Chapter 6

THE UN-INVENTIVENESS OF INDO-EUROPEANS

It is well established that Science drew far more from Technology during the first few centuries of its development than it ever contributed, as the third volume of Singer's *History of Technology* makes clear. Stafford Hatfield remarks that Scientists have in fact invented remarkably little - except in ideas. Thus of the 21 presidents of the Royal Society, only 4 invented anything, and of 174 recipients of the Copley Medal, only 12 invented anything. Moreover, a consideration of these 'inventions' shows that they were sometimes more in the nature of extensions of existing ideas than truly original contributions. As Hatfield puts it, *"superficially* regarded, the scientist is discovering what is there, while the inventor is creating what has never existed before." [44]

He does not feel this is absolutely true, for it makes such 'inventions' accidental by-products of a search for something else. This is by no means the case in applied research, but pure Science must surely result in 'accidental' discoveries in this sense, rather than in inventions. It thus gives us one clear distinction between Science and Technology.

Discoveries vs. solutions

The same author points out how the most important discoveries are not the result of a search for solutions to practical problems. As he says; [45]

44. Hatfield, H. Stafford, *The Inventor and His World,* Harmondsworth, UK, Penguin Books, 1948, p.38.
45. Hatfield, H.Stafford., *ibid*., p.39.

> Dewar invented the vacuum flask, Einthoven the string galvanometer, Aston the mass spectrograph, Crookes the X-ray tube, quite "by the way" in the course of pure research and without any thought of the general utility of these instruments. The same is true of innumerable chemical methods. But the highest order of creative effort is exemplified in the great hypotheses which in the last marvelous 50 years of Science have sprung from the brains of Einstein, Rutherford, Bohr, Planck, de Broglie, Heisenberg, Schrodinger, and others. These are tested, like technical inventions, by trying whether they will work. But it is obvious that an aeon of

> experimenting would not discover them in nature, but only result in a mountain of facts without any structure whatever.

When primitive people use some chemical in conjunction with their 'magic' they are completely indifferent to experimenting with it. This is beautifully illustrated by a story told recently over the BBC and reported in *The Listener.*

E. H. Robinson tells how E.Evans-Pritchard visited the Azande, an African people and discovered that they were using a certain method to get positive or negative answers, which depended on giving a chicken a poisonous substance called *benge.* If the chicken died the answer was Yes, or No, depending on which answer the spirits had been asked to give. [46] Evans-Pritchard asked what would happen if they were to administer a double dose to a chicken which had recovered from the usual dose. The Azande were simply not interested. No one has been fool enough to waste good oracle *benge* in making such a pointless experiment. Only a European could imagine such a stupid waste of good material! In fact, Evans-Pritchard says that were a European to make such a test in which Azande opinion was proved wrong, the natives would not be impressed. They would simply stand amazed at the credulity of the European. If the chicken died, they would say it was not good *benge* - the very fact that the chicken died would prove it! There is absolutely no desire to speculate - and no experiment is ever undertaken merely to satisfy 'idle curiosity.'

In editing a valuable collection of Papers published under the title *The Intellectual Adventure of Ancient Man,* and later republished under a new title *Before Philosophy,* H. Frankfort opens his introductory remarks with the following observation: [47]

46. Robertson, E.H., "The Beliefs of Science," *The Listener,* BBC, (London, UK), Jan. 28, 1954, p.183.
47. Frankfort, H, and H.A. Frankfort, *et. al., The Intellectual Adventure of Ancient Man,* University of Chicago Press, 1946, p.3

> If we look for "speculative thought" in the documents of the ancients, we shall be forced to admit that there is very little indeed in our written records which deserves the name of 'thought' in the strictest sense of the term. There are very few passages which show the discipline, the cogency of reasoning, which we associate with thinking.

This volume contains a number of papers dealing with Egypt, Mesopotamia, and the Hebrews. There is unanimity on this point. The reasons for the absence of Science are in each case traced to a certain mental attitude towards the world around, i.e., towards Nature, organic and inorganic, coupled with a strange disinterest in metaphysical problems, which discouraged certain activities such as experiment and certain forms of thought essential to the development of the scientific attitude.

