R.G.H. SIU

THE TAO OF SCIENCE

an essay on Western knowledge and Eastern wisdom

"In the years since Northrop published *The Meeting of East and West,* no book has been issued more valuable than *The Tao of Science*. . . he (Dr. Siu) opens the way to re-integration of the sciences and humanities."

F.L. Kunz, *Main Currents in Modern Thought*

by
R. G. H. SIU

The Tao of Science

An Essay
on Western Knowledge
and
Eastern Wisdom

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Part I

A Perspective of Scientific Progress

Chapter 1

Science Speeds on Unabashed

THE ADVANCEMENT OF SCIENCE continues at a terrifying pace.

A tiny fork of light was photographed in January 1939 in a cloistered German laboratory. Within the short span of six and a half years the joint efforts of two other nations parlayed this innocent observation into the most awesome weapon of death. A single atomic bomb obliterated a hundred thousand lives and destroyed eight square miles of a fourth community. And scarcely ten years later, threats shuttled across the international waters involving still a fifth country that intercontinental missiles thousands of times more devastating were in the offing.

Scientists are debating whether their brain child intends to leave any earth for them to inhabit, not to say investigate and understand. They are recalling the tragedy of the mythical Greek hunter Actaeon, who accidentally saw Artemis, the goddess of chastity, bathing on Mount Cithaeron. For that he was changed into a stag, to be chased by his own fifty hounds until they killed him. Is there any moral in the story for scientists?—men are beginning to ask.

And all the while, the Devil's words to Shaw's Don Juan keep taunting in the background: "And is Man any the less destroying himself for all this boasted brain of his? . . . and I tell you that in the arts of life man invents nothing; but in the art of death he outdoes Nature herself. . . . This marvellous force of Life of which you boast is a force of Death: Man measures his strength by his destructiveness."

The Devil's distortion is a sly one. The scientist must join Don Juan in his "Pshaw!" He can point to the eighteen tons of material spawned by his fecund genius, which are annually consumed by the average American. For a specific example, he need look no farther than his medicine chest. Concurrently with the engineering of that dreadful implement of death, the very same two powers joined hands to develop the most effective instrument of life that the world of medicine has ever known. Penicillin and the dozen other antibiotics were transformed from test tube curiosities to life-saving prescriptions within the same period of time.

Meanwhile, impatient and inquisitive, science sent her scouts into the dark depths of the ocean and the far reaches of the sky. At the midpoint of the twentieth century they have sounded 35,000 feet below the surface of the seas and ranged to 90,000 above. Where they could not personally touch and observe, they extended their hands through 300 miles of heavens by speedy rockets, their eyes to 10 billion trillion miles by powerful lenses.

If nature attempts to conceal her tiny secrets, science bares them publicly with magnifications of five millionfold. Neither the porcupine nor the mosquito can keep its love life to itself any longer. Scientists peep into their private familiarities and delight in detailed descriptions in lectures and papers. If God's molecular gifts are too bulky for human utility, science chops them into little pieces of useful chemicals. If the natural bits are too small, science joins them together into larger units. If the Thanksgiving turkey is too large, a small one is bred. If seeds are not wanted in fruits, seedless varieties are developed. Not satisfied with man's mundane three-dimensional world, science conjures up four- and six-dimensional phantasms.

The curiosity of science and her bent for innovation seem uncontrollable. She pries into every heavenly nook and earthly cranny. She respects neither the ancient sanctity of tombs nor the caressing intimacies of boudoirs.

Science speeds on unabashed!

Chapter 2

Historical Forces behind Modern Science

NOTHING SEEMS TO DETER modern science from plunging into areas where even "angels fear to tread." Nothing seems to restrain her audacious momentum. How did she get this way? Let us peer into her lineage and heritage. Perhaps we can find some clues.

To begin with, science did not conjure forth herself phoenix-like out of her own ashes. Nor did she spring like Athena full-grown from the teachings of Bacon, Newton, and Locke, suddenly dispelling the darkness of the earlier world. Science was the natural consequence of a long cultural progress extending thousands upon thousands of years. Her birth coincided with the creation of Adam and Eve. Her development paralleled the intellectual refinement of their descendants. Her modern inventions are the culminations of infinite numbers of small increments of interacting and cumulative advancements.

Man's bodily evolution reached its present form about twenty-five thousand years ago. Since then there has been a continuous unfolding of his mental capacities. Even at that time the Cro-Magnons in France were already paying attention to life far beyond the bare necessities of food. Spirited inscriptions of women and animals were being made on the walls of their caves. Expressive creativity was an early human trait.

