

The Scientific Enterprise

2. Ancient Science and Worldviews*

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Introduction

During the eighteenth and nineteenth centuries, as a result of the enormous successes of modern science, the general impression arose that there were no serious or creative thinkers in Europe prior to the sixteenth century. Thus, medieval times were regarded as a period of intellectual darkness. However, as a result of the labors of many scholars it was established that there had indeed been keen minds in those times whose works had, in fact, sowed some of the seeds for modern science.

Likewise, up until the twentieth century, the general impression was that all of science was essentially of Western vintage, except for some Arab translations of ancient Greek texts. Again, as a result of the dedicated work of science historians, we now know that solid and significant scientific work had been carried out in ancient non-Western cultures like Mesopotamia, India, and China too. Perhaps the scientific endeavors of ancient Africa will be better known some day.

Science, in the sense of the effort of the human mind to explain the myriad features of the experienced world, has been present in every society since the dawn of thought and self-awareness. Many achievements: material, cultural and spiritual belong to our ancestors all over the world from the most remote days of our emergence as a species. Over the ages, as new generations built upon the knowledge and wisdom of older ones, as civilizations rose and fell, new ideas were born, fresh points of view developed, and more insights were gained about the world in which we live.

Yet, it is also a fact of history that humanity's worldview before the rise of modern science was in many ways significantly different. Flashes of the modern scientific outlook can no doubt be found in the writings of some ancient thinkers. But the vast majority of the ancients, including scientific investigators, lived and functioned in a conceptual world that seems totally strange to the modern scientifically awakened mind. Large numbers of people all over the world, including India, still function with those worldviews.

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Exceptionally brilliant minds can and do forge their own paths quite independently of what the generally accepted ideas of their times may be. On the other hand, the fact that such people don't always succeed in affecting major changes in the beliefs and outlooks of their contemporaries points to another aspect of science history: that external conditions and cultural constraints play a role in the advancement or retardation of science. When the social, political, and cultural environment of society is not conducive to its growth, science cannot develop, no matter how many individuals of genius there are in that society. What the appropriate conditions for this to happen are, it is difficult to know fully. But it does appear from the history of various societies that if only certain material and social factors had existed, most of all the printing press and rulers who permit freedom of thought, modern science as we understand the term could well have evolved much earlier.

The phrase *pre-modern scientific* may be used to describe certain attitudes and beliefs that were characteristic of practically all societies and cultures of the past prior to the advent of modern science. Our knowledge of pre-modern scientific worldviews derives not only from the writings of earlier generations that have survived, but also (and even more dramatically) by studying contemporary cultures and strata of society that flourish in a phase of intellectual and informational framework that has been only slightly affected by modern scientific thought.

In recent years, general interest in the old ways has been on the rise everywhere. Even some scientists are exploring and re-evaluating pre-modern scientific belief systems. But re-formulations of old views in terms of modern discoveries have not led to any new significant scientific discovery. It is important for us to recognize this, for all too often we feel elated when some Western scientists refer to ancient Hindu wisdom in the context of quantum mechanics or cosmology.

Roots of all Worldviews

We all hold certain views and opinions about the world and about life. If we pause to trace the origins of these, we will find that they have resulted, for the most part, from our interactions with others through our personal and cultural environment. These include our parents, teachers and friends, as well as the books we read, the movies we see, the places we visit, etc. From a more general perspective, however, if one traces the origins of human beliefs and worldviews, it will be found that they arise from three distinct factors which may or may not interact with one another. These factors are:

(a) ***The Logical Framework of the Human Mind.*** Because of our biological evolution the normal human brain functions in a particular way. There are clearly recognizable laws of thought which conform to what we call basic logical principles. Logical reasoning is a capacity



of the human mind, *not* its unfailing characteristic. Practically all systems of thought, i.e., philosophies, opinions, and sciences that reflect a worldview, have a logical basis.

(b) *Our Own Experiences in the World around us.* Clearly any worldview is a function of what we experience. Indeed, science tries to explain these experiences. In speculative systems where one goes beyond one's immediate perceptions, one still takes these into account, whether consciously or otherwise. Thus, for example, Thales of Miletus said that everything is made up ultimately of water, because he had seen the river-based civilizations of Egypt and Mesopotamia. When a sage-poet described the *hiranya-garbha* (golden egg) that emerged from water, he might have been inspired by the sight of the rising of the morning Sun from the sea. Likewise, our views on political, moral, or religious questions, for example, are governed by our own personal experiences in these matters.

