

Doorway Papers by Arthur C. Custance

Part I: *Technology: the Contribution of Non-Indo-Europeans*

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The Achievements of Primitive Cultures

[Introduction](#)

To return to the New World again, J. Grahame Clark, speaking of the contributions made by the Indians of North and South America to the Old World, has this to say:¹⁴

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Baron Nordenskiöld, unlike some European theorists, who found it difficult to credit the aborigines with the ability to raise their own civilization independently of the Old World inspiration, had spent many long and arduous years in the field of South American archaeology, and his conclusions carried with them outstanding authority. In addition to many technical inventions he attributed to the American Indian the achievement of domesticating the animal and plant life of his habitat so effectively that during the four centuries since the Discovery the White Man had failed to make a single contribution of importance. The native fauna gave poor scope, but from it he domesticated the llama, alpaca, guinea-pig, and turkey. Of plants he domesticated hundreds. . . .

Matthew Stirling, Chief of the American Bureau of Ethnology at the time of this writing, speaks of this contribution thus:¹⁵

Among the plants developed by these ancient botanists are maize, beans (kidney and lima), potatoes, and sweet potatoes, now four of the leading foods of the world. Manioc, extensively cultivated by the natives of tropical America is now the staff of life for millions of people living in the equatorial belt. Other important items, such as peanuts, squash, chocolate, peppers, tomatoes, pineapples and avocados might be added.

In addition the Indian was the discoverer of quinine, cocaine, tobacco, and rubber, useful commodities of modern times. Maize or Indian corn was one of the most important contributions of the American Indian to mankind. Over a considerable portion of the Americas, it was the staff of life.

Kenneth Macgowan adds to this list, the custard apple, strawberry, vanilla bean, chickle, and cascara, besides a number of others less familiar. His whole list of important plants made up by the Indian's agriculture is impressive, as he says, for it contains 50 items, not one of which is an Old World species! ¹⁶ Every one of them can be cultivated with a hoe, requiring no draft animals whatever. He also mentions one other accomplishment which is very difficult to account for. The Indian devised a method of extracting a deadly poison (cyanide) from

14. Clark, J. Grahame, "New World Origins," *Antiquity*, vol.14, no.54, June, 1940, p.118.

15. Stirling, Matthew, "Americas First Settlers, the Indians," *National Geographic Magazine*, Nov., 1937, p.592.

16. Macgowan, Kenneth, *Early Man in the New World*, Macmillan, New York, 1950, p.199 and 202 (cyanide)

an otherwise useless plant, manioc, without losing the valuable starch it contained. Macgowan says that Henry J. Bruman called this "one of the outstanding accomplishments of the American Indian." The remarkable thing about it is that they should ever have thought of making use of a plant which, as they found it, contained a deadly poison.

M.D.C. Crawford gives a list of vegetables which were cultivated by the American Indians prior to 1492, which in addition to the above are the following:¹⁷

aloe	Jerusalem artichoke
alligator Pear	pineapple
arrowroot	Indian fig (Prickly pear)
cacao	pumpkin
chili pepper	star apple
cotton (gossypium barbadense Linn.)	

J. L. Collins wrote more recently:¹⁸

The pineapple shares the distinction accorded to all major food plants of the civilized world, of having been selected, developed, and domesticated by people of prehistoric times, and passed on to us through one or more earlier civilizations. The pineapple, like a number of other contemporary agricultural crops . . . originated in America and was unknown to the people of the Old World before its discovery.

Just where the Indians found the original plants which they improved upon to produce modern pineapples, we do not now know. None of the existing varieties compares with the domesticated product, and as Collins observes, "none of these can be singled out now as the form or forms which gave rise to the domesticated pineapples of today, or even of those varieties in the possession of the Indians at the time of the Discovery of America." This was no accidental by-product then, but a deliberate and intelligent breeding process which progressed so far before we knew anything about it, that we cannot now retrace the steps by which it was first accomplished.