We observe increasing skills as primitive man progressed beyond the papyrus containing calculations of areas and volumes date back to 2000 B. C. *The Canonical Book of Changes,* the *Yi-ching,* written in 1200 B. C., described the Chinese hypothesis on transformations in nature resulting from the interactions of the polar contraries, the Ying and the Yang. The concept of the elemental composition of matter had been recorded a thousand years earlier in the *Canonical Book of Records,* the *Shu-ching.* In the latter treatise matter consisted of the five elements: metal, wood, earth, fire, and water.

More elaborate systems were developed by the Hindus. Their religious texts of the period contained references to nine universal constituents of nature: the tangible atomic substances of water, fire, air, and earth; the infinite, eternal, nonatomic ether; the nonmaterial time-space; the individual soul; the universal soul; and the Manas, which is the medium of sensing and understanding for the individual soul.

The Greeks, too, had their share of great abstract thinkers. Thales, for example, had predicted the eclipse of 585 B. C. A theory of biological evolution of man was advanced over two millennia before Darwin by Anaximander around 560 B. C. The use of geometrical analyses was begun by Pythagoras in his astronomical studies around 520 B. C. In contrast to Thales, who thought that everything was made of water, Heraclitus (ca. 500 B. C.) proposed that fire is the primordial element. The atomic construction of matter was stated over two millennia before Dalton by Democritus in 420 B. C. His contemporary Socrates, who allegedly learnt much as a youth from the erudite Parmenides, was followed by the philosophers Plato (ca. 428–348 B. C.) and Aristotle (384–322 B. C.).

It becomes readily apparent from these excerpts of human attainments before Christ that the urge toward material and intellectual advancement is not novel with modern science. This is as old as man. Neither is the fruitful realization of its power an accomplishment unique to today's scientific society. This too is as old as man. Let us now scan the periods after Christ and note the changing modes of thought which finally led to the maturity and vitality of modern science. Santayana depicted the Western transformation in an elegant fashion by contrasting the writings of representative poets from three eras: Lucretius (ca. 99–55 B. C.), Dante (1265–1321), and Goethe (1749–1832).

In the pre-Socratic days Greece was pervaded with a materialism in began to decay, there was a transfer of business from the country to the city. People became free of their divinely anointed rulers. They were organized into states, which were believed to exist for the satisfaction of human needs and human ideals. The importance of the individual in his freedom of opinion permeated the times. A newly found independence and initiative of thought resulted.

Together with this ranging of the mind, there had been a thoroughgoing conviction in Medieval Europe that every detailed occurrence in nature was traceable to a demonstrable cause. This was the natural extension of the rationality of God. The universe was a casting of the Master Plan. This outgrowth of medieval theology generated a receptive attitude toward the rationality of science, which was spearheaded by the rise of mathematics and rationalism of the later Middle Ages. Science felt certain that reason can illumine the darkness of human puzzlement. She will not require an appeal to Holy Writ. She will rely on her own verifiable concepts and observations.

The emergence of modern science in the seventeenth century was accompanied by an explosive brilliance of contributions in all phases of human creation. The century was ushered in by the publication of Gilbert's pioneering work on the magnet in 1600. This was quickly followed by Shakespeare's early edition of *Hamlet* in 1604 and Cervantes' *Don Quixote* in 1605. Soon Rembrandt and Milton were to be born. The invention of the telescope took place in 1608 and Kepler's pronouncements of his first two laws of planetary motion in 1609. Galileo was launching his trail-blazing experiments. El Greco was in his prime. Rubens was beginning his career. In 1628 Harvey advanced his theory of the circulation of blood. Descartes published his *Discourse on Method* in 1637. This was just 10, 5, and 3 years after the births of the chemist Boyle, the architect Wren, and the philosopher Spinoza, respectively, and 5 years before the birth of the physicist Newton.

Undisputed dominance in the field of the intellect was finally established by science when she allied herself with industrial and economic interests. Her willingness to forsake scholastic for material objectives attracted larger subsidies that resulted in a rapid expansion of scientific effort. Business provided not only financial support but also concrete, achievable incentives. In the medieval days, God's world was in His power alone. Man was helpless before pestilences, drought, and famine.

Man could only hope that these symptoms of God's wrath would be alleviated through his humility and good works. In his new frame of mind, however, man became rapidly dissatisfied with the gifts of nature. Incited by commerce and industry, Promethean man forged science into an instrument of change. Her principal task is to modify the contents of the cosmos according to man's designs and wants. The medieval bastions for the search of God's truth tottered from the assault of utility.