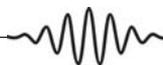
(c) *Emotional and Psychological Factors:* We are creatures, not only of the mind, but of feelings and emotions as well. Indeed, feelings and emotions are more fundamental to our being than pure logic and reasoning. Consequently these factors play a role in the ideas we develop, the beliefs we hold, and the worldviews we accept. Just as in the application of the logical principles we are not always consciously aware of, we seldom recognize the psychological and emotional undercurrents in our thoughts and behavior.

What distinguishes pre-modern science from modern science regarding the nature of the world may be stated thus:

In the pre-modern scientific outlook, the logical framework of our minds is as fully exploited as in the modern scientific stage. Many Greek thinkers, the authors of the *Nyaya* system in India, Arab thinkers, medieval scholastics: all were keen logical thinkers. However, their thought was purely *rationalistic*: reasoning with little reference to facts of observation.

In the pre-modern scientific stage, the role of experiences is much less. There is relatively less conscious effort to reconcile one's worldviews with the facts and data of experience. Thus Aristotle could say that men have more teeth than women, although it would have been easy for him to check out if this statement was correct. Even if blatant contradictions are recognized between a firmly held belief and observed facts, one is not greatly perturbed by such discoveries. Thus even when comets appeared and disappeared without causing any great catastrophes, people continue(d) to believe that such correlations exist(ed). In the modern scientific framework, however, factor (b) relating to actual experience is of utmost importance.

The third factor, namely, the emotional and psychological component, plays a major role in the pre-modern scientific outlook. But often one is totally unaware of its influence. In the modern



scientific context too, this factor sometimes comes into play, but there is every effort to minimize and eliminate this as a determining element in the scientific worldview.

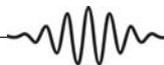
Many pre-modern scientific views arose from the same urge to understand and explain the world that inspires modern science. But that urge is satisfied more easily at a less sophisticated stage, often by relatively simplistic answers. The most superficial impressions of experience were likely to be accepted without further examination. Thus, from the observed impression of the rising and setting of the Sun and the stars it was concluded that the Earth stands still while the firmament revolves around it.

At that stage, one also tends to make unreasonable extrapolations from observed facts. Thus, because there are seven apertures on the human face it was once argued that there could be only seven planets in the heavens. In the ancient framework, there was also a general indifference to verifying claims that were propounded to be true, especially by authorities. The requirement that statements must be subjected to observational tests before they are accepted is quite natural to the modern scientific mind. But it was rarely taken as seriously by people, even by thinkers, in pre-modern scientific times. Even today, in matters beyond technical science, one often tends to ignore this criterion.

This is obvious in the way people accept statements in the scriptures and mythologies of their tradition. That mythological explanations for natural phenomena were offered at all testifies to the scientific spirit of the peoples who propounded them, for it reflects their urge to understand and explain the world of experience. Finally we must note that psychological factors giving rise to our worldviews arise for the most part from the human need to feel a sense of security, and our helplessness in the face of invincible dangers that are implicit in the brute forces of nature, let alone our recognition of our mortality. Let us now consider more specifically some of the items from the pre-modern scientific worldview of past generations.

Astrology

One of the most universal of ancient beliefs was astrology. There are heated debates among scholars as to the origins of astrology, but these need not concern us here. Whether it was the Chaldeans or the Babylonians or thinkers in Vedic India is of little relevance in acknowledging that astrology is an ancient belief system which had, and continues to have, much impact on the worldview of countless people in many cultures, from Greece and Rome to India and China, the Middle East and Europe. It arose from the suspicion – soon the suspicion matured into an elaborate set of convictions – that the Sun, the Moon, the planets and the constellations, all affect human life and destiny. Astrology has changed and evolved over the centuries.



The following are some of the principal assumptions in astrology:

(a) Life on Earth is influenced in subtle ways by matter and motion in the skies. Thus, the Sun and the Moon and various planets have impacts on living organisms on Earth. This has some scientific justification, given that the moods and reactions of at least some people and creatures are known to be affected by sunshine or clouds, and by lunar phases.

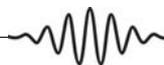
(b) Unusual phenomena in the heavens, such as the appearance of a comet or the conjunction of planets, portend and result in unusual events in human history

(c) The life of every individual is affected in well-defined ways by specific constellations and planetary configurations with respect to one's birth-date and age, as if there were some kind of a personal interaction between heavenly bodies and individuals here below.