Philosophy vs. wisdom literature

China presents a more difficult problem. This is partly because in recent years

more and more research into their literature has been made available to Europeans, and considerable difference of opinion has existed among the authorities to the significance of some Chinese speculations. For example, Needham feels there is some justification for discerning in the writings of the neo-Confucianists certain forecasts of modern scientific theories regarding the nature of matter. He holds that the Sung philosophers, in their view of Nature as a kind of balanced system of opposing forces, were almost ready to reach the conclusions of Bohr and Rutherford in the field of electricity. [48]

On the other hand, one recent reviewer of second volume of Needham's *magnum opus,* Homer H. Dubs, who is both a Chinese scholar well able to understand the Chinese Classics and appears to be a Philosopher in his own right, believes that Needham is misguided in his conclusions here. Dubs praises much of Needham's work, but feels that at times he mis-translates Chinese texts because he really has not mastered Chinese philosophy. As he says, "Classical Chinese is such a concise language that one must first understand a philosophy before translating it." [49]

Yet at the very beginning Needham has tried to indicate that caution is required in interpreting Chinese

48. Needham, J., *Science and Civilization in China,* Cambridge, UK, Cambridge University Press, 1954, vol.2, p.467,
49. Dubs, Homer, H., reviewing J. Needham, *Science and Civilization in China* in *Endeavour,* July, 1957, p.178.

philosophy because "in China the word *Philosophy* did not quite mean what it came to mean in Europe, being more ethical and social than metaphysical." [50]

This, it seems to me, is of fundamental importance, for it means that such 'philosophers' as China produced, were really only concerned with practical problems. Not, indeed, problems of mechanics always, but still *practical* problems; for after all, human behaviour and interaction is a very practical matter!

This is no new thought. While Confucius is commonly referred to as a philosopher, he actually was far from being one. Epiphanius Wilson, a Chinese classical scholar, points out the fallacy of this common assumption. [51]

> The strangest figure that meets us is the annals of Oriental thought, is that of Confucius. To the popular mind he is the founder of a religion, and yet he has nothing in common with the great religious teachers of the East. The present life *they* despised, the future was to them everything in its promised satisfaction. The teachings of Confucius were of a very different sort. Throughout his whole writings he has not even mentioned the name of God. He declined to discuss the question of immortality. When asked about spiritual beings he remarked, "If we cannot know men, how can we know spirits?"
>
> The influence of Confucius springs, first of all, from the narrowness and definiteness of his doctrine. He was no transcendentalist. His teaching was of the earth, earthy. . . . Even as a moralist he seems practical -- the slight emphasis he puts on virtue of truth places him low down in the ranks of the moralists.

Needham writes much about the different systems of Chinese 'philosophy,' Confucianism, Taoism, Mohism, Buddhism, etc., which influenced Chinese thinking - but nothing that is presented in second volume of his great work, has convinced me that they were really concerned with the proper subject matter of Philosophy except as they were influenced by Buddhism. And even Buddhism, which originated in India where one branch of the Indo-European stock had left a clear mark upon the thinking of educated people, when transferred to China lost its truly philosophical character, though not immediately. Alan W. Watts says: [52]

> Although Buddhism was originally an Indian religion, emerging from the traditions of Hindu Philosophy, it did not attain its full vitality until the Tang Dynasty in China -- about the 8th century A.D. Philosophy, Buddhas, Bodhisattvas and religious rites are far less significant in China.

50. Needham, *Science and Civilization in China,* Cambridge, UK, Cambridge University Press, 1954, vol. 2, p.1.
51. Wilson, Epiphanius, in the Introduction to *The Literature of China,* in *The World's Greatest Classics,* New York, NY, Colonial Press, Renaissance Edition, vol.39, 1900, p.3,4.
52. Watts, Alan, W., "How Buddhism Came to Life,' *Asia,* Oct, 1939, p.581.

> Chinese Buddhism ceased to be a matter of other worldly mysticism
> When Buddhism first came to China, the method used for attaining spiritual illumination followed the lines of Indian Yoga; it was concerned with the practice of Dhyana -- a profound state of consciousness obtained by sitting for hours, days, months, or even years in solitary meditation. But this did not really appeal to the practical spirit of the Chinese, who wanted a Dhyana that could be applied to everyday life.

It seems that we may speak of the Wisdom of the Chinese, as we may speak of the Wisdom of the Egyptian Ptah-hotep (and of the Sapa Inca Pachacuti or of Solomon [53]): but we cannot perhaps properly speak of Chinese or Egyptian Philosophers.