Utilitarianism focused the expansive view of eternity and universal generalities into intensely localized particulars. Human achievement in the concrete became the goal of those professing to the social good. This was the modern phantasmagorical substitute in lieu of the pious resignation to the unfathomable ways of the Lord. Not only science but also labor, art, and at times even religion came to be looked upon as means to sensuous enjoyment. Learning was no longer a passive process of ethereal reflection but an active, terrestrial, and practical pursuit.

The broad base for the popularity of modern science was thus laid. For the first time man found a versatile outlet for his multitudinous desires and diverse ends. Science was the magic wand for all human passions. It worked for saints and sinners, young and old, proud and humble. It had no preferences, no morals, no feelings. The scholar found science useful in tracing the majesty and the beauty of the Lord's creation. The humble looked to science in contemplating man's feeble insignificance in the uncovered vastness. The vain exploited science to garnish themselves with honors and adulation. The theologian used science as a convincing tool for the confirmation of God's ways. The atheist employed science as the basis for his godless world. The general waged war, with science providing his implements of destruction. The pacifist emphasized science as an agent to world peace through the perpetuation of material abundance. The businessman paid generous bonuses to science as the ideal servant who gets things done, makes money, and never asks questions. The artist was fascinated by the aesthetic patterns that kept unfolding before the successive explorations of science.

The patronage of science in the Western world was universal as she stood on the threshold of the nineteenth century. With such auspicious support, her tremendous progress during the ensuing years was a foregone conclusion.

Chapter 3

Specialists and Research Teams

IN THIS CHAPTER WE SHALL OUTLINE the main factors that contributed to the sweeping growth of science in her pursuit of utilitarianism. There was an intensity of specialization, driving deep salients into the frontiers of knowledge. There was an increase in facilities for training the required specialists. There was an improvement in communications, which made possible the fertile exchange of ideas. There was the practice of organized research, which fused relevant skills into concerted and directional action. These were the chief elements that fed the breeder reaction in the ever-expanding pile of science.

Before the Middle Ages, the scope of the scholar was all encompassing. The leaders of society sought a comprehension of God's total universe. Increase in one's understanding was directed toward the simultaneous movement along the entire front of knowledge. Such an approach had serious drawbacks. First, it provided little concentration of energy at any point for a penetrating thrust. Second, it limited the number of successful participants, since there were few individuals with the requisite breadth of mind. Third, it lacked direction and consequently was limited in utility. It did not take science long to recognize that for maximum effect a new approach must be perfected. The search quickly led to a division of intellectual labor.

Specialization accorded considerable advantages to the individual. Inasmuch as the horizon of possible knowledge is unlimited, the number of areas open to his selection is very large. Under such a scheme most people, talented or mediocre in native ability, are capable of at least restricted excellence. To gain the esteem of the world as a learned authority one needs only to persevere in a circumscribed field of interest which is carefully selected to fit his temperament and is relatively shorn of competitors. This enables the generally inept but concretely capable, who comprise a goodly number in the world, to contribute significantly to science and at the same time to gain considerable recognition. The universal scholar gradually became a dodo of the past; the narrow specialist rapidly gained ascendancy.

Recurring attempts have been made to stem the advances of the "intellectual splitters." The philosophically-minded argued that the specialist surveys too skimpy a perspective of the world. What one should acquire is a familiarity with a wider array of disciplines in order to develop a broader cognizance of life and an integrated knowledge of nature. Many educators have modified teaching curricula for the development of generalists.

These movements have never realized much momentum, however. They were unable to offer compensating rewards to offset the alluring successes of the specialists. Philanthropic foundations committed large financial resources to the advancement of confined disciplines. Governments established grants toward the same end. Prizes and honors were dangled before the eyes of students who would join the race in the natural sciences. Always the greatness of specialists is acclaimed: Galileo, Boyle, Newton, Darwin, Gibbs, Morgan, Einstein. The Leonardo da Vincis, the Benjamin Franklins, the Johann Wolfgang von Goethes were considered departures from the norm of true scientists. Against these incentives for specialization few but the starry-eyed would wander off the fashionable path. How many of our professionals would follow Albert Schweitzer's example of deliberately reducing his specialized advancement in order to add stature to his life in its entirety? By the beginning of the twentieth century, the experts of the particulars commanded by far the greater respect. No matter how valuable the aesthetic sensibilities that were passed over, hard cash and fame now followed the specialized elaborator.