(d) Details of how such influences may be detected or even foretold could be obtained from professional astrologers who (usually on payment of a certain sum) calculate these from a knowledge of the precise aspect of the heavens at the moment of the individual's birth (some hold, at the moment of one's conception).

(e) Specific colors, stones, and metals, as also specific qualities, are associated with the various planets. Thus, for example, the color red and the gem ruby are believed to go with Mars, the planet which is also supposed to govern our muscular system, especially between the ages of 40 and 50. Wearing a ring or a medallion of the appropriate color or metal or stone will win favorable influences from the planet in question.

These are some of the basic tenets of astrology. From the time of the ancient Babylonians until the European Renaissance and even beyond, there was little distinction between astrologers and astronomers. In our own times their notions about the sky and the heavens are poles apart. In pre-modern scientific times astrologers commanded great respect and fear. Many remarkable stories were common about their predictive prowess. On the other hand, some unfortunate astrologers were also tortured ruthlessly or killed more humanely when they were recognized as having made erroneous predictions. Some sensitive ones are even known to have committed suicide in shame or in surprise on seeing events quite different from their own projections. Usually such unpleasant ends came about only when predictions involved royalty. Or else the entire profession might have disappeared long ago. Generally speaking, there was (is) a happy relationship between astrologers and the public: the former explained away unrealized prophecies which the latter forgot anyway.



While it is true that astrology was taken far more seriously and was far more rampant and terror-ridden in pre-modern scientific times, as pointed out earlier, it has not exactly disappeared as a result of the rise of modern science. In fact, the early contributors to modern science, such as Kepler, Galileo, and Newton, were all addicted to astrology. In our own times, astrology continues to have a stronghold, and not just on the gullible multitude. Not only individuals in distress or in love, but also business executives, corporations, politicians, and monarchs are known to consult professional astrologers so as to ensure greater success in their enterprises or at least avert unnecessary hurdles. No wonder that for some it has become a lucrative business, with computers, calculators, etc.

Instances of modern astrological thinking in relation to public events are many. It has been claimed, for example, that the development of the atomic bomb occurred because of the discovery of the planet Pluto in 1930. The uninitiated may wonder what the relation is. But one eminent astrologer has given the following explanation. The first atomic bomb utilized in its construction the transuranic element. Clearly the use of Plutonium would not have occurred if Pluto had not been discovered. It is simply impossible for ordinary science to fathom such connections. In the mid-fifties, perhaps in the panic of the Suez War, some perspective astrologers made the cruel announcement that Britain's Queen Elizabeth was entering a period of very grave danger. Causing even greater concern to more people of that cheerful island, they blurted out that the British Empire was on the verge of an imminent collapse. Resorting perhaps more to their betting instincts than to planetary studies, and inspired as much by newspaper headlines as by celestial symbolism, they declared that in less than a century the Soviet Union would be the major power in the world. This in itself may not have been an altogether impossible occurrence, but to blame it all on Uranus does seem somewhat unfair to a planet that, to all appearances, has done us no harm or good. In the face of all this, it is not surprising that science and astrology do not see eye to eye.

Magic and Witchcraft

Today, the word 'magic' refers to a trick or to a clever illusion. But the term had a more serious connotation in pre-modern scientific times. In its more technical sense the word refers to a complex set of practices whose aim is to influence human beings and events without direct or obviously causal interaction. In our own times anthropologists and psychologists have studied such practices extensively in different cultures. Many theories have been put forward to explain the origins and persistence of this very powerful element in human culture.

Associated with magic is witchcraft, an exercise whose primary aim is to harm. Here the medium (or agents) take on more importance than the methods or the goals to be attained.



Witchcraft was far more rampant in pre-modern scientific times, but it has not disappeared from modern societies.

Magic is based on a few simplistic beliefs among which are the following:

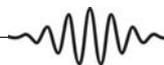
(a) Invisible (supernatural) forces of good and evil permeate the world. Our distant ancestors must have recognized that some people and animals, some climatic changes and natural occurrences, are helpful; while others are harmful and hinder our interests. Thus, rain and sun are useful and necessary, but thunder and hurricane are frightful and destructive. This led to a broad classification of everything into good and evil forces.