No philosophy, no science

It is my thesis that the evidence indicates that where Philosophy is absent, Science does not develop, because it is indicative of the absence of philosophic thinking. China had no Science because she had no Philosophers to exercise themselves and carry out experiments for the sheer delight of understanding, although the technical skills for instrumentation were readily available. If one confuses Philosophy with practical Wisdom, one will confuse Science with Technology. It is, in both cases, a confusion of 'concerns' -- neither Science nor Philosophy strictly concern themselves with 'practical problems' in the ordinary sense of the term. I think throughout his treatment of Science in China, Needham is overlooking this fundamental distinction.

53. It is hardly necessary to give references from the proverbs of Solomon, but a few sayings of

Pachacuti (or Pachacutec) may be of interest. Envy is a worm that gnaws and consumes the entrails of the envious.

It is very just that he who is a thief should be put to death.

Adulterers who destroy the peace and happiness of others, ought to be declared thieves and punished with death as such.

Judges who secretly receive gifts from litigants ought to be looked upon as thieves and punished with death as such.

The noble and generous man is known by the patience he shows in adversity.

Such sayings are the accumulated wisdom of many, born of experience, and expressed pithily in a few words. These examples are taken from Philip A. Means, "The Incas: Empire Builders of the Andes," *National Geographic Magazine*, Feb., 1938, p.251.

Robert Multhauf, in a review of the second volume of this work says: [54]

> That [Needham] fails to produce a clear exposition of the relationship of technology to scientific thought is a weakness of the book, but an understandable one - since it remains to be accomplished in the relatively better known area of Western Science.

Multhauf then concludes that the Chinese world-view depended on "a totally different line of thought" from the West. It is an "organismic" world-view, a view which looks upon Nature as a Person, acting as an organism rather than a 'thing'. This attitude is quite characteristic of all non-Indo-European peoples, who have therefore tended to favour the idea that man and Nature are personally related, a view reflected in Totemism. In our own Culture, man is again tending more and more to be made simply a fragment of the natural order. But instead of the marriage being achieved by the personalization of nature, it is achieved by the depersonalization of man.

World view: the relationship to nature

In other Cultures this feeling of community with Nature, curiously enough, led to a peculiar callousness in the treatment of animals. It seems to have been the result of a feeling that the equality of man and animals gave both parties the same opportunity to defend themselves so that there was no thought of the 'defenselessness' of the latter. In any number of cases, in fact, the animal had the advantage, and where his presence was not essential to the native for food or clothing, he would exult in being cruel because it was a kind of savage triumph he enjoyed in an effort to shame the defeated enemy.

In Europe, while man has not felt this community of spirit, he has taken the view instead that the stronger must protect the weaker, a certain 'love' of nature has resulted. It is a curious kind of inversion.

Now Taoism, according to Needham, differs from Confucianism in this respect that while Confucius said man must achieve social security by dominating nature, the Taoist said this social security will be achieved more successfully by attempting to gain an insight into nature's workings so that one may no longer be afraid of its

power. This does not encourage experiment however, for such an activity would be almost rude! It means only

54. Multhauf, Robert, reviewing J. Needham, *Science in China*, vol.II in *Science,* vol.124, Oct. *5,* 1956, p.631.

study and observation. And even this involves no theorizing. One merely observes and learns, though technical aids in this are entirely in order, such for example as astronomical instruments - which were developed quite successfully.

Thus in speaking of Taoism, he says "the spirit of technology without science seems thus to be found within Taoist philosophy itself" but he also points out that although Taoists never developed a systematic theoretical account of Nature, this did not at all prevent great progress in all practical Technology. As he says, "Technologists, lacking scientific background to their thought, have a habit of doing the right thing for the wrong reasons, and this was very true of China." [55]

A. L. Kroeber, the Dean of American Anthropologists and a keen student of Culture patterns, remarks: [56]

> It is significant that the Chinese have made many important inventions, but not one major scientific discovery. They have sought a way of life but neither an understanding nor a control of nature beyond what was immediately useful.

And a Chinese scholar, Lui Wu-Chi, writing of his own people's attitude to Confucianism, said: [57]

> The distinguishing features of Confucianism are many. First of all it is a moral system which is both practical and practicable. Without any trace of the metaphysical and the supernatural (i.e., of philosophy or religion) its contents are readily understood by the man in the street; and its ethical teachings, replete with wisdom and common sense, can be applied to daily life.