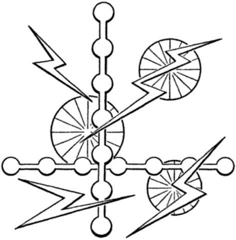
during the Depression that it was more important to carry on research than to pay dividends. Sixty per cent of the sales of his company in 1970 will probably grow from products still in their infancy today. This is the general industrial picture. It has been estimated that scientific discoveries account for 95 per cent of the current income for the mining industry, 90 per cent for manufacturing, 85 for commerce, 80 for agriculture, 50 for forestry, and 100 for transportation. In the thirty-year interval between 1920 and 1950 the number of industrial laboratories in the United States rose tenfold to 6000. The national expenditure in research and development increased over twentyfold from 166 million dollars in 1930 to 3.7 billion in 1952. Today there are about 180,000 researchers in the United States, nine tenths of whom are subsidized through organized programs. These figures are impressive indices of the recent growth of organized research.

The demand for increasing numbers of specialists was met by a streamlining of the training methods. The production of specialists in universities thus became an organized effort in itself. With the separation of the Ecole Polytechnique from the Ecole des Beaux-Arts at the end of the eighteenth century, the modern educational dichotomy between science and art became firmly set. Expert scientists began a serious program of research apprenticeship for students at the Ecole Polytechnique. Since then there followed a rapid increase of training centers. The rate can be gained from a count of the number of universities, technical schools, and theological institutions in the Western world. From the fifteenth to the nineteenth centuries inclusive the numbers ran: 57, 98, 129, 180, 603. In 1954 the total enrollment of students in the 170,000 schools of the United States ran to 38,000,000 or 24 per cent of the total population.

In the field of research, universities are looked upon primarily as strong centers for individual investigations. Yet even here the practice of a team approach has been steadily gaining ground. This trend is reflected in the type of authorship of papers being published. Eighty-five per cent of the articles in *Science,* for example, were contributed by single authors in 1921 and 15 per cent by two co-authors. Three decades later single authors accounted for only 35 per cent; co-authors of two comprised 38 per cent; the other 27 per cent stemmed from joint authorships involving three to eight persons. In the laboratory academicians band

Part II

Effectiveness and Limitations of the Scientific Method



Chapter 4

Basic Research

BEFORE WE EXAMINE THE EFFECTIVENESS of the scientific method in solving the problems of man, let us first clarify its nature. The next five chapters are devoted to this undertaking. This particular chapter will dwell on the question of truth in science and its relation to the currently much touted emphasis on "basic research" as the path to truth and human welfare.

Science cannot float in a vacuum. She must have an anchorage. Philosophers have pondered for centuries over an eternal and universal point of reference. So far there have been deep probings and involved theorizings but no generally accepted conclusions. Meanwhile scientists relied on their senses. Perceptions became the foundations of their elaborations. What was sought was a coherent and concise arrangement of experience. Some workers have even staked out the extreme position that everything is unreal and empty in the universe save perceptions. But then perceptions in dreams would also be real. The Taoist Chuang-tze, who lived in the third century before Christ, put the dilemma thus: He once dreamt that he was a butterfly fluttering among the flowers of the spring forest. Suddenly he awoke. Was he a man who had dreamt that he was a butterfly or was he a butterfly who was then dreaming that he was a man?

Since facts do not lie, any discrepancy between data and concepts must be ascribed to defects in the concepts. So argues the theorist in his search for truth. He invites attention to the improvement of theoretical formulations.

Einstein envisions two components in scientific knowledge. One is immediately apprehended and empirically observed and the other is imagined or theoretically given. These two are joined by correlation. The single experiences are correlated with the theoretical structure. They are not tied together by logical relation or extensive abstraction. Thus the "blue" as observed color is correlated with the "blue" as wave length. The axiomatic basis of science must therefore be freely invented in Einstein's method of tentative deduction. As Northrop admirably points out, there are important implications to this way of thinking. It suggests that we cannot validly derive theoretical descriptions from empirical assertions. This would mean that knowledge gained from a priori theoretical constructs provides something different from experimental observations. Tentative deduction provides a knowledge of reality itself. This assumption enkindles the hope that truth itself can be approached through the scientific method.