(b) These forces were believed to enter human beings and operate through them. The fact that some people behave in useful and friendly ways, while others are decidedly mischievous, must have led to this belief. We see here an example of the unwarranted (but unconscious) extrapolation that characterized pre-modern science.

(c) An object or a person can be affected by manipulating an image or a symbol. This belief probably arose from frustrations of not being able to bring about some effects on a thing or a person, and from wishful thinking which is an inborn tendency in humans. When we desire to harm somebody who is much stronger than ourselves or to control someone beyond our reach, we get satisfaction by imagining that we are actually harming the person or influencing him or her by acting upon an image or a picture. This practice is still with us in different kinds of fantasies. On the political plane there is considerable emotional release when people burn leaders in effigy. Invariably such acts result from utter frustration or from the recognized inability to reach a person directly.

(d) Objects, people, and events can be influenced through words, motions, and emotions. Normally we think of words as only a means of communication. But words accomplish a great deal more. They perpetuate knowledge and memory, they convey feelings and moods, they can evoke love and laughter, tear and fear. Primitive peoples recognized this more consciously than we do, if only because it was a recent achievement of theirs, the invention of their immediate ancestors. The ability to give command through words rather than with grunts and grumbles, and seeing them obeyed, must have given rise to the idea that words can accomplish such effects on other things and events as well. Vestiges of this belief are still with us in our practices of saying, “Good morning!”, or “Good bye!”, or, “Go to hell!”, which actually mean, “May you have a good morning”, “May God be with you”, and “May you have all sorts of difficulties”.

(e) The phenomenal world finds symbolic expression in numerous ways. The capacity



for symbolism is a powerful aspect of human faculty. It is at the root of most of human culture. Language itself is the most effective use of symbols. Because of this, humans began to see symbols in everything. This led to some extraordinary extrapolations.

Similarities between Magic and Science

Both magic and science accept the existence of fundamental entities in the universe which are ultimately responsible for our world of experience. Both regard these entities to be invisible to the naked eye, although one might become aware of them in indirect ways. In magic these are the good and evil forces, in science these are the atoms and the electrons, the protons and the neutrons and other fundamental particles and forces of present day physics. Explanations in terms of the hidden are thus a common characteristic of magic and science.

In magic, as in science, one tries to put the knowledge of these fundamental entities and forces to practical use. It is not enough to know that there are good and evil forces, that there are friendly spirits and mischievous agents of the devil or asura. One should learn to encourage them to act in our interest. So too, one of the goals of science is to turn to our advantage our understanding of the laws of physics and chemistry.

For this one must adopt well-defined procedures. This again is as true in magic as in modern science. In magic such procedures are referred to as rituals. It is very important that rituals be followed meticulously for controlling the magical forces. In science, unless one follows the procedures in a laboratory precisely the facts and fruits of science cannot come under our sway.

When it turns out that even carefully following well-established procedures does not result in expected results, one seldom questions the validity of the accepted principles. Rather, one is inclined to think that the fault lies with the practitioner. His or her inadequacy is what causes the failure. Indeed this is why one needs to be trained by an expert, whether in magic or in science. Rigorous training under a specialist in the field is absolutely essential before one can hope to take full advantage of the knowledge, be it in magic or in science.

We also see a strong parallel between science and magic in the attitude of the public (or the masses) towards the two enterprises. In former times, the magician was held in high esteem, respected and feared also, because with extraordinary powers arising from the esoteric knowledge of the earth and the heavens the magician could influence people and events. The same is true of scientists in our own times. They are the know-alls, and on their expertise depends the very foundations of modern civilization. Their words must therefore be listened to with great interest and attention, even if one does not always understand what they utter.

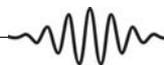


Finally, we note that both magic and science have resulted from the human being's unique capacity to think in symbolic terms. Were it not for this ability, magic could not have developed in human culture; and neither could science. In both cases abstract thought and the play of symbols is present all through. At the theoretical level the magician imagines all sorts of unseen and invisible forces reigning supreme in the world around him. He interacts with them through chants and rituals. And for this he develops his instruments which range from twigs and sacred grass to candles and incense. In the world of modern science, the abstract entities consist of sophisticated conceptual creations bearing such esoteric names as entropy and the lagrangian, while at the concrete level the variety of instruments which are the symbols of scientific activity include items from the simple thermometer and the Geiger counter to such complex systems as mammoth radio telescopes and the expansive laboratories of high energy physics.