Philip G. Fothergill in a study of the history of evolutionary thinking, notes an interesting point here, namely, that among the Chinese, the primary elements are wood and gold, which are both substance of great value and utility. The primary elements of the Greeks on the other hand can be considered more as abstractions - earth, air, fire and water -- as he says "equally useful, of course, but much more in the nature of ideas than things as the Greeks themselves conceived them." [58]

55. Needham, J., *Science and Civilization in China,* Cambridge, UK, Cambridge University Press, 1954, vol.2, p.85.
56. Kroeber, Alfred, L, *Configurations of Culture* Growth, Berkeley, CA, University of California, 1944, p.184.
57. Wu-Chi, Liu, *A Short History of Confucian Philosophy,* Harmondsworth, UK, Penguin Books, 1955*,* p.9
58. Fothergill, Philip *G., Historical Aspects of Organic Evolution.* London, UK, Hollis and Carter, 1952, p.10

In fact the same writer draws attention to another important equation which the Greeks made. He remarks: [59]

> Unfortunately there is very little record and no extant continuous account at all of the development of the biological ideas of the ancient Chinese, Babylonian and Egyptian Cultures. The marvellous civilizations of the East have left few traces of their scientific thought. The Greeks... *regarded science as a branch of philosophy, and in fact did not discern between the two.* [Emphasis mine]

Rise of philosophy: the Aryan contribution

In many of these works on the history of Scientific thought, the Greeks are given credit for its beginnings as such. This may not be altogether justified. The Aryans in India played their part also -- and independently.
In *Eveiyman's Encyclopedia,* under "Philosophy," there is the following observation: [60]

> It was not until man sought wisdom *for its own sake,* and with no religious or other motives, that he philosophized in the true sense, and previous theogonies, cosmogonies, etc., cannot strictly claim the title of Philosophy. . . .
>
> The beginnings of Philosophy are as a rule attributed to the Greeks but the Indian ideas of the sixth century B. C., and much later, form an interesting parallel philosophic development.

A new history of Indian chemistry, edited by Prof. P. Ray, of Calcutta, has recently been reviewed by Partington in the British journal *Nature.* The reviewer makes reference to the relationships between Indian and Greek thought. He says, on this point: [61]

> The problem of the independent development of alchemy and chemistry in India is an extremely difficult one. It will no doubt continue to give rise to conflicting opinions and it may never be satisfactorily solved. The related problem of the Greek and Indian atomic theories also gives rise to controversy, although informed opinion now seems to consider that they may well have been independent.

59. Fothergill, Philip G., *ibid.,* p.9
60. *Everyman's Encyclopedia*, London, UK, J.M.Dent, 1913 Edition, vol.10, p.305, 306.
61. Partington, J.R., reviewing *The History of Chemistry in Ancient and Medieval India,* edited by Professor P. Ray, in *Nature,* Jan.*5,* 1957, p.5.

It is quite enlightening to see how this philosophical bent expressed itself in India. Ralph Linton, another deep student of Culture patterns, points out that the Hindus were always highly receptive to new philosophic ideas, "but have shown an almost complete indifference to improved techniques of manufacture". [62] The material world was felt to be of so little importance that minor advances in its control were not considered worth the trouble of changing established habits.

In the same connection, A. L. Kroeber observed that "Hindu civilization is not

only other-worldly, but mystical, rationalizing, and extravagant in its ethos." [63] And Robert Lowie adds that "the Hindus made their contribution in the field of pure mathematics, to which they added the concept of negative numbers" [64] -- a highly abstract mental creation.

Miriam Chapin points out that Hindustani has an enormous vocabulary, and that it contains words for all kinds of scientific concepts and for "the most abstruse speculation." [65] It is a development out of the more ancient Sanskrit, a language well able to give expression to philosophical concepts.

Speaking of a 'philosophy of grammar,' it is interesting to note that Hegel referred to this aspect of Hindu thought. In his *Philosophy of History,* he wrote: [66]

> The recent discoveries of the treasures of Indian Literature, have shown us what a reputation the Hindus have acquired in geometry, astronomy, and algebra, and that they have made great advances in Philosophy, and that among them Grammar has been so far cultivated that no language can be regarded as more fully developed than the Sanskrit.

