Thus man, although a product of evolution, retains his sovereignity in an evolving universe. Evolution thus preserves man's "rights" as an individual. This also follows from man being part of an ecosystem (in which he has been placed by evolution), for every entity in the system has a "place" and a "right" within the system. Individual "rights" are thus justified within the framework of the ecosystem for they allow that action that is imperative for the maintenance of the system.

It is within the ecological framework that man is nurtured and sustained. He reaches his full development in society, as he both creates and is created by society. This ensures man's rightful place, and consequently, that of society in an ecosystem. Each society adapts in a particular way to the environment (adaptive radiation), and thus creates and is created by the environment. The ecosystem thus constitutes the womb within which man resides. It is the acknowledgement and realization of this position that shows man his place in the ecosystem - his place in nature. To disregard the dynamic balance of the ecosystem would amount to a disregard for his place in nature. It would constitute a severence of the cord that binds him to the ecosystem through which he hs nurtured and which he influences. His place in nature shows man the need to maintain a balance and not to alienate himself from nature.

Through evolution, man has emerged from and is thus a part of the other life-forms in the ecosystem. Consequently, it is of value to man not only as a resource, but also because he is a part of it. Because of the dependence of the different parts of the ecosystem on each other, the destruction of any part of it would result in the destruction of the whole. This dependence has been created and expanded and become more closely interwoven by the processes of evolution. The destruction, therefore, of even one thread of the fabric, would mean the undoing of the whole tapestry: thus the ecological imperative!

Evolution has also shown that as life-forms become more complex their dependence on more of the ecosystem increases. In a system in which each life-form has a particular ecological niche, the greater is the need for the maintenance of a balance between the different niches.

The contemporary imbalance of the ecosystem can be seen to rise largely out of different interpretations of Darwin's theory of evolution. The ideas of the struggle for survival" and "survival of the fittest" and the "individualism" that emerged from this, have contributed largely to the imbalance of contemporary systems.

Although science and its child, technology, have contributed largely to knowledge of nature, they have also been responsible for the contemporary position of the world.

Evolution, therefore, as a biological theory, shows the need for a balance between all the life-forms; a balance that would preserve the ecosystem, and life. This is the principle aim of evolution, to adapt life-forms to their particular conditions of life. In such a context the "struggle for survival" and "survival of the fittest" cannot be interpreted in terms of Dawkins' or ethologists' theories, only. Evolution does not only mean competition and consequent progress, as many biologists believe; it also means "balance". The ecological imperative thus points to the need to discard ideologies or to modify them in the presence of other ideologies, in order to maintain a balance.

According to Skolimowski: "Within the structure of evolution, the more highly developed the organism, the greater its complexity and its sensitivity and the more reason to treat it as more valuable and precious than others. In a nutshell, the exquisiteness of man is more precious than the exquisiteness of the mosquito. In time of conflict, we care more for the life of a human being than for the life of a mosquito. We have always known instinctively that the life of a human being is more important than the life of a mosquito" (Skolimowski, H. 1981 p.84). This view, however, does negate the expression of the ecological imperative. But if man is important, he is so in view of the fact that it is he who has caused the most destruction to the ecosystem; and it is his responsibility to correct the situation. Although nature has "corrective mechanisms" within itself, man has upset these to a large extent. It is, therefore, his responsibility to correct the problem, which can be accomplished through ecological thinking. And in this he should not just assume his importance: for it lies only in the fact that it is he who has caused the present situation.

The social and ethical aspects of evolutionary and ecological theory arise out of the fact that man is, like his fellow creatures, a product of evolution and therefore an integral part of nature. Consequently, he has to live so as to maintain the dynamic balance in nature. Since the balance continually changes, man must not alienate himself from the world situation by absolutization and conflict. Ecological thinking seeks to avoid such conflict and shows that harmony can be achieved only through realization of the need for interdependence.

In this sense evolution can be seen as biological history.

It shows how different conditions produce different life-forms. Thus on both a theoretical and a practical level evolution shows how historical conditions are important in the production and development of values. Those aspects of conduct are valuable, which serve in the enhancement of evolution. From this point of view evolution becomes the product of action and interaction in the constant search for stability or for harmony for through evolution the present becomes a product of, and is related to the past. Evolutionary theory thus "fits" its different pasts or aspects into a definite (often hierarchical order) order or cosmos.

7.3 The cosmic imperative

The metaphysical aspects of scientific theory, both physical and biological, point to the transcendent character of understanding or reality. Even though knowledge is constituted from man's experience of reality (of the physical world) it is understood only within certain categories which have their "origins" in metaphysical entities. Those not able to fit into scientific categories just have to be accepted (on faith) and are used in man's attempt to lead an "authentic existence". To find the basis of such existence, man has to go beyond the physical, for without such transcendence existence would seem meaningless and void.

Scientific theory (contemporary scientific theory) and existentialism leave man "aimlessly drifting through the meaningless universe, a desperate lonely particle" (Skolimowski, H. 1981 p.108). Man thus loses his uniqueness and life has no more purpose than existence, becoming merely an "instrument" of survival, thought of in terms of chemistry and physics. Reduced to the mechanisms of atoms, life is thought of in terms of "mechanistic interactions of physical bodies and chemical particles" - scientific rationality reducing life to mere "physio-chemical matricies".

But viewed in the background of evolution and ecology, it can be seen that life is much more than the product of the mechanistic terms into which it has been reduced. The metaphysical aspects of scientific theory show that life cannot be reduced to these terms only. In his search for his identity man has struggled to preserve his humanity and his spirituality. He has always reached beyond himself to secure explanations giving meaning and purpose to his life. Religion has provided a framework for ideals which inspire and sustain life. Through absolutization and idealization (perfection) of human qualities deities have been endowed with "perfection". It is through the emulation of these attributes that man attempts to direct his life or live a moral life. In this "symbolic" transformation of reality, man attains his humanity through "mirroring qualities he has himself vested in deities. Thus religion, through transcendental ideas inspires man to unselfish and altruistic acts to preserve life and unity in society. This has resulted in the development of religious practices and rituals that have enriched culture.

Thus even in religion, in attempting to understand himself or in searching for his identity man has reached far beyond himself. In search of his origins scientific theory has taken man to the farthest reaches of the universe. For it is in the search and knowledge of origins that it might be possible to determine "authenticity", for "authentic existence" is of moral value: an "authentic existence" is a moral existence since it is of the very fabric of nature.

Religion, of consequence, does provide man with an ideal or a world-view in which man can strive for perfection and so develop a moral universe. The world-view provided by science seems to be devoid of values, concerned as it is with the "ideal of material progress". But seen from an evolutionary point of view, the scientific world-view can provide the basis on which to view the world as part of a moral universe. This emerges not from any religious precepts provided by the great religions of the world but from scientific theory itself.

Evolutionary and genetic theory concern the change of life-forms or the different manifestations of life itself - how it changes under changing historical conditions. Life constitutes both the store and the act of knowledge. If this could be expressed in material terms it would be the gene that is knowledge, and life the articulation and manifestation of knowledge. Theory and practice thus coincide or are identical in the gene. It constitutes the knowledge of millions of years (of knowledge of changing historical conditions) that it has gained in its evolution and manifestation in one form or another; through diverse interactions in changing historical conditions. In its perpetual experience, of changing environments, which it attains through the sense organs of life forms (it has itself created) the gene changes and stores the acquired knowledge it requires for survival. Its efforts are continually directed to adjusting itself, and consequently, the life-forms, to be in harmony both with the Universe and with other life forms. The knowledge that it acquires thus constitutes the basis for its "behaviour" towards other life-forms. This does not mean that the gene is deterministic in its direction of behaviour, but that the knowledge it has acquired constitutes the basis for the potentiality of its reactions. The gene recognized the need for other life-forms for they provide the environment in which it must survive. In its interactions with other life-forms, the gene increases its knowledge in directions conducive to survival.