Melville Herskovits¹⁹ points out that the North American Indians increased the fertility of their land artificially, by putting a fish in each Maize hill, and practiced multi-planting highly successfully. In each hill

17. Crawford, M.D.C., *The Conquest of Culture*, Fairchild, New York, 1948, p.145, 146.

18. Collins, J.L., "Pineapples in Ancient America," *Scientific Monthly*, vol.66, no.11, Nov., 1948, p.372.

planted with Maize they placed squash and bean seeds together, so that the bean plants could climb the corn stalks and the squash vines run along the ground. The same practice is apparently found in West Africa, where gourds take the place of squashes. Their reasoning here, as Herskovits points out, is different from ours: they hold that a plant which grows erect, one that climbs, and one that hugs the earth must each have a different nature and therefore extract a different food from the earth.¹⁹ Thus they will not compete with each other.

Speaking of the Orient, Dr. F. H. King who has made a most careful

examination of the farming methods practiced by the Chinese, the Koreans, and the Japanese, drew special attention to their painstaking care in maintaining or enhancing the fertility of their soils using all kinds of fertilizers and other special means. ²⁰

Ingenuity: in food gathering

Necessity is the Mother of invention (although laziness helps!) and food is a necessity. Primitive people have shown extraordinary ingenuity in obtaining food. We have already mentioned one or two devices used by the Eskimo . . . the spring bone for killing wolves, for example. In other parts of the world there is the same remarkable ingenuity -- and not the least remarkable element is the variety.

For example, according to George P. Murdock, the Ainu of Northern Japan use dogs to do their fishing for them. There are shoals of fish in the shallow water along some of their coasts, and to catch these they have trained their dogs to swim straight out to sea in a line until a given signal. The dogs then wheel around and come back in an arc towards the shore, barking and making a big splash thus driving the fish into even shallower water where each dog seizes one in his mouth, runs ashore, and drops it at his master's feet receiving the fishes' heads as a reward!

²¹

Ralph Linton speaks of one device for catching wild fowl, which he feels should certainly be awarded top prize for simple ingenuity.²² A flat stone of about 18 inches diameter is given a small raised rim of mud or clay, and certain nuts are placed in the enclosure. These nuts are a particular delight of the local guinea fowl. But the natives of several parts of Africa where these birds are found, take care to ensure that the nuts are just too large for the fowl to pick up in their beaks.

Attracted to the food, the birds try again and again to get a nut in their mouth, each time striking the flat rock with their beak instead. They are persistent creatures apparently, and so they keep it up until their beaks

19. Herskovits, Melville, *Man and His Works*, Knopf, New York, 1950, p.250.

20. King, F.H., *Farmers for 40 Centuries*, Emmaus, PA, Rodale Press, reviewed in *Scientific Monthly*, vol.66, Dec., 1948, p.448, by W.M. Myers, under the title, "Those Clever People."

21. Murdock, George P., *Our Primitive Contemporaries*, New York, Macmillan, 1934. p.167.

22. Linton, Ralph, *The Tree of Culture*, New York, Knopf, 1956, p.83.

are quite swollen and they have literally knocked themselves silly. Each day the owner of the stone calls by and picks up the stupefied birds from the immediate neighbourhood.

Poultry farmers have found that the same thing can happen to chickens fed on a concrete floor. But there is no evidence that Indo-Europeans ever put this observation to any practical use.

We may mention a further example of native ingenuity in this connection which is found in certain parts of Oceania, where there are cuttlefish which have long sucker-tipped arms that are stretched out to catch fish. The natives attach these cuttlefish to lines and use them to catch food for themselves instead. ²³

Lord Raglan tells how in some areas of Oceania, the natives of Java, of the Banda Islands, and the Dobuans, catch a particular species of fish that is difficult to approach, by using fishing-kites.²⁴ The kite is flown on a line of some length, and the fish hook dangles from the tail of the kite, thus allowing the fisherman to keep a considerable distance from the fish which would otherwise evade him.