These parallels between science and magic do not imply that magic has the same degree of reliability as modern science. There is little convincing evidence that any of the assumptions of magic has objective validity. What may be said with some certainty is that our beliefs and values have far greater impacts on our behavior and sense of security and of fear than our knowledge or understanding of any so-called objective fact. As a result, the tenets of magic have often influenced human behavior in more specific and detectable ways than scientific information ever has. Examples of this abound in human societies. The periodic rituals in places of worship as well as the commemorating parades for the birthday of Lenin or the anniversary of the Iranian Revolution, the breaking of the champagne bottle when a new ship is launched, the waving of the flag on important occasions, the sending of get-well cards and the wishing before blowing birthday candles: all are vestiges of magic. Failure to recognize this is the reason why we tend to look upon magic as being associated with only primitive cultures.

Aspects of Magical Practices in Pre-modern Scientific Times

As noted above, magical beliefs and practices are age old, and very deeply rooted in human culture; they have not died out anywhere in the world, even after the advent of modern science, and they probably never will. More particularly, in recent years even some scientists and scientific organizations have begun to show interest in the matter from a professional point of view. And there have been quite a few apologists for accepting magic on the same footing as science; this, notwithstanding the fact that one of the underlying theses in the theoretical framework of magical writings is that reason and intellect are not to be trusted. While it is true that we should never write off any set of beliefs or practices as being baseless or untrue simply because they do not conform to the framework and assumptions of the current scientific enterprise, it is good to remember some aspects of life and society when magic was taken quite seriously, and modern science had not yet emerged to challenge it.



REFLECTIONS

It was not uncommon to torture helpless animals in magical practices: skinning pigs alive or decapitating helpless animals was/is all part of magical rituals. Indeed the idea of sacrificial animals, and even humans, has its roots in magical thought, for it was one way of propitiating the supernatural forces to win favors. In certain magical traditions sexual intercourse became an element of the practice, but given the exotic and abnormal requirements of the magical enterprise, the rituals developed into obscenities of the painful sort which caused more harm and suffering than excitement and pleasure, all in the name of seeking union with cosmic principles. Then there were unhealthy tinkering with corpses, on the belief that dead bodies were sources of magical powers and secrets since the disembodied spirit may be close at hand.

The variety of magic called *black*, and more popularly known as witchcraft, surpassed everything else in sheer horror. The intent here was clearly and explicitly to cause physical harm and possibly death to other individuals. When this was attempted by sticking pins into wax-dolls to the accompaniment of supposedly potent gestures, the target was of course left unaffected. Nor could much harm ensue from the chanting of rhythmic spells or the articulation of vehement curses, especially if the intended victim, even within earshot, did not take all of this seriously. But unfortunately, in the general atmosphere of poor education and collective fears that pervaded pre-modern scientific societies, and the general ignorance of the very basic features of physical laws and forces, there were very few among the masses who had the wit to even suspect that these may have no objective basis. As a result, the psychological impact of these practices was enormous.

During the Renaissance period, and especially in the 15th century, witchcraft reached new heights of horror in Europe. The general belief that evil forces were acting through a selected set of individuals provoked a need to counteract. Propitiating good forces was no doubt commendable. But what to do when the bad ones took over? It was felt that the agents of evil must be dealt with quickly and effectively.

And so, whenever a house caught fire, an epidemic broke out, a lightning struck, a child died, a church window cracked, or a dead mouse was discovered, some helpless wretch used to be picked up as the Satanic agent, and treated to the most inhuman torture. The Roman Catholic Church tried many witches in its notorious Inquisitions, and burned many of them at the stake. Luther and Calvin were no less horrified by witches and their evil capabilities than the Popes of the period. In the course of the 16th century hundreds of helpless old females were hunted down and ruthlessly burnt in public squares, all with the conviction that these were indeed agents of the evil forces that were part of the framework of magical theory.

Some enthusiastic defenders of the past and concerned critics of aspects of madness in our own



times have compared pre-modern scientific phobia for witches to the political persecutions of the twentieth century. Indeed, even the phrase witch-hunting has been used to characterize some of the reactions to the anti-communist panic in the US and to the savage political repressions of Stalinist Russia. Without in any way condoning these horrors of our own times we must be careful not to exaggerate present day cruelties. No one suspected of communism or similar anti-American tendencies was ever burnt at the stake in a public square; nor can we cite similar atrocities in the Soviet Union. What is more, witchcraft and witch-hunting were based on patently unscientific distortions about the nature of the physical world, while political persecutions are at least based on the (however questionable) conviction that the policies and philosophies of those in power are more conducive to the attainment of noble national goals than those of people who subscribe to an opposing ideology. Present-day victims of political persecutions are committed individuals who think and act with some knowledge and conviction, whereas the charred out witches of past centuries were helpless and innocent creatures, whose only crime was their age, sex or a distorted figure.