This knowledge also manifests itself in the embryological development of life-forms. It reveals itself in the mechanisms embryos employ to survive and find their niches in the ecosystem, to maintain the balance of that system. The gene's continual survival (through reproduction) ensures that the knowledge it has gained in its relationships and interactions under different historical conditions (geological periods) is serviceable in the survival of life-forms. Its variety of form thus becomes the expression of life.

Although the gene is directive in the way life-forms develop and behave, this must not be read to mean that it is totally in control of the behaviour in the sense that life-forms become mere machines as Dawkins', ethologists' and sociobiologists' theses might suggest. The gene is the embodiment of knowledge and where knowledge is directive, the idea of choice is inherent and with it that of freedom.The living of life-forms can be seen as the expression of that knowledge in all its diversity of behaviour and form. This shows the very close link between life and knowledge.

A curious aspect of life is that is transcends its varied categorizations by the scientific method and its manifestations in life-forms. Both religion and the evolutionary theory agree than man is the most important life-form. But even he cannot understand the "epistemology of life". Living life has endowed man with the ability to objectivize. Scientific understanding or interpretation is the product of this activity which abstracts from experience and categorizes - understanding being in terms of those categories. But these categories express but parts of wholes, not the whole itself.

Religion accepts the "Whole on faith; the entire cosmos is accepted on faith, as divine creation. Without this basic acceptance which emerges from experience, neither religion nor science could hope to survive. It is accepted on faith that there is a coherent and integrated whole that can be investigated and understood through categories of the mind's making. Viewed in the background of evolutionary theory, the entire knowledge of the cosmos is in man, and has directed his evolution. it is contained in the "chemistry of life" (Skolimowski, H. 1981) that circulates in his blood: the elements of which the cosmos is constituted in its material form. The "chemistry of life" can be seen as the expression of cosmic order, which is the basis of life.

Both religion and science (evolution) have required the entire cosmos for their expression: man has required the entire cosmos for his origin and development. This view has been corroborated by Hoyle and Wickramasinghe (Hoyle, F. and Wichramasinghe, C. 1983, 1986). Their findings show that life "arrived" on earth from outer space in the form of "cosmic genes". This theory lends support to the view that life pervades the Universe. Through evolutionary (and genetic) theory, therefore, man is more closely related to the cosmos: he is constituted of the elements of the cosmos. In it he has his origins and through his interrelationships with the rest of it, he has attained his present form. In this view man becomes a manifestation of the interrelationships of life with the rest of the cosmos.

Man, therefore, has his origins in the depths of order; an order that is maintained by balance. He also has knowledge of this order, for it can be said that a "piece" of the cosmos is in him or that, it is he! Such balance or order originates in the depths of love and is maintained in the realization of responsibility. Consequently, if man has his origins in the cosmos, he is related to the rest of the cosmos, and thus has a responsibility to the cosmos. It is in the realization of this relationship and responsibility, that man's life is fulfilled and his existence meaningful. And it is this fulfillment in realization that originates in love (cosmos) that constitutes the basis of moral conduct.

CONCLUSION

An investigation of scientific theory from its origins in Greek philosophical systems to contemporary physical and biological scientific theories reveals that no theory is conclusive in the sense that it can provide a final answer to the problems that confront the human condition, which condition has in itself been constituted by the human. In this sense there is an almost organic link between theories. Thus although theories are not conclusive, they cannot be said to be incorrect since they are posited under certain historical conditions and serve as a worldview or as part of a worldview in those particular conditions. Succeeding theories are therefore dependent on and are built on preceeding ones.

Since scientific theories are inconclusive and are posited under certain historical conditions by humans who themselves bear limitations, it points to the ethical aspect of theory in any given situation: since the theory arises from such situation. As scientific theories continue to be posited in different historical conditions the dialogue between different theories is assured, in the sense of a continuing critical and self-critical relationship. This again reveals the ethical dimension of scientific theories. In such a relationship scientific theories continue to change historical conditions and are themselves influenced and changed by the historical conditions. This ongoing critical relationship between theories implies an ought showing the practical dimension of scientific theories. Taken positively, the moral ought shows human limitations leading to the view that the scientific argument should be conducted in a spirit of patience and tolerance. The understanding of scientific theory in this light can contribute to the avoidance of destructive ideologies.

Viewed in the background of changed and changing historical conditions the evolutionary aspect of scientific theory becomes evident. In such a view the interrelatedness of theory implies the interrelatedness of different and seemingly diverse cultures, traditions, religions and peoples. All have drawn from their experience of the universe, in the development of their theories. And since these theories are linked and dependent on each other it implies a universal dependence. Evolutionary theory also implies a universal dependence and relatedness. In such a view the ethical aspect of scientific theory also emerges showing that religion, nationality, race, ethnicity, etc., bear no absolute relevance and can be seen as only aspects of a changing universe.

REFERENCES: PART I

Afnan, S.M., 1958. Avicenna. His life and works. George Allen and Urwin Ltd. London, 298 pp.

Aquinas, T. Commentary on the eight books of Aristotle's physics: A precis. In Durbin, P.R. 1968. Philosophy of science: an introduction. McGraw-Hill. New York.

Bazin, G., 1964. A Concen history of Art. Thames and Hudson. London. 549 pp.

Brehier, E. 1968. The history of philosophy. Chicago Univ. Press.

Brittain, G.G. (Jr.) 1978. Kant's theory of science. Princetown Univ. Press. New York.

Burnet, J., 1958. Early Greek Philosophy. Adam and Charles Black. London. 375 pp.

Chadwick, J. 1932. Possible existence of a neutron. Nature. 129: 312.

Cline, D.B., Mann, A.K., Rubbia, C. 1976. The search for new families of elementary particles. Scientific American. 234(1): 44-54.

Clodd, E., 1897. Pioneers of Evolution. From Thales to Huxley. Grant Richards. London. 250 pp.

Copleston, F., 1962. A history of Philosophy. Vol. II. Mediaeval philosophy. Part I. Augustine to Bonaventure. Image Books. Doubleday and Co. Inc., New York. 346 pp.

Copleston, F., 1962. A history of Philosophy. Vol. 2.

Mediaeval philosophy. Part II. Albert the Great to Duns Scotus. Image Books. Doubleday and Co. Inc., New York. 357 pp.

Copleston, F., 1963. A history of Philosophy. Vol 3. Late Mediaeval and Renaissance Philosophy. Part I. Ockham to the Spectulative mystics. Image Books. Doubleday and Co. Inc., New York. 239 pp.

de Chardin, Teilhard P. The phenomemon of man. New York.

De Grood, D.H. 1965. Haeckel's theory of the unity of nature. The Christopher Publishing House. Boston U.S.A.

Descartes, R. A discourse on method. Tralslated by J. Veitch 1969. Everyman's Library. New York. 254

Dobyzhansky,T. Ayala, F.J.; Stebbins, G.L. and Valentine, J.W., 1977. Evolution. W.H. Freeman and Co. San Francisco. 572 pp.