Yet in spite of this capability, India added little to the world's scientific knowledge. The reason for this was probably because the technical background which might have been supplied by the non-Indo-European element in India was either lost (with the destruction of the Indus Valley Cultures) or made impossible by the reduction

62. Linton, Ralph, *The Study of Man,* New York, NY, Student's Edition, Appleton-Century, 1936, p.343.
63. Kroeber, A.L., *Anthropology,*New York, NY, Harcourt Brace, 1948, p.294.
64. Lowie, Robert, An *Introduction to Cultural Anthropology,* New York, NY, Farrar and Rinehart, 1940, p.340.
65. Chapin, Miriam, *How People Talk,* Toronto, ON, Longmans Green, 1947, p.121.
66. Hegel, Georg, W. F., *The Philosophy of History,* in *The World's Great Classics,* New York, NY, Colonial Press, vol.20, p.161, 162.

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to a low caste of the survivors of those Cultures. Labourers and mechanics are lowest in the Brahma Caste System.

Yet philosophy alone does not give rise to science

To sum up what has been said thus far, a somewhat lengthy quotation from Maritain beautifully draws these threads of evidence together. He writes: [67]

> It is not surprising that all peoples in the primitive stage of history were ignorant of philosophic speculation. But it is more astonishing that even certain civilizations were devoid of philosophy- for example, the *Semite,* and the *Egyptian,* which is, in this respect in the same category as the Semite. Despite the high level of scientific [i.e., technical ACC] culture reached by the intellectual aristocracy of these races, the sole philosophical conceptions, it would seem, which the Egyptians and Chaldeans possessed, were a few very general ideas, implicit in their religion, concerning the Deity, the human soul, and its state after death, and the precepts of morality. These truths, which,

> moreover (as in the case of every race), are purer the further back we follow their history, were never made the subject of rational study and speculation, but were simply accepted, as also were their scientific beliefs, as part of a sacred tradition. Religion took the place of philosophy, and from religion these races received certain philosophic truths; philosophy they had none. In this matter the Jews did not differ from their fellow Semites. Scornful of human wisdom and the achievements of pure reason, and, indeed, without aptitude for such investigation, they produced no philosophers (at least not before Philo). . . .

This last remark is a striking observation, because Philo was a Jew who had rejected his own Culture and adopted the Gentile one, at least to the extent of receiving a Greek education and becoming thoroughly conversant with their systems of philosophy. Only such Jews became philosophers, as Jessie Bernard pointed out. Their inspiration was not from within their own culture.

Maritain then examines briefly the other Indo-European Cultures which lie outside the European area, such for example as the Persians and the people of India. He opens this inquiry with the words: [68]

> All the great Indo-European civilizations, on the other hand, manifest an impulse, which no doubt took widely different forms, towards rational and, in the strict sense, philosophical speculation.

67. Maritain, J., *An Introduction to Philosophy,* New York, NY, Sheed and Ward, 1937, p.25.
68. Maritain, J., *ibid.*, p.26.

In Persia this impulse expressed itself in a deeply speculative attempt to give a rational explanation of the vast problem of evil. This attempt took place under the stimulus of Zoroaster, somewhere about the 8th to the 6th century B.C.

In India, as Maintain puts it: [69]

> When the original religion -- the primitive religion of the Vedas -- no longer proved sufficient to satisfy the intellectual demands or social needs of a more advanced civilization, philosophical notions, which seem to have originated as interpretations of sacrifice and other sacred ritual, but developed in a spirit hostile to the ancient traditions and the cult of the gods, found a home among the sacerdotal class and took possession of the priesthood... The priests... directed their worship no longer to the old gods, but to the undefined and secret forces of the Universe.
>
> This resulted, after a period of confusion, in the formation of a new system, Brahmanism (or Hinduism), which is essentially a philosophy, a metaphysic, a work of human speculation, was invested from the outset with the sanctions and attributes of a religion.

The subsequent history of Indian philosophy is then traced by Maritain very briefly, until the rise of a heterodox teacher, Cakya-Muni, surnamed Buddha, who began to place more emphasis upon practice instead of contemplation and speculation, though his philosophy was grounded in (and may be regarded as a

corruption of) the Brahman philosophy. Its practical emphasis appealed to the Chinese who soon abandoned most of what remained in Buddhism of the older Hindu speculative elements. In India, Buddhism was still a philosophy, though agnostic or atheistic - in China it became a practice.