In sheer proportion to the total population there were far more victims of belief in magic and witchcraft than there have been of political persecutions. In Switzerland alone, between the years of 1591 and 1610 over 500 witches are known to have been burnt at the stake. In Germany and England, Holland and France, Spain and Italy, hundreds more suffered also. These are some of the aspects of pre-modern scientific magic and witchcraft that should not be forgotten.

Pre-modern Scientific Views on Disease

Many methods of curing diseases were developed in various ancient cultures. Yet, by and large, pre-modern scientific views on diseases were intimately related to evil forces of the supernatural variety. Most cures for diseases included a number of magical components.

In ancient Egypt and China, India and Greece, one finds references to demons and Satan as causing ailments. From the Vedic literature to the Old and the New Testaments, references to diseases as resulting from the wrath of the gods or the intervention of harmful spirits may be found.

From simple massaging to baths in hot water, from the use of medicinal herbs to oils as purgatives, ancient medicine men developed effective cures for a variety of common ailments. But in a context of pre-modern scientific framework, great many unnecessary, useless, and even harmful potions and procedures also came into use. Some items of ancient medicine were simple and effective, and certainly harmless when not so. Such, for instance, were fruits and leaves. Others were rather unusual, and of doubtful efficacy. Such were horns and hairs that were mixed up in alchemical elixirs. And then there was a whole list of concoctions that included such ingredients as spittle, dung, and the urine of virgins.



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Medicines were often administered with fetishes and magic verses. Incantations were more important than intakes. Sometimes the patient had to repeat the magic syllables, sometimes it was only the priest who evoked the spirits which had control over the disease. There was widespread use of amulets to stave off evil spirits or to chase away the ones that had already made their way into the patient's body. Since epidemics affected large groups of people, they were often handled by collective appeals to the powers in the celestial sphere.

The plight of those afflicted with a disfiguring disease was often very pitiable. These were believed to be possessed by evil spirits who had taken a fascination for them. Consequently, such patients were regarded as collaborators of Satan. They were looked upon as witches. Insanity was regarded in demonic terms. It has been pointed out that more inhuman torture was carried out in medieval lunatic asylums in Europe than at any other time or place in all of history.

The blind were looked upon with suspicion. The deaf were considered irrational human beings. The Latin word for deaf, *surdus*, is the same one that describes the so-called irrational numbers, and has also given rise to the English word *absurd*. Likewise, the mute were also imagined to be agents of the devil, and their inability to talk was regarded as an expression of their dull-headedness. Whence the double meaning of the word *dumb*.

Equally, there was the belief that physical and mental ailments could be caused by the evil eye. The idea was that envious individuals, by their mere ill wish, could upset the health and good fortune you might be enjoying. This could only be avoided by taking appropriate protective measures. These included the uttering of prescribed chants, the burning of suitable incense after the suspicious party had left the scene, the holding on to efficacious amulets, and the like. To this day little bells or trinkets are tied to the arms or ankles of children in some cultures so as to protect them from even the unconscious envious look of strangers or friends. All ancient cultures had the concept of the evil eye.

The microbial and viral bases of diseases as well as the psychological aspects of mental illnesses were not recognized until quite recently in human history.

Toleration of Unorthodox Idea

The monopoly of knowledge was guarded in pre-modern scientific societies with the same zeal with which political power is held in some modern nations, and economic privilege in some others. Those in power were convinced that they were in the right as far as perceptions and interpretations of the world were concerned. And they would not easily admit to alternative worldviews, nor tolerate contrary opinions.



It is said that when the Greek sophist Protagoras expressed his doubts as to the existence of gods, and added that life was too brief and the subject too obscure for anyone to say anything definite on the matter, the Athenian Assembly exiled him from the great capital, and had all his writings burnt. This happened four centuries before Christ in a society where there was much intellectual awareness. In China and in India, as elsewhere in the world, other thinkers have been treated to similar punishments when they wrote or spoke out against orthodoxy.