Gardner, M. 1979. Realism and instrumentation in Nineteenth Century atomism. Philosophy of Science. 46(1)

Glashow, S.L. 1975. Quarks with colour and flavour. Scientific American. 223(4): 38-50.

Gould, S.J., 1982. Darwinism and the expansion of evolutionary theory. Science, 216: 380-387.

Haeckel, E. 1899. The history of creation. Vol. 1 (Translated by E.R. Lankester). Kegan Paul, Trench Truber and Co. Ltd. England.

---1910. The wonders of life. (Translated by Joseph McCobe). Watts and Co. London. 160 pp.

Harrison, J.B. and Sullivan, R.E., 1975. A short history of western civilization. (4th Ed.). Alfred A. Knopf. New York. 734 pp.

Heisenberg, W. 1952. Philosophic problems of nuclear science. Faber and Faber. London.

---1958. The physicist's conception of Nature. Hutchinson. London. 192 pp.

---1963. Physics and philosophy. George Allen and Unwin. London.

---1976. The nature of elementary particles. Physics today. 29(3).

Hobbes, T. (1588-1679) Leviathan. Introduced by Lindsay, A.D. Dent. London.

Holton, G., 1974. Thematic origins of scientific thought. Harvard Univ. Press. Cambridge, Mass. 495 pp.

Hume, D. A treatise concerning human nature. In Ayer, A.J. and Winch, R. (ed.) 1965. British empirical philosophers. Routledge and Kegan Paul. London.

Huxley, J., 1929. Essays of a biologist. Chatto and Windus. London. 311 pp.

1939. The living thoughts of Darwin. Cassell and Co. Ltd. London. 144 pp.

Huxley, J., 1948. Evolution: The Modern Synthesis. George Allen and Urwin Ltd. London.

Huxley, J., 1953. Evolution in Action. Chatto and Windus. London. 160 pp.

Jammer, M. 1966. The conceptual development of quantum physics. McGraw Hill.

Kuhn, T.S., 1962. The structure of scientific revolutions. Univ. of Chicago Press. Chicago. 147, 149.

Lakatos, I. and Musgrave, A. (ed.). 1970. Criticism and the growth of knowledge. Cambridge Univ. Press.

Lyell, C. In Gould, S.J. 1982. Darwinism and the expansion of evolutionary theory. Science. 216: 380-387.

Monod, J., 1972. Chance and necessity. Collins. London.

Murray, L., 1967. The late Renaissance and Mannerism. Thames and Hudson. London. 215 pp.

Nambu, Y. 1976. The confinement of quarks. Sci. American. 325(5): 48-60

Polkinghorne, J.C. 1981. The particle play. W.H. Freeman and Co. London.

Popper, K.R., 1945. The open society and its enemies. Rontledge and Kegan Paul. London.

Popper, K.R. 1959. The logic of scientific discovery. Hutchinson. London.

Randall, J.H.(Jr.). The significance of Aristotle's natural philosophy. In Durbin, P.R. 1968. Philosophy of science. An introduction. McGraw Hill. New York.

Rauche, G.A. 1966. A student's key to ancient Greek thought. Fort Hare Univ. Press.

---1970. Contemporary philosophical alternatives and the crisis of truth. Martins Nijhoff. Netherlands. 147pp.

---1981. Social relations and reality. Journal of the Univ. of Durban-Westville. 3(4): 251-260.

---1984. The function of method in the constitution of knowledge. Journal of the Univ. of Durban-Westville. New Series 1.

---1985. Theory and practice in philosophical argument. Institute for Social and Economic Research. University of Durban-Westville. Durban, S.A. Special Publication, No. 1. 303 pp.

---1987. Unpublished and Personal communication.

Reichenbach, H., 1970. From Copernicus to Einstein. Dover Publications, Inc., New York. 123 pp.

Richards, S., 1983. Philosophy and sociology of science. Basil Blackwell. England.

Robinson, C.E., 1966. A history of Greece. Methuen and Co. Ltd. London. 480 pp.

Ross, W.D. (ed.) 1966. The works of Aristotle: Ethica Nicomachea. Vol. IX. O.U.P.

Sayers, J., 1982. Biological politics. Travistock Publications. New York. 235 pp.

Schrader-Frechette, K. 1977. Atomism in crisis! An analysis of the current high energy paradigm. Philosophy of science. 44(3): 409-440.

Singh, R. 1981. Knowledge and faith in philosophy. Journal of the Univ. of Durban-Westville. 3(4): 375-382

---1986. (ed) Perspectives. The institute for social and economic research. Univ. of Durban-Westville. Special publication No. 4. 240pp.

Spencer, H., 1892. The Data of Ethics: The biological view. From: The principles of ethics. Vol. 1. D. Appleton and Co. New York. 995-100. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Tobias, P.V., 1969. **Man's Past and Future.** Witwatersrand Univ. Press. Johannesburg. 45 pp.

Waddington, C.H., 1960. **The ethical animal.** Univ. of Chicago Press.

Warrington, J. (editor and translator) 1970. **Aristotle's metaphysics.** Dent. London.

Weisheipl, J.A. **The method of Galileo Galilei.** In Durbin, P.R. 1968. Philosophy of science: **An introduction.** McGraw Hill. New York.

Windelband, W., 1956. **History of ancient philosophy.** (Translated in 1956 by H.E. Cushman). Dover Publications Inc. 393 pp.

REFERENCES: PART II

Aaronson, S.A. and Torado, G.A. 1969. Human diploid cell transformation by DNA extract from the tumor virus SV40. Science 166: 390-391.

Afnan, S.M., 1958. Avicenna. His life and works. George Allen and Urwin Ltd. London, 298 pp.

Agarwal, K.L. 1970. Total synthesis of the gene for an alanine transfer RNA from yeast. Nature, 227, 27-34.

Agassiz, L., 1857. Essay on Classification. In Mayr, 1972. The nature of the Darwinian revolution. Belkrap Cambridge Mass.

Allee, W.C., 1943. Where angels fear to tread: A contribution from general sociology to human ethics. Science, 97: 517-525.

Allen, E., Beckwith, B., Beckwith, J., Chorover, S., Culver, D., Duncan, M., Gould, S., Hubbard, R., Inouye,I.,Leeds, A., Lewontin, R., Madansky, C., Schreier, H. Against sociobiology. 1978. In Caplan, A.L.,(ed.) 1978 The Sociobiology Debate.

Alper, J. 1976 The implications of sociobiology. Science 192: 424-427.

Alper, J. Beckwith, S.L., Chorover, J., Hunt, H., Inouye, H., Judd, R.V., Lange, P.1978. Sociobiology is a political issue. In Caplan, A.L.(ed.). 1978. The Sociobiology Debate.

Alper, J., Beckwith, J., Miller, L.G. 1978. Sociobiology is a political issue. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Barash, D. 1979. Sociobiology: The whisperings within. Souvenir Press. London.

Bechwith, J. 1969. In Wade, N. 1974. Genetic manipulation:temporary embargo imposed on research. Science. 195: 332-334.

Benzer, S. 1962. The fine structure of the gene. Sci. American. 206(1): 70-84.

Berg, P.D. Baltimore, H.W., Boyar, S.N. Cohen, R.W., Davis, D.S., Hogness, D., Nathans, R. 1974. Potential biohazards of Recombinant DNA molecules. Science. 185: 303.

Berns, M.W. 1974. Directed chromosome loss by laster irradiation. Science, 186: 700-705.