Later on, Maritain touches upon the Chinese 'philosophers.' Of Confucianism, he says there can be no doubt that it was a form of enlightened selfishness, and completely indifferent to metaphysical speculation. [70] Of Lao-Tse, he speaks with some hesitation, doubting whether the interpretations of his teachings offered by modern Taoists are altogether valid.

Philip Jourdain, speaking of Egyptian mathematics and their solutions to certain practical geometric problems, says: [71]

69. Maritain, **J.,** *ibid.*, p.27.
70. Maritain, **J.,** *ibid.*, p.39.
71. Jourdain, Philip, "The Nature of Mathematics," in *The World of Mathematics,* edited by J.R.Newman, Simon and Schuster, 1956, vol.1, p.12.

> This method seems also to have been known to the Chinese nearly 3000 years ago, but the Chinese made no serious attempt to classify or extend the few rules of arithmetic or geometry with which they were acquainted, or to explain the causes of the phenomena which they observed.

It is remarkable how consistently this attitude of indifference to theory has therefore been reflected among non-Indo-Europeans, whether ancient or modern, primitive or highly civilized.

Intellectual bifurcation: technology and philosophy

Thus it appears that we have a kind of intellectual bifurcation of mankind into two broad classes, technicians and philosophers, a bifurcation which seems to be culturally if not racially determined. Whether this is due to the nature of Indo-European as opposed to non-Indo-European language structure is a point worthy of some careful consideration. Has the mentality given us the language or the language the mental attitude? Certainly, as we shall seek to show in the next chapter, language is of great importance. As Harry Hoijer put it: [72]

> It is quite an illusion to imagine that one adjusts to reality essentially without the use of language, and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is that the "real world" is to a large extent unconsciously built up on the language habits of the group. . . . The worlds in which societies live are distinct worlds, not merely the same world with different labels attached.

Susanne Langer has said that to master a new language is to enter a new universe. At any rate, among Indo-Europeans there seems to be a certain calculated indifference towards, or at least an inability to detect, the practical usefulness of

things. We have already mentioned how both the Hittites and the Chinese used cast iron. We use millions of tons of it now, too, but it is known that the Romans evidently 'discovered' it, but failed to recognize their discovery! R. J. Forbes says, on this point: [73]

> There is the possibility that some knowledge of Cast Iron reached the Roman Empire from the country where cast iron was invented, from China by way of the desert route. It seems to have been known to the Graeco-Roman world, as an accidental and useless product formed by raising the temperature (in smelting iron ores) but *since its nature was not recognized it was thrown away.* Even at Halstatt sites, for instance at Byciskala near Brno, cast iron pieces were found in the slag heaps.

72. Hoijer, Harry, 'The Relation of Language and Culture", in *Anthropology Today,* edited by A. L. Kroeber, Chicago, IL, University of Chicago Press, 1953, p.558.
73. Forbes, R. J., R.J., *Metallurgy in Antiquity,* Leiden, NL, Brill, 1950, p.407.

How differently the Chinese treated this 'useless product'! Of course, this was a long time ago. Would it happen today? Well, the story of Kipping's discoveries in Chemistry is revealing.

E.G. Rochow, in his work on the Silicones, refers to Kipping's experiments. He points out that between the years 1907 and 1944, Professor F.S. Kipping published no less than 51 papers on silicone compounds which resemble organic compounds of carbon. It was a subject which he opened up himself and upon which he was for the entire period, the world's leading authority. In 1937 Kipping delivered the Bakerian Lecture to the Royal Society. In this he declared that he could see no future for such compounds, and remarked, "The prospect of any immediate and important advance in this section of Chemistry does not seem very hopeful." [74]

Yet Kipping never investigated methylsilicone, though he must have encountered both it and similar products on hundreds of occasions. Since 1940 these products have assumed enormous importance and have opened up an entirely new branch of the Plastics Industry. In a recent article on these substances, Dermot Canning says: [75]

> Silicones have been called "magic sand with a thousand uses," and certainly the possible utilizations and applications of this resourceful chemical family do seem to be almost unlimited
>
> Silicone chemistry, although still very much in its infancy, has already shown that it is one of the most useful gifts science has bequeathed to us, and the intensive research now going on is certain to increase the applications of silicones still more.

Today it has been estimated that the silicones have come to represent somewhere in the neighbourhood of one third of the entire plastics industry. Yet his scientific mind missed their practical importance entirely. The same thing has happened with other chemical discoveries in the past. Insecticides were being synthesized over 50 years ago, but were not recognized.