In medieval Europe, wherever the Catholic Church was a mighty force, the Church fathers claimed to know what was the ultimate Truth on all matters, and dictated what was right and what was wrong. In the 13th century, to give but one example, when some professors at the University of Paris raised questions on the then accepted versions of Truth regarding the nature of the world, the Bishop of Paris was quick to declare that their views were heretical, which was the current equivalent of treason. It was common practice, as late as in the 16th century, to set fire to books that contained statements markedly different from those accepted by the authorities.

The practice of burning books, a hallmark of pre-modern scientific societies, has not disappeared. The suppression of ideas by such flagrant means may not be so common in our own times. But in more subtle and less public ways, governments in many countries still control the thoughts and ideas to which their citizens may be exposed, and subject those who hold unorthodox opinions to more than mild reprimands.

Concluding Remarks

What are called pre-modern scientific views continue to persist in our own times in many ways. The term 'pre-modern scientific' therefore does not refer to any specific period of human history prior to a certain date or year, but rather to elements of culture which were far more common in the long centuries of rich and colorful civilizations before the advent of modern scientific thinking. The deeper elements of the modern scientific worldview have hardly begun to permeate human culture, and it is doubtful that they ever will to a universal degree.

Modern science has by no means cleared all the mysteries of life or of the universe, nor solved humanity's never ending problems. On the contrary, newer and more complicated problems have arisen from the scientific adventure. This is often cited by some as a reason for not rejecting certain pre-modern scientific views. In recent years many writers have argued for the acceptance of such views, while not recommending that we abandon our modern scientific interpretations altogether.



REFLECTIONS

Modern apologists for pseudo-sciences fall under three broad categories. First, there are the simple minded and gullible majority who trust the declarations of a white-robed nuclear physicist as readily as those of the village astrologer, for they simply do not see any logical inconsistencies in the intellectual positions of the two. They are so confused by the jargon of present day science and technology that old time beliefs and traditional superstitions seem far more understandable, even acceptable than lectures on the unification of the electromagnetic and the weak interactions or on the structure of the DNA.

To the second category belong serious scientific investigators who apply all the technical information and methodology of modern science to the exploration of as yet ill-understood or only partially elucidated facets of the human spirit and its interactions with the physical world. Professional scientists from Kepler and Newton to many in our own times have never ceased to wonder about the unknown and apparently intractable aspects of consciousness and of the vast universe. They too have, from time to time, indulged in researches of the mystical sort. With the growing successes of matter-of-fact science, such inquiries came to be looked down upon by the scientific establishment.

To the third category of people who are enthusiastic about these matters in our own times belong a variety of well-informed, intelligent, and persuasive writers who probably give the most effective support to some of the pre-modern scientific beliefs. Wielding considerable knowledge (if not expertise) in science, and ably handling an incisive logic, they are able to argue persuasively that the myth and magic of the past are no more absurd than the dogmas and deviations of modern science; indeed that the former may even embody truths too subtle for the limited resources of empirical science to be able to unravel. By overplaying the limitations of the modern scientific enterprise, by exposing the narrow hard-headedness of unenlightened specialists, and by drawing colorful analogies between the principles of modern physics and the aphorisms of ancient wisdom, authors of this kind manage to create the impression among the uninformed, and even among intelligent scientists and educated people, that the essence of modern science is only old wine in new bottles.

It is important to recognize in this context that the modern scientific enterprise is significantly different from the endeavors of earlier generations, not only in that many of its results and concepts are radically different, but even more importantly because of an entirely different outlook, attitude, and methodology in the efforts to understand the world. This is not to underestimate the valuable contributions of ancient societies, nor to criticize their approaches, but to recognize that there are non-trivial differences between the old and the new sciences. Indeed one of the prerequisites for the emergence and growth of modern science seems to be a



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radical, if not conscious, severance with past modes of thought and practice: something that Europe succeeded in accomplishing before other cultures, and which is only gradually occurring in those parts of the world where the scientific enterprise is taking root.

Perhaps the most significant aspect of the modern scientific worldview is that fear has been eliminated from our approach to nature, thus ridding us of needless terrors and superstitions that characterize the pre-modern mindset. This accomplishment of modern science is seldom remembered by those who point to the good old days when science and technology had not yet come to corrupt man's pristine innocence and happiness. Unfortunately, the scientific worldview, in its turn, has led to a series of other unpleasant consequences.

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