Bevan, W., 1971. The General scientific association: a bridge to society at large. Science, 172: 349-152.

Bevan, W., 1972. The Welfare of Science in an era of Change. Science. 176: 990-996.

Bock, W.J., 1978. Principles and methods of comparative analysis in sociobiology. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Brosseau, G. 1977. DISCUSSANT. In Lipkin, M. and Rowley, P.T. (ed.) 1977 Genetic responsibility. Plenum Press. New York.

Burian, R.M. 1978. A methodological critique of sociobiology. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Burnet, J., 1958. Early Greek Philosophy. Adam and Charles Black. London. 375 pp.

Burns, G.W., 1976. The science of genetics. (3rd ed.) Collier Macmillan. Canada Ltd.

Caplan, A.L. 1978. Ethics, evolution and the milk of human kindness. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Caplan, A.L.(ed.) 1978. The Sociobiology Debate. Harper and Row Publishers. New York. 514 pp.

Chambers, R. 1844. Vestiges of creation. In Clodd, E. 1897. Pioneers of evolution. From Thales to Huxley. Grant Richards. London. 250pp.

Clodd, E., 1897. Pioneers of Evolution. From Thales to Huxley. Grant Richards. London. 250 pp.

Cohen, S.N., 1975. The manipulation of genes. Sci. Amer. 233(1): 24-33.

Darwin, C., 1859. The Origin of species. Vol. I & II. The Worlds Popular Classics. Books Inc., New York. 467 pp.

Darwin, C., 1859. Neutral Insects. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Darwin, C., 1901. The descent of Man and selection in relation to sex. John Murray. London. 1301 pp.

Darwin, F. (Sir.) (ed.) 1942. Autobiography of Charles

Darwin. Wattes and Co. London. 154 pp.

Davis, B.D., 1970. Prospects for genetic intervention in Man. Science. 170: 1279-1283.

Davis, B.D., 1974. Genetic engineering: How great is the danger? Science. 186: 309.

Dawkins, R. The selfish gene. Oxford Univ. Press. New York

Desmoyers, A. DISCUSSANT. In Lipkin, M. and ROWLEY, P.T. (ed.) 1977. Genetic Responsibility. Plenum Press. New York.

Diamond, S. and Belasco, B., 1980. Biological and cultural evolution. In Rossi, I. (ed.) 1980. People in culture: A survey of cultural anthropology. Praeger Books.

Dobzhansky, T., 1962. Mankind Evolving. Yale Univ. Press. 380 pp.

---1963. Anthropology and the natural sciences-the problem of human evolution. Current Anthropology. 4(138): 146-148.

---Ayala, F.J.; Stebbins, G.L. and Valentine, J.W., 1977. Evolution. W.H. Freeman and Co. San Francisco. 572 pp.

Durham, W.H., 1978. Towards a co-evolutionary theory of human biology and culture. In Caplan, A.L. (ed.) 1978 The Sociobiology debate.

Edel, A.1955. Attempts to derive definitive moral patterns from Biology. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Edwards, R.G. 1970. Fertilization and Cleaveage in vitro of Preovulator Human Oocytes. Nature. 227: 1307-1309.

Eisenberg, L. 1972 The "Human" nature of human nature. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Etzioni, A. 1968. Sex control. Science and Society. Science, 161: 1107-1112.

Frolov, I.T., 1985. Genes or culture? A Marxist perspective on Humankind. Biology and Philosophy. 1(1)

Gould, S.J., 1976. Biological potential vs Biological determinism. Natural History Magazine. (May, 1976.) In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Gould, S.J., 1982. Darwinism and the expansion of evolutionary theory. Science, 216: 380-387.

Hamilton, W.D. 1978. The genetical evolution of social behaviour. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Hobbes, T. (1588-1679) Leviathan. Introduced by Lindsay, A.D. Dent. London.

Holton, G., 1974. Thematic origins of scientific thought. Harvard Univ. Press. Cambridge, Mass. 495 pp.

Horstadius, S., 1969. The neural crest. Hafner Publishing Co. London.

Hoyle, F. and Wickramasinghe, C., 1981. Evolution from Space. J. M. Dent and Sons. Ltd. London. 198 pp.

Hume, D. A treatise concerning human nature. In Ayer, A.J. and Winch, R. (ed.) 1965. British empirical philosophers. Routledge and Kegan Paul. London.

Huxley, J., 1929. Essays of a biologist. Chatto and Windus. London. 311 pp.

1939. The living thoughts of Darwin. Cassell and Co. Ltd. London. 144 pp.

Huxley, J.H. and T.H., 1947. Evolution and ethics. Pilot Press. London. 82 pp.

Huxley, J., 1948. Evolution: The Modern Synthesis. George Allen and Urwin Ltd. London.

Jemison, E.W. DISCUSSANT. In Lipkin, M. and Rowley, P.T. (ed.) 1977. Genetic responsibility. Plenum Press. New York.

King, M.C. and Wilson, A.C. 1975. Evolution at two levels. Science. 188: 239.

Koltzoff, N.K. and Schroder, V.N., 1933. Artificial control of sex in the progeny of mammals. Nature, 131: 329.

Krotpotkin, P., 1903. Mutual aid: A factor of Evolution. From: Mutual aid: A factor of Evolution. McClare Phillips and Co. 293-300. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Kuhn, T.S., 1962. The structure of scientific revolutions.

Univ. of Chicago Press. Chicago. 147, 149.

Ladimer, I., 1977. Progress in Medical Genetics: Legal problems. In Genetic Responsibility. Ed. Lipkin, M. (Jr.) and Rowley, P.T. Plenum Press. New York.176 pp.

Lakatos, I. and Musgrave, A. (ed.). 1970. Criticism and the growth of knowledge. Cambridge Univ. Press.

Lewontin, R.C., 1972. Testing the theory of natural selection. (Review of R. Creed, ed. Ecological genetics and evolution. Blackwell Scientific Publications, Oxford. 1971). Nature. 236(5343): 181-182 London.

Lindahl, R.E., 1958. Separation of Bull spermatazoa carrying X- and Y- chromosomes by counter streaming centrifugation. Nature, 181: 784.

Locke, J. A essay concerning human understanding. In Ayer, A.J. and Winch, R. (ed.) 1965. British empirical philosophers. Routledge and Kegan Paul. London.

Lorenz, K. (Eng. Translation), 1966. The functional limits of Morality. From: On aggression. Dr. G. Borotha-Schoeler Verlag. Wien. 264-274.

Mattern, R., 1978. Altruism, ethics and sociobiology. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Mayr, E., 1961. Cause and effect in Biology. Science. 134: 1501-1506.

Mayr, E., 1972. The nature of the Darwinian Revolution. Science. 176: 981-989.

Miller, L.G., 1976. Fated Genes. In Caplan, A.L. (ed.)

1978. The Sociobiology Debate.

Monod, J., 1972. Chance and necessity. Collins. London.

Morrison, R.S. The Biotopy of Behaviour. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Muller, H.J., 1961. Human Evolution by Voluntary choice from Germ Plasm. Science. 134(3450): 643.

Peterson, A.S., and Somit, A. 1978. Sociobiology and politics. In Caplan, A.L. 1978. The Sociobiology Debate.

Popper, K.R., 1945. The open society and its enemies. Rontledge and Kegan Paul. London.

Quinton, A. Ethics and the theory of Evolution. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Rawls, J. 1971. A theory of justice. Harvard Univ. Press. In Lipkin, M. and Rowley, P.T. (ed) 1977. Genetic responsibility. Plenum Press. New York.