Yet it is inconceivable that absolute truth will be given to mere man. Astronomers tell us that about twice the distance reached by the Mount Palomar telescope today represents the farthest we can ever hope to see. Beyond that point the galaxies of our expanding universe are receding from us at a rate faster than light. How can man, who boasts of only a few thousand years of literate knowledge in his million years of roaming this one speck of earth in one of a thousand million galaxies, each with a hundred billion stars, expect to peer into the secrets of the gods? And does man dare to extrapolate backward and forward infinite spans of space-time from his meager 400 years of scientific observations? Can his one mind encompass the interactions of infinite natures? Pilate was not merely posting a pretext when he asked, "What is truth?"

In contrast to Einstein most scientists have retreated from this barrage of questions. They have contented themselves with more tangible goals. Prevailing theories are modified in the light of more accurate observations. The feeling exists that successively refined measurements will lead to increasingly more precise predictions of events. Yet there is a limit to this progression. There are situations in mathematics, for example, in which the approximation to the solution becomes worse as computation is labored beyond a certain point. In experiments involving minute increments of matter, there is also a level of refinement beyond which a different set of rules comes into play. Bridgman makes the terse statement: "Events are not predictable in the realm of small things." Difficulties in the old Newtonian concepts were not dissolved by improvements along the same channel of thinking but by the introduction of radically new relativity concepts. We cannot extrapolate from thin statistical slices into the remote reaches of space and time.

Man has always been fond of fairy tales. Primitive men were strangers to the inanimate. Before the early days of the cipher and the alphabet animal forms were assigned to nature. The universe was composed of personalities. Babylonians used to say that the hot breath of the Bull of Heaven brought on the drought and scorched their crops until it was devoured by the giant bird Imdugud, which brought rain to the good people of Babylon. In modern times children find the stork and Santa Claus reassuring bearers of good tidings.

Until the mid-nineteenth century science had tried to purge herself of fictions. She had clung tenaciously to the search for the real world and clues to its unchanging principles. Twentieth century science, unable to divest herself of the human limitations in which her ideas were cast, began to follow the avenue of tentative concepts. She returned to the age of myths, although of a more convincing and useful order. Instead of the poetic and charming thoughts of Thor, humors and the like, there are now the id, free radicals, hyperon, and others.

Scientific figments have all been useful guides in their day of fashion. Consider, for example, the idea of force. It would have been extremely difficult for Newton to envision his first law of motion without the simplifying notion of one body exerting a tug-of-war control over the other. Force in this old and popular sense is no longer in vogue among the physicists. Instead of explaining that the sun exerts a force on the earth, the physicist now says that the earth is moving in the simplest fashion it possibly can in view of a particular "space-time relationship" to the sun.

Consider the concept of energy. What happens when a stone falls? It becomes a trifle warmer upon contact with the ground. So does the dirt around it. Where does the heat originate? From potential energy, was too good to last. Recently it was shown that a clever trickster had fitted an ape's jaw to a human cranium. With a bit of chemical aging and appropriate scientific releases, he had convinced the majority of the scientific world. It took science forty-five years to realize her gullibility.

So far, we have restricted ourselves to what the Buddhists call "truth in the common sense." If we are to examine "truth in the higher sense," the picture becomes far more complex, such as is being hinted at in scientific theories concerning universes of higher dimensions. It may be of some diversionary interest to glance at these "truths in the higher sense," in order to gain a broader perspective of the place of science in the world of thought. Chi-tsang, a great master of the Buddhist School of the Middle Path of the sixth century, delineated three levels of double truth. According to Fung Yu-lan's translation, these are:

> The common people take all things as really *Yu* (having being, existent) and know nothing about *Wu* (having no being, non-existent). Therefore the Buddhas have told them that actually all things are *Wu* and empty. On this level, to say that all things are *Yu* is the common sense truth and to say that all things are *Wu* is the higher sense truth.
>
> To say that all things are *Yu* is one-sided; but to say that all things are *Wu* is also one-sided. They are both one-sided, because they give people the wrong impression that *Wu* or non-existence only results from the absence of *Yu* or existence. Yet in actual fact, what is *Yu* is simultaneously what is *Wu*. For instance, the table standing before us need not be destroyed in order to show that it is ceasing to exist. In actual fact, it is ceasing to exist all the time. The reason for that is that when one starts to destroy the table, the table which one thus intends to destroy has already ceased to exist. The table of this actual moment is no longer the table of the preceding moment. It only *looks* like that of the preceding moment. Therefore on the second level of double truth, to say that all things are *Yu* and to say that all things are *Wu* are both equally common sense truth. What one ought to say is that the "not-one-sided middle path" consists in understanding that things are neither *Yu* nor *Wu*. This is the higher sense truth.
>
> But to say that the middle truth consists in what is not one-sided (i.e. what is neither *Yu* nor *Wu*), means to make distinctions. And all distinctions are themselves one-sided. Therefore on the third level, to say that things are neither *Yu* nor *Wu* and that herein lies the not-one-sided middle path, is merely common sense truth. The higher truth consists in saying that things are neither *Yu* nor *Wu*, neither not-*Yu* nor not-*Wu* and that the middle path is neither one-sided nor not one-sided.