There is a rather illuminating (and amusing) instance of this kind of lack of

practical appreciation of what is available. This is in the area of electricity. It came as a very great surprise to the technical world when wet cell batteries were found in the Middle East, at least 2000 years old, and evidently used for the plating of metals. We have already mentioned this discovery. It is however by no means the only case of the use of electricity by non-Indo-Europeans.

74. Rochow Eugene G., An *Introduction to the Chemistry of Silicones,* New York, NY, Wiley, 1946, p.60-62
75. Canning, Dermot, "Science Utilizes Silicones," *World Science Review,* Feb., 1958, p.25.

Exactly one hundred years ago (1858), George Wilson, Regius Professor of Technology at the University of Edinburgh, presented a Paper before the then Canadian Institute, on the use of Electricity for therapeutic purposes in antiquity. Among those who were using various species of electric eels, etc., in various ways, he mentioned the Egyptians, Abyssinians, Etruscans, and the South American Indians, as well as some African tribes. 76

The Romans thus learned of these animals and the uses to which they had been put, from the Etruscans; and both Roman and Greek physicians copied the practice. Many classical writers refer to these fishes, including Plato, Aristotle, Cicero, Plutarch, Pliny, Oppian, Aelian and Athenaeus.

Subsequent references are to be found in the works of Scribonius Largus (1st century), Galen (2nd century), Aetius (5th century), and Paulus Aegineta (7th century). Questions began to be asked about the nature of the shock received from contact with these creatures by such writers as Aegineta who asked "Is not this an application of the principle of galvanism in medicine?" This was the beginning of a series of questions and experiments.

Meanwhile, headache, gout, rheumatism, and various more serious mental cases were given 'the shock treatment.' Its use in Abyssinia is described by Dr. Bradley in the following way:

> The patient is first strapped to a table, and the numb-fish then applied successively over every organ of the body; the operation is reported to be both painful and successful.

African tribes along the Old Calabar River made therapeutic use of an electric fish found in the river to cure sick children, simply by putting such a fish into a bowl of water and leaving the child to play with it! Sometimes a baby was put into the tub first -- and then the fish thrown in. Humboldt stated that the American Indians used the species *gymnotus* in medicine, and the same author reports its use in Dutch Guiana, at Demerara for instance, to cure paralytic affections. Wilson concluded his paper with these words: 77

> Writing as a physicist, I would remind naturalists, that it was the careful study of the powers of the torpedo (fish) that first enabled electricians to understand some of the most important laws of action of their artificial machines and batteries.

76. Wilson, George, "On Electric Fishes as the Earliest Electric Machine Employed by Mankind," *The Canadian Journal,* New Series, 13, Jan.,1858, p.58ff.
77. Wilson, George, *ibid.,* p. 69.

Cavendish tried to imitate the effects of the Torpedo fishes with electricity and as a result enunciated the difference between intensity and quantity, i.e., between amperage and voltage.

And so we find non-Indo-Europeans employing electricity in two forms but never apparently asking any questions. Then the Indo-European picks up the trail and begins to ask, Why? Through Galvani and Volta we come to Faraday, and it is here that the humour and surprise of the record comes in.

One of Faraday's great discoveries was the phenomenon of induction, without which modern electrical equipment would never have been possible. According to David Dietz, there is a story of a visit by Prime Minister Gladstone to Faraday's laboratory at the Royal Institution in London. [78] Faraday was then engaged in those experiments which led in time to the development of generators, electric motors, transformers, and a host of other things.

"What's the use of all this?" asked Mr. Gladstone.

Faraday thought for a moment, and then replied. "Don't worry, Milord, you'll tax it yet!"

What really inspired Faraday was not the possible use of his findings which he quite probably did not see, but curiosity. As one writer on this famous man put it recently, "He wanted to know why electromagnetic induction occurred." [79]

The differences between 'discovery' and 'invention'

Interestingly enough, a trade journal recently carried an article entitled "The Role of the Scientist and Engineer in Society," by L. R. Hafsted of the General Motors Corporation. Hafsted has a right to speak on this subject, for he is Vice-President of Research, a position of no mean importance. In his article he says: [80]

> A scientist's work is completed when an item of information is established and recorded. The same man who makes a discovery may choose, or be persuaded, to attempt to apply it to a practical problem. In this case he *ceases to be a scientist* and works essentially as an engineer. He is not motivated internally as a Scientist, but *externally by society.* (Emphasis mine]

78. Dietz, David, *Cultural Values of Physics,* in the Smithsonian Report for 1940, p.143.
79. Kondo, Herbert, 'Michael Faraday," *Scientific American,* Oct., 1953, p.93.
80. Hafsted, L.R, "The Role of Scientists and Engineers in Society,' *The Tool Engineer,* Apr., 1957, p.223.