Rhodes, F.H.T., 1983. Gradualism, punctuated equilibria and the origin of species. Nature. 305: 269-272.

Richards, S., 1983. Philosophy and sociology of science. Basil Blackwell. England.

Rosenberg, L.E., 1977. Medical genetics: progress and problems. In Genetic Responsibility. 1977. Ed. Lipkin, M. (Jr.) and Rowley, P.T. Plenum Press. New York. 176 pp.

Ruse, M., 1978. Sociobiology: a philosophical analysis. In Chaplan, A.L.(ed.) 1978. The Sociobiology Debate.

Sade, D.A. 1975. The Evolution of Sociality. Science. 190: 261-263.

Sahlin, M., 1976. The use and abuse of biology. Univ. of Michigan Press. Ann. Arbor. 18.

Sayers, J., 1982. Biological politics. Travistock Publications. New York. 235 pp.

Schmidt, O., 1883. The doctrine of descent and Darwinism. Kegan Paul, French and Co. London. 334 pp.

Schurman, J.G., 1888. The ethical import of Darwinism. William and Morgate. London. 264 pp.

Shapiro, J. et al, 1969. Isolation of pure lac. opera. DNA. Nature. 224: 768-774.

Simpson, G.G. 1963. Biology and the nature of science. Science. 139: 81-89.

Singer, M. and Soll, D., 1973. Guidline for DNA Hybrid molecules. Science. 181: 1114.

Singer, P., 1981. The expanding circle. Clarenden Press, Oxford.

Skolimowski, H. Eco-Philosophy. Marion Boyars. London.

Sociobiology study group of science for the people: Allen, E., Beckwith, B., Beckwith, J., Chorover, S., Culver, D., Daniels, N., Dorfman, E., Duncan,M., Engelman, E., Fitten, R., Fuda, K., Gould, S., Gross, C., Hubbard, R., Hurt, J., Inouye, H., Lange, M., Leeds, A., Levins, R., Lewontin, R., Loechler, E., Ludwig, B., Madansky, C., Miller, L., Morales, R., Motheral, S., Muzal, K., Ostrom, N., Pyeritz, R., Reingold, A., Rosenthal, M., Mersky, M., Wilson, M., Schreier, H. 1976. Sociobiology- another biological determinism. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Sonneborn, T.M., 1968. H.J. Muller. Crusader for human betterment. Science. 162: 772-776.

Spencer, H., 1892. The Data of Ethics: The biological view. From: The principles of ethics. Vol. 1. D. Appleton and Co. New York. 995-100. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Stoddard, L., 1925. The revolt against civilization. Chapman and Hall Ltd. London. 255 pp.

Suzuki, D.T.; Griffiths, A.J.F. and Lewontin, R.C., 1981. An introduction to genetic analysis. W.H. Freeman and Co. San Francisco. 910 pp.

Tiger, L. and R. Fox, 1971. The human biogram. From: The Imperial animal. Holt, Rinehart and Winston. New York. 17-23.

Tobias, P.V., 1969. Man's Past and Future. Witwatersrand Univ. Press. Johannesburg. 45 pp.

Tobias, P., 1979. Men, minds and hands: Cultural awakenings over two million years of humanity. S. Afr. Archaeol. Bull. 34: 85-92.

Trivers, R.L. 1971. The evolution of reciprocal altruism. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Waddington, C.H., 1960. The ethical animal. Univ. of Chicago Press.

Wade, N., 1974. Genetic Manipulation: Temporary embargo proposed on research. Science. 195: 332-334.

Wade, N., 1976. Sociobiology: Troubled birth for new discipline. Science. 191: 1151-1155.

Wallace, A.R., 1897. Darwinism. Macmillan and Co. London. 494 pp.

Warrington, J. (editor and translator) 1970. Aristotle's metaphysics. Dent. London.

Weisheipl, J.A. The method of Galileo Galilei. In Durbin, P.R. 1968. Philosophy of science: An introduction. McGraw Hill. New York.

Whewell,W. 1840. The philosophy of the inductive sciences. vol. II. In Richards, S. 1983. Philosophy and sociology of science. An introduction. Basil Blackwell. London.

Wilson, E.O. 1975. Sociobiology: the new synthesis. Harvard Univ. Press.

Wilson, E.O., 1975. Slavery in ants. Sci. American. 232(6): 32-36.

Wilson, E.O., 1976. Academic vigilantism and the political significance of sociobiology. Bioscience. 26(3): 183,187-190.

Wilson, E.O., 1980. Sociobiology: The Abridged Edition. The Belknap Press of Harvard University Press. London. 366 pp.

Winchester, A.M. and Mertens, J.R., 1983. Human genetics (4th ed.). Charles, E. Merrill Publishing Co. London.

314 pp.

Wynne-Edwards, V.C., 1963. Intergroup selection in the evolution of social systems. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Wynne-Edwards, 1976. Bulls'-eye of sociality. Nature. 253-254.

Wynne-Edwards, V.C., 1978. Ecology and the evolution of social ethics. In Caplan, A.L. 1978. The Sociobiology Debate.

REFERENCES: PART III

Hoyle, F. and Wickramasinghe, C., 1981. Evolution from Space. J. M. Dent and Sons. Ltd. London. 198 pp.

Huxley, J., 1948. Evolution: The Modern Synthesis. George Allen and Urwin Ltd. London.

Krotpotkin, P., 1903. Mutual aid: A factor of Evolution. From: Mutual aid: A factor of Evolution. McClare Phillips and Co. 293-300. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Rauche, G.A.1985. Theory and practice in philosophical argument. Institute for Social and Economic Research. University of Durban-Westville. Durban, S.A. Special Publication, No. 1. 303 pp.

Richards, S., 1983. Philosophy and sociology of science. Basil Blackwell. England.

Serrill, M.S. 1986. Anatomy of a disaster. Time Magazine. (35): 10-15.

Skolimowski, H. Eco-Philosophy. Marion Boyars. London.

Waddington, C.H., 1960. The ethical animal. Univ. of Chicago Press.

BIBLIOGRAPHY

Aaronson, S.A. and Torado, C.A. 1969. Human diploid cell transformation by DNA extract from the tumor virus SV40. Science 166: 390-391.

Afnan, S.M., 1958. Avicenna. His life and works. George Allen and Urwin Ltd. London, 298 pp.

Agarwal, K.L. 1970. Total synthesis of the gene for an alanine transfer RNA from yeast. Nature, 227, 27-34.

Agassiz, L., 1857. Essay on Classification. In Mayr, 1972. The nature of the Darwinian revolution. Belkrap Cambridge Mass.

Allee, W.C., 1943. Where angels fear to tread: A contribution from general sociology to human ethics. Science, 97: 517-525.

Allen, E., Beckwith, B., Beckwith, J., Chorover, S., Culver, D., Duncan, M., Gould, S., Hubbard, R., Inouye,I.,Leeds, A., Lewontin, R., Madansky, C., Schreier, H. Against sociobiology. 1978. In Caplan, A.L.,(ed.) 1978 The Sociobiology Debate.

Alper, J. 1976 The implications of sociobiology. Science 192: 424-427.

Alper, J. Beckwith, S.L., Chorover, J., Hunt, H., Inouye, H., Judd, R.V., Lange, P.1978. Sociobiology is a political issue. In Caplan, A.L.(ed.). 1978. The Sociobiology Debate.