So much for truth in the higher Buddhist sense, except to voice the opinion parenthetically that the silent feeling for such "higher truths" would appear necessary for sympathetic human understanding and effec-

This approach fits well the hands of science in her drive to change the world. She has upheld whatever tools are effective in use and discarded those that are ineffective. Assertability and not truth per se has become the focus of attention in the development of theories.

What seems to matter is that if we start with a given set of raw data we end up with another, which corresponds to our predictions. Since a welter of ad hoc hypotheses can satisfy this condition, there must be some guideline for the selection of the most acceptable one. Toward this end scientists feel that Occam's advice is good: "Entities are not to be complicated beyond necessity." The largest amount of voting facts are to be brought within the framework of a minimum set of axioms. Yet simplicity itself is not a simple affair. A theory may appear simple in the mathematical formulation describing the order and coherence of a world structure. Such are the final equations of Einstein. Yet it is not an easy exercise for man to picture or sense the curvature of space-time.

Careful analysis must be made before concluding that one theory is preferable to another. What is usually referred to as "descriptive simplicity" should not form a basis of choice. This type is illustrated by the greater ease of handling measures in the Continental over the British system. The pertinent variety is "inductive simplicity." This involves nonequivalent descriptions operating within the framework of inductive considerations. For example, the simplest curve through a mass of points on a graph is considered preferable to the infinite number of others that may be drawn.

Simplicity should not be mistaken for imaginative parsimony. Scientists should not confound the intent of Occam's Razor with a restricted insight into the infinite charm and variety of life. It is this confusion that misleads uninspired scientists to feel that nature has only a few facets and like a miser shows off only one at a time.

Let us recapitulate. Despite its aspirations for truth, science is not organized around it. It is organized around concepts. Its approach is not necessarily the path to reality but necessarily the path to utility. The utility of the concept lies in its verification. Industrialists invest money in the repeated verification of the concept of the electron. Farmers pledge generations of descendants to the same land in the repeated verification of the concept of the gene. Following such a dissection of the anatomy of the scientific effort, research can be broadly divided into two orientations: the development of concepts and the verification of concepts, and the unity of science lies in their fusion.

By and large scientists polarize toward one of the two attitudes. Those who seek new concepts are in the minority. By far the majority busy themselves with the verification of concepts. The latter includes the industrial scientists, engineers, and technologists, as well as many academicians who call themselves "basic researchers."

The currently muddled distinctions between "basic research" and "applied research" have long outlived their usefulness. There is much in common from the conceptual point of reference between the repeated confirmation of the Mendelian laws using the Black Angus cattle and that using the *Drosophila* fruit fly. The fact that a new strain of cattle may benefit the farmer but a new strain of fruit fly benefits no one does not make the former research "applied" and the latter "basic." To say that a given piece of research is "basic" because there is no foreseeable practical value attached to its completion may only be a myopic assessment of its usefulness. A keen and imaginative observer may well envision the highly utilitarian ramifications of the same work.

This discussion recalls to mind Hobbes' statement that "will is the last appetite in deliberation" and Dewey's dissertation on means and ends. According to Dewey's thesis, the end is merely an action viewed at a remote stage, whereas the means is part of the same series but viewed at an earlier stage. Means are merely the steps before the last in a proposed course of action. He therefore considers the terms to have no difference in reality but only in judgment. An analogy may be employed to distinguish between the so-called basic and so-called applied research. The precise nature of the momentary activity itself does not determine whether it is one or the other. It is to be considered "basic" if the scientist is oriented toward the development of new concepts. It is to be considered "applied" if he is oriented toward the verification, extension, or adaptation of prevailing concepts.

The formulation of concepts should be given much greater attention than it is receiving today. Even industry is recognizing its leavening importance on the vigor of the scientific society. Industry has generously supported free and independent researchers within the compass of its profit motives. Nobel laureate I. Langmuir at General Electric, W. Carothers at du Pont, and Nobel laureate C. J. Davisson at Bell Laboratories are

Philosophy/Eastern Religions

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