This seems to me to contain several very important observations. It will be noted that he uses the word 'discovery' in relation to Science, just as Kroeber and others have been careful to do -- and not the word 'invention.' He points out that when the

scientist becomes an engineer (or technician) he has ceased be a scientist. Thereby, he underscores the fundamental difference between the two. And finally he remarks upon the fact that the scientist is motivated by an internalized urge to discover, the technical man by externally applied pressures demanding invention or creation to satisfy a recognized need in society. An excellent illustration of this is to be found in Plutarch's account of how Archimedes had to be persuaded to put his genius to practical use to prevent the Romans from capturing Syracuse, and how he afterwards refused to leave any record of the devices he invented for this purpose.

I suggest therefore that the real contribution of non-Indo-Europeans has been in the field of *invention:* and of the Indo-Europeans in *discovery.* And that these both result from an attitude of mind, a feeling towards the Universe which is significantly different in the two classes of people. Each has its advantages. Properly wedded they produce the grandest results. Neither alone, as we can see, produces this high achievement; for in China a certain level was reached in a materialistic civilization beyond which it did not go; and in India, where circumstances left the intelligentsia without technical assistance, a mystical culture reduced the greater number of its vast population to almost abject poverty and privation.

Before closing this Chapter, one further observation is in order. In his study of *Science in Antiquity*, Benjamin Farrington has this to say: [81]

> After the death of Aristotle the renown of Athens as a center of scientific research was rapidly eclipsed by Alexandria. Here Ptolemy, one of the great generals of Alexander the Great, had established himself as head of a portion of the vast empire Alexander had won. And the dynasty he founded in the new capital of Egypt, where a Greek court ruled over the ancient people of Egypt . . . patronized learning with lavish generosity. The Museum which the Ptolemies founded and maintained in Alexandria rapidly became the centre of a Scientific Movement that might have transformed society into a semblance of the modern world. Ancient society halted on the threshold of a modern age.

Why? Could it be because the Indo-European influence was slowly eclipsed by a Semitic, an Arab one?

In itself however, a philosophical or scientific mind is not necessarily a superior type of instrument to the

81. Farrington, B., *Science in Antiquity,* Home University Library, Oxford, 1947, p.168.

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inventive mind. It is not to our credit that we developed Science where non-Indo-Europeans did not. It is to everyone's benefit when the two contributions become complementary. There is no room for racial pride here. As Abbott Payson Usher put it: [82]

> Although transcendental idealism is justly insistent upon the fundamental importance of abstract concepts and the analytic truths, the idealists misrepresent the processes of thinking and of evaluation

> when they represent abstract concepts as the highest and ultimate level of thought.

The indifference of Indo-Europeans to practical ends has been as marked as the indifference of the non-Indo-Europeans to speculation. As Lord Raglan says: [83]

> The Scientists of the 17th century were but little interested in the utilitarian aspect of their inventions. Their object was to cause wonder and surprise, to produce "a most incredible thing." Nothing was farther from their minds than the idea of developing their inventions for the purpose of altering the conditions under which they lived.

The scientist in his Ivory Tower may be a kind of heroic figure in our Culture, but he can also be a ludicrous one. James Conant says "the scientific attitude is essentially that of the savants who, drinking to the next discovery, coupled with their toast the hope that it might never be of any use to anybody." [84] And Robert Clark, to match this, makes reference to the great Irish mathematician William Rowan Hamilton, who, when he had developed a theory of quarternions in the middle of the 19th century, "was very pleased because it has no practical application!" [85]

82. Usher, Abbott P., *A History of Mechanical Inventions*, Cambridge, MA, Harvard University Press, 1954, p.59
83. Raglan, Lord, *How Came Civilization?* London UK, Methuen, 1939, p.176.
84. Conant, James B., *On Understanding Science*, New York, NY, Mentor, 1951, p.117
85. Clark, R.A. *Six Talks on Jung's Psychology*, Pittsburgh, PA, Boxwood Press,1953, p.22.

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