Alper, J., Beckwith, J., Miller, L.C. 1978. Sociobiology is a political issue. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Altmann, S.A., 1965. Sociobiology of Rhesus monkeys: II, stochastics of social communication. Journal of Theoretical Biology, 8(3), 490-522. In Wilson, E.O. 1980. Sociobiology. The abridged edition. The Belknap Press of Harvard Univ. Press. London.

Andrew, A., 1971. The origin of intramural ganglia. J. Anat. 108, 1 : 169-184.

Andrew, A., 1979. An experimental investigation into the possible origin of pancreatic islet cells from rhombencephalic. J. Embryol. Exp. Morphol., 52 : 23-38.

Aquinas, T. Commentary on the eight books of Aristotle's physics: A precis. In Durbin, P.R. 1968. Philosophy of science: an introduction. McGraw-Hill. New York.

Ardrey, R. 1966. The territorial imperative. Athenium. New York.

----1970. The social contract. Athenium. New York.

Ayala, F.J., 1974. The concept of biological progress. In Ayala and Dobzhansky, (ed.). 1977. Studies in the philosophy of biology. London Macmillan.

Barash, D. 1979. Sociobiology: The whisperings within. Souvenir Press. London.

Barbour, I.G., 1960. Christianity and the scientist. Association Press. New York.

Barbour, I.G., 1966. Issues in science and religion.

Lowe and Brydone (Printers) Ltd. London. 470 pp.

Barbour, I.G., 1970. Science and Secularity. (The ethics of Technology). Harper and Row, Publishers. London. 157 pp.

Barth, F., 1974. On Responsibility and Humanity. Calling a colleague to account. Current Anthropology. 15, 99-103.

Bazin, G., 1964. A Concise history of Art. Thames and Hudson. London. 549 pp.

Bechwith, J. 1969. In Wade, N. 1974. Genetic manipulation:temporary embargo imposed on research. Science. 195: 332-334.

Bender, H., 1977. The right to choose or to ignore. In Lipkin, M. and Rowley, P.T.(ed.) Genetic responsibility. Plenum Press. New York. 176pp.

Benzer, S., 1962. The fine structure of the gene. Sci. Amer. 206(1): 70-84.

Berg, P.D. Baltimore, H.W., Boyar, S.N. Cohen, R.W., Davis, D.S., Hogness, D., Nathans, R. 1974. Potential biohazards of Recombinant DNA molecules. Science. 185: 303.

Berns, M.W. 1974. Directed chromosome loss by laster irradiation. Science, 186: 700-705.

Bevan, W., 1971. The General scientific association: a bridge to society at large. Science, 172: 349-152.

Bevan, W., 1972. The Welfare of Science in an era of Change. Science. 176: 990-996.

Bock, W.J., 1978. Principles and methods of comparative analysis in sociobiology. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Brehier, E. 1968. The history of philosophy. Chicago Univ. Press.

Brittain, G.G. (Jr.) 1978. Kant's theory of science. Princetown Univ. Press. New York.

Brosseau, G. 1977. DISCUSSANT. In Lipkin, M. and Rowley, P.T. (ed.) 1977 Genetic responsibility. Plenum Press. New York.

Burian, R.M. 1978. A methodological critique of sociobiology. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Burnet, J., 1958. Early Greek Philosophy. Adam and Charles Black. London. 375 pp.

Burns, G.W., 1976. The science of genetics. (3rd ed.) Collier Macmillan. Canada Ltd.

Caplan, A.L. 1978. Ethics, evolution and the milk of human kindness. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Caplan, A.L.(ed.) 1978. The Sociobiology Debate. Harper and Row Publishers. New York. 514 pp.

Carlson, E.A., 1966. The Gene: a critical history. Saunders Company. London. 301 pp.

Chadwick, J. 1932. Possible existence of a neutron. Nature. 129: 312.

Chambers, R. 1844. Vestiges of creation. In Clodd, E.

1897. Pioneers of evolution. From Thales to Huxley. Grant Richards. London. 250pp.

Cline, D.B., Mann, A.K., Rubbia, C. 1976. The search for new families of elementary particles. Scientific American. 234(1): 44-54.

Clodd, E., 1897. Pioneers of Evolution. From Thales to Huxley. Grant Richards. London. 250 pp.

Cohen, S.N., 1975. The manipulation of genes. Sci. Amer. 233(1): 24-33.

Copleston, F., 1962. A history of Philosophy. Vol. II. Mediaeval philosophy. Part I. Augustine to Bonaventure. Image Books. Doubleday and Co. Inc., New York. 346 pp.

Copleston, F., 1962. A history of Philosophy. Vol. 2. Mediaeval philosophy. Part II. Albert the Great to Duns Scotus. Image Books. Doubleday and Co. Inc., New York. 357 pp.

Copleston, F., 1963. A history of Philosophy. Vol 3. Late Mediaeval and Renaissance Philosophy. Part I. Ockham to the Spectulative mystics. Image Books. Doubleday and Co. Inc., New York. 239 pp.

Darwin, C., 1859. The Origin of species. Vol. I & II. The Worlds Popular Classics. Books Inc., New York. 467 pp.

Darwin, C., 1859. Neutral Insects. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Darwin, C., 1901. The descent of Man and selection in relation to sex. John Murray. London. 1301 pp.

Darwin, F. (Sir.) (ed.) 1942. Autobiography of Charles Darwin. Wattes and Co. London. 154 pp.

Davis, B.D., 1970. Prospects for genetic intervention in Man. Science. 170: 1279-1283.

Davis, B.D., 1974. Genetic engineering: How great is the danger? Science. 186: 309.

Dawkins, R. The selfish gene. Oxford Univ. Press. New York

de Chardin, Teilhard P. The phenomemon of man. New York.

De Grood, D.H. 1965. Haeckel's theory of the unity of nature. The Christopher Publishing House. Boston U.S.A.

De la Mettrie, J.O. 1747. Man as a machine. In Heisenberg, W. 1958. The physicist's conception of nature. Hutchinson and Co. Ltd. London.

Descartes, R. A discourse on method. Tralslated by J. Veitch 1969. Everyman's Library. New York. 254

Desmoyers, A. DISCUSSANT. In Lipkin, M. and ROWLEY, P.T. (ed.) 1977. Genetic Responsibility. Plenum Press. New York.

Diamond, S. and Belasco, B., 1980. Biological and cultural evolution. In Rossi, I. (ed.) 1980. People in culture: A survey of cultural anthropology. Praeger Books.

Dobzhansky, T., 1962. Mankind Evolving. Yale Univ. Press. 380 pp.

---1963. Anthropology and the natural sciences-the problem of human evolution. Current Anthropology. 4(138): 146-148.

---Ayala, F.J.; Stebbins, G.L. and Valentine, J.W., 1977. Evolution. W.H. Freeman and Co. San Francisco. 572 pp.

Durham, W.H., 1978. Towards a co-evolutionary theory of human biology and culture. In Caplan, A.L. (ed.) 1978 The Sociobiology debate.

Eddington, A. 1952. The expanding universe. Cambridge Univ. Press.

Edel, A.1955. Attempts to derive definitive moral patterns from Biology. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Edwards, R.G. 1970. Fertilization and Cleaveage in vitro of Preovulator Human Oocytes. Nature. 227: 1307-1309.

Ehrenfeld, D., 1978. The arrogance of humanism. O.U.P., New York. 237pp.

Eisenberg, L. 1972 The "Human" nature of human nature. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Etzioni, A. 1968. Sex control. Science and Society. Science, 161: 1107-1112.

Frolov, I.T., 1985. Genes or culture? A Marxist perspective on Humankind. Biology and Philosophy. 1(1)

Gardner, M. 1979. Realism and instrumentation in Nineteenth Century atomism. Philosophy of Science.

46(1)

Glashow, S.L. 1975. Quarks with colour and flavour. Scientific American. 223(4): 38-50.

Gould, S.J., 1976. Biological potential vs Biological determinism. Natural History Magazine. (May, 1976.) In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Gould, S.J., 1982. Darwinism and the expansion of evolutionary theory. Science, 216: 380-387.

Haeckel, E. 1899. The history of creation. Vol. 1 (Translated by E.R. Lankester). Kegan Paul, Trench Truber and Co. Ltd. England.

---1910. The wonders of life. (Translated by Joseph McCobe). Watts and Co. London. 160 pp.

Hamilton, W.D. 1978. The genetical evolution of social behaviour. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Harrison, J.B. and Sullivan, R.E., 1975. A short history of western civilization. (4th Ed.). Alfred A. Knopf. New York. 734 pp.

Heisenberg, W. 1952. Philosophic problems of nuclear science. Faber and Faber. London.

---1958. The physicist's conception of Nature. Hutchinson. London. 192 pp.

---1963. Physics and philosophy. George Allen and Unwin. London.

---1976. The nature of elementary particles. Physics today. 29(3).

Herskovits, M.T., 1963. Cultural Anthropology. Alfred A. Knopf. new York. 603 pp.

Hesin, Y.E. Choosing my children's genes: genetic counseling. In Lipkin, M. and Rowley, P.T.1977. Genetic responsibility. Plenum Press. New York.

Hobbes, T. (1588-1679) Leviathan. Introduced by Lindsay, A.D. Dent. London.

Holton, G., 1974. Thematic origins of scientific thought. Harvard Univ. Press. Cambridge, Mass. 495 pp.

Horstadius, S., 1969. The neural crest. Hafner Publishing Co. London.

Hoyle, F. and Wickramasinghe, C., 1981. Evolution from Space. J. M. Dent and Sons. Ltd. London. 198 pp.

Hume, D. A treatise concerning human nature. In Ayer, A.J. and Winch, R. (ed.) 1965. British empirical philosophers. Routledge and Kegan Paul. London.

Huxley, J., 1929. Essays of a biologist. Chatto and Windus. London. 311 pp.

1939. The living thoughts of Darwin. Cassell and Co. Ltd. London. 144 pp.

Huxley, J.H. and T.H., 1947. Evolution and ethics. Pilot Press. London. 82 pp.

Huxley, J., 1948. Evolution: The Modern Synthesis. George Allen and Urwin Ltd. London.

Huxley, J., 1953. Evolution in Action. Chatto and Windus. London. 160 pp.

Huxley, J. and Kettlewell, H.B.D., 1974. Charles Darwin and His World. Book Club Associates. London. 143 pp.

Huxley, T.H., 1911. Man's place in Nature and other essays. J.M. Dent and Sons, Ltd. London.

Jammer, M. 1966. The conceptual development of quantum physics. McGraw Hill.

Jantsch, E. and Waddington, C.H. (ed.), 1976. Evolution and Consciousness. Addison-Wesley Publishing Co. London. 259 pp.

Jemison, E.W. DISCUSSANT. In Lipkin, M. and Rowley, P.T. (ed.) 1977. Genetic responsibility. Plenum Press. New York.

Kant, I., 1949. Fundamental Principles of the Metaphysic of morals. Translated by Abbot, T.K. and Fox, M. The Liberal Arts Press. N.Y. 80 pp.

Keith, A., Sir. 1928. Darwinism and what it implies. Watts and Co. London, 56 pp.

King, M.C. and Wilson, A.C. 1975. Evolution at two levels. Science. 188: 239.

Koltzoff, N.K. and Schroder, V.N., 1933. Artificial control of sex in the progeny of mammals. Nature, 131: 329.

Krotpotkin, P., 1903. Mutual aid: A factor of Evolution. From: Mutual aid: A factor of Evolution. McClare Phillips and Co. 293-300. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Kuhn, T.S., 1962. The structure of scientific revolutions.

Univ. of Chicago Press. Chicago. 147, 149.

Ladimer, I., 1977. Progress in Medical Genetics: Legal problems. In Genetic Responsibility. Ed. Lipkin, M. (Jr.) and Rowley, P.T. Plenum Press. New York.176 pp.

Lakatos, I. and Musgrave, A. (ed.). 1970. Criticism and the growth of knowledge. Cambridge Univ. Press.

Lewontin, R.C., 1972. Testing the theory of natural selection. (Review of R. Creed, ed. Ecological genetics and evolution. Blackwell Scientific Publications, Oxford. 1971). Nature. 236(5343): 181-182 London.

Lindahl, R.E., 1958. Separation of Bull spermatazoa carrying X- and Y- chromosomes by counter streaming centrifugation. Nature, 181: 784.

Locke, J. A essay concerning human understanding. In Ayer, A.J. and Winch, R. (ed.) 1965. British empirical philosophers. Routledge and Kegan Paul. London.

Lorenz, K. (Eng. Translation), 1966. The functional limits of Morality. From: On aggression. Dr. G. Borotha-Schoeler Verlag. Wien. 264-274.

Lovelock, J.E. 1982. Gaia. O.U.P. 157pp.

Lyell, C. In Gould, S.J. 1982. Darwinism and the expansion of evolutionary theory. Science. 216: 380-387.

Mattern, R., 1978. Altruism, ethics and sociobiology. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Mayr, E., 1961. Cause and effect in Biology. Science. 134: 1501-1506.

Mayr, E., 1972. The nature of the Darwinian Revolution. Science. 176: 981-989.

Miller, L.G., 1976. Fated Genes. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Monod, J., 1972. Chance and necessity. Collins. London.

Morrison, R.S. The Biotopy of Behaviour. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Muller, H.J., 1961. Human Evolution by Voluntary choice from Germ Plasm. Science. 134(3450): 643.

Murray, L., 1967. The late Renaissance and Mannerism. Thames and Hudson. London. 215 pp.

Nambu, Y. 1976. The confinement of quarks. Sci. American. 325(5): 48-60

Peterson, A.S., and Somit, A. 1978. Sociobiology and politics. In Caplan, A.L. 1978. The Sociobiology Debate.

Polkinghorne, J.C. 1981. The particle play. W.H. Freeman and Co. London.

Popper, K.R., 1945. The open society and its enemies. Rontledge and Kegan Paul. London.

Popper, K.R. 1959. The logic of scientific discovery. Hutchinson. London.

Quinton, A. Ethics and the theory of Evolution. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Radice, B., 1977. Plato: The Republic. Penguin Books. London. 467 pp.

Randall, J.H.(Jr.). The significance of Aristotle's natural philosophy. In Durbin, P.R. 1968. Philosophy of science. An introduction. McGraw Hill. New York.

Rauche, G.A. 1966. A student's key to ancient Greek thought. Fort Hare Univ. Press.

---1970. Contemporary philosophical alternatives and the crisis of truth. Martins Nijhoff. Netherlands. 147pp.

---1981. Social relations and reality. Journal of the Univ. of Durban-Westville. 3(4): 251-260.

---1984. The function of method in the constitution of knowledge. Journal of the Univ. of Durban-Westville. New Series 1.

---1985. Theory and practice in philosophical argument. Institute for Social and Economic Research. University of Durban-Westville. Durban, S.A. Special Publication, No. 1. 303 pp.

---1987. Unpublished and Personal communication.

Rawls, J. 1971. A theory of justice. Harvard Univ. Press. In Lipkin, M. and Rowley, P.T. (ed) 1977. Genetic responsibility. Plenum Press. New York.

Reichenbach, H., 1970. From Copernicus to Einstein. Dover Publications, Inc., New York. 123 pp.

Reid, L., 1981. Choice and action. Macmillan Publishing Co. Inc. New York.

Rhodes, F.H.T., 1983. Gradualism, punctuated equilibria and the origin of species. Nature. 305: 269-272.

Richards, S., 1983. Philosophy and sociology of science. Basil Blackwell. England.

Robinson, C.E., 1966. A history of Greece. Methuen and Co. Ltd. London. 480 pp.

Rosenberg, L.E., 1977. Medical genetics: progress and problems. In Genetic Responsibility. 1977. Ed. Lipkin, M. (Jr.) and Rowley, P.T. Plenum Press. New York. 176 pp.

Ross, W.D.1958. Aristotle's metaphysics. VOL. I & II. Clarenden Press. Oxford.

Ross, W.D. (ed.) 1966. The works of Aristotle: Ethica Nicomachea. Vol. IX. O.U.P.

Rossi, I. (ed), 1980. People in culture: A survey of cultural anthropology. Praeger books.

Ruse, M., 1978. Sociobiology: a philosophical analysis. In Chaplan, A.L.(ed.) 1978. The Sociobiology Debate.

Sade, D.A. 1975. The Evolution of Sociality. Science. 190: 261-263.

Sahlin, M., 1976. The use and abuse of biology. Univ. of Michigan Press. Ann. Arbor. 18.

Sayers, J., 1982. Biological politics. Travistock Publications. New York. 235 pp.

Scheler, M., 1981. Man's place in Nature. (Translated, and with an Introduction by H. Meyerhoff). Farrar, Straus and Giroux. New York. 105 pp.

Schmidt, O., 1883. The doctrine of descent and Darwinism. Kegan Paul, French and Co. London. 334 pp.

Schott, R., 1965. Michelangelo. Thames and Hudson. London. 254 pp.

Schrader-Frechette, K. 1977. Atomism in crisis! An analysis of the current high energy paradigm. Philosophy of science. 44(3): 409-440.

Schurman, J.G., 1888. The ethical import of Darwinism. William and Morgate. London. 264 pp.

Serrill, M.S. 1986. Anatomy of a disaster. Time Magazine. (35): 10-15.

Shapiro, J. et al, 1969. Isolation of pure lac. opera. DNA. Nature. 224: 768-774.

Simpson, G.G. 1963. Biology and the nature of science. Science. 139: 81-89.

Singer, M. and Soll, D., 1973. Guidline for DNA Hybrid molecules. Science. 181: 1114.

Singer, P., 1981. The expanding circle. Clarenden Press, Oxford.

Singh, R. 1979. Theory and practice in Kant's moral and political philosophy. Doctorate thesis. Univ. of Durban-Westville.

---1981. Knowledge and faith in philosophy. Journal of the Univ. of Durban-Westville. 3(4): 375-382

---1986. (ed) Perspectives. The institute for social and economic research. Univ. of Durban-Westville. Special publication No. 4. 240pp.

Skolimowski, H. Eco-Philosophy. Marion Boyars. London.

Sociobiology study group of science for the people:

Allen, E., Beckwith, B., Beckwith, J., Chorover, S., Culver, D., Daniels, N., Dorfman, E., Duncan,M., Engelman, E., Fitten, R., Fuda, K., Gould, S., Gross, C., Hubbard, R., Hurt, J., Inouye, H., Lange, M., Leeds, A., Levins, R., Lewontin, R., Loechler, E., Ludwig, B., Madansky, C., Miller, L., Morales, R., Motheral, S., Muzal, K., Ostrom, N., Pyeritz, R., Reingold, A., Rosenthal, M., Mersky, M., Wilson, M., Schreier, H. 1976. Sociobiology- another biological determinism. In Caplan, A.L.(ed.) 1978. The Sociobiology Debate.

Sonneborn, T.M., 1968. H.J. Muller. Crusader for human betterment. Science. 162: 772-776.

Spencer, H., 1892. The Data of Ethics: The biological view. From: The principles of ethics. Vol. 1. D. Appleton and Co. New York. 995-100. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Stoddard, L., 1925. The revolt against civilization. Chapman and Hall Ltd. London. 255 pp.

Suzuki, D.T.; Griffiths, A.J.F. and Lewontin, R.C., 1981. An introduction to genetic analysis. W.H. Freeman and Co. San Francisco. 910 pp.

Theobald, D.W., 1969. An introduction to the philosophy of Science. Methuen and Co. Ltd. London. 144 pp.

Tiger, L. and R. Fox, 1971. The human biogram. From: The Imperial animal. Holt, Rinehart and Winston. New York. 17-23.

Tobias, P.V., 1969. Man's Past and Future. Witwatersrand Univ. Press. Johannesburg. 45 pp.

Tobias, P., 1979. Men, minds and hands: Cultural awakenings over two million years of humanity. S. Afr. Archaeol. Bull. 34: 85-92.

Trivers, R.L. 1971. The evolution of reciprocal altruism. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Waddington, C.H., 1960. The ethical animal. Univ. of Chicago Press.

Wade, N., 1974. Genetic Manipulation: Temporary embargo proposed on research. Science. 195: 332-334.

Wade, N., 1976. Sociobiology: Troubled birth for new discipline. Science. 191: 1151-1155.

Wallace, A.R., 1897. Darwinism. Macmillan and Co. London. 494 pp.

Warrington, J. (editor and translator) 1970. Aristotle's metaphysics. Dent. London.

Weisheipl, J.A. The method of Galileo Galilei. In Durbin, P.R. 1968. Philosophy of science: An introduction. McGraw Hill. New York.

Whewell,W. 1840. The philosophy of the inductive sciences. vol. II. In Richards, S. 1983. Philosophy and sociology of science. An introduction. Basil Blackwell. London.

Wilson, E.O. 1975. Sociobiology: the new synthesis.

Harvard Univ. Press.

Wilson, E.O., 1975. Slavery in ants. Sci. American. 232(6): 32-36.

Wilson, E.O., 1976. Academic vigilantism and the political significance of sociobiology. Bioscience. 26(3): 183,187-190.

Wilson, E.O., 1980. Sociobiology: The Abridged Edition. The Belknap Press of Harvard University Press. London. 366 pp.

Winchester, A.M. and Mertens, J.R., 1983. Human genetics (4th ed.). Charles, E. Merrill Publishing Co. London. 314 pp.

Windelband, W., 1956. History of ancient philosophy. (Translated in 1956 by H.E. Cushman). Dover Publications Inc. 393 pp.

Wynne-Edwards, V.C., 1963. Intergroup selection in the evolution of social systems. In Caplan, A.L. (ed.) 1978. The Sociobiology Debate.

Wynne-Edwards, 1976. Bulls'-eye of sociality. Nature. 253-254.

Wynne-Edwards, V.C., 1978. Ecology and the evolution of social ethics. In Caplan, A.L. 1978. The Sociobiology Debate.