It is well known that the Japanese have for years used Cormorants to do their fishing for them.²⁵ The birds seem to be well trained and to enjoy themselves immensely! The Samoans use a native plant drug which, when poured on the water, makes the fish dozey and easy to catch.²⁶ According to Carleton Coon, the Australian aborigines poison the water holes with a mild drug that similarly makes the animals who drink from them stupefied. By such means, for example, they easily catch the swift-footed emu.²⁷ A paper published by the Smithsonian Institution lists hundreds of such poisons used by primitive people in all parts of the world to catch game.²⁸

The Terra del Fuegians have so many different traps and other devices for catching ducks and geese, etc., that it would be wearying to detail them. Coon refers to them as being many, and ingenious, and varying according to the nature of the locality.²⁹ They are moreover characterized by a remarkable degree of

23. Cotton, Clare M., "Animals: Old Hands at Angling," *Science News Letter*, Mar. 6, 1954, p.155

24. Raglan, Lord, *How Came Civilization?* London, Methuen, 1939, p.130.

25. Gudger, E.W. "Fishing with the Cormorant in Japan," *Scientific Monthly*, vol.29, July, 1929, p.5ff.

26. Murdock, George P., *Our Primitive Contemporaries*, New York, Macmillan, 1934, p.51.

27. Coon, Carleton S., *A Reader in General Anthropology*, New York, Henry Holt, 1948, p.220.

28. Heizer, Robert F., "Aboriginal Fish Poisons," Paper No. 38, in *Anthropological Papers*, Bulletin 151, Smithsonian Institution, Washington, 1953, p.225, 283. Several hundred poisons are listed.

29. Coon, C.S., *A Reader in General Anthropology*, New York, Henry Holt, 1948, p. 220.

originality, so that it becomes difficult to imagine any further alternatives. Yet these same Terra del Fuegians were considered by Darwin, when he visited them during his voyage with the *Beagle*, to be the very lowest of all humans -- hardly people at all.³⁰ Sir John Lubbock shared this opinion.³¹ Yet their inventiveness where it had to be exercised knew almost no limitations.

Inventions: simplicity the hallmark of genius

I should like to draw attention to this point, here. Inventiveness was exercised where needs arose, seldom otherwise. And this inventiveness did not (as ours so often does) display itself by merely modifying the products of others. The results were as diverse as they were original, and they are almost always characterized by a grand simplicity that is completely misleading to the Westerner whose products are so terribly complicated. Yet simplicity is the essence of genius.

Take as an illustration of this, the bola. Here is a weapon that is effectiveness itself in bringing down small rapidly moving game. The device is composed of a number of stones (usually about 2 to 3 inches in diameter), around each of which a cord is fastened in a groove with a free end about 12 to 18 inches long. From four to eight such stones form the weapon, which is made by tying together the free

ends of the long cords. Holding these cords at their junction, the native swings the stones around like a windmill and lets the whole affair fly at a flock of birds, or rabbits, or other such small game. The stones tend to part company in flight, but only of course to the extent of the cords which tie them to one another. The weapon is thus widely spread by the time it reaches the game, and the chance of a hit is greatly increased. The same effect is of course obtained with 'shot.' However, if any one of the stones makes contact or if any of the cords do, the whole weapon at once wraps itself around the victim and down it comes! What could be simpler?

These bolas are found in many parts of the world, and even in prehistoric sites -- a mute testimony to the inventiveness even of prehistoric man,³² for it seems hard to believe that they were invented only once and that all modern instances are derivatives.

Of all primitive people, perhaps the Australian aborigines have aroused the most interest, not merely because they are so well known and among the last to retain to a large extent the greater part of their ancient skills and traditions, but also because of the extraordinary simplicity of their material culture. Virtually the whole of a man's worldly wealth can normally be carried with him, often in one hand! Of added interest, of course, is the fact they seem to be negroid (because so very black) and yet have much body hair and bushy beards -- which negroes never have: thus their origin is somewhat of an intriguing mystery still.

30. Darwm, Charles, *Journal of Researches*, New York, Ward, Lock and Co., preface dated 1845, p.206ff.

31. Lubbock, Sir John, *Prehistoric Times*, New York, New Science Library, J.A. Hill, 6th edition, revised 1904, p.201.

32. Bolas: see Robert Braidwood, *Prehistoric Man*, Chicago, Field Museum of Natural History, in *Popular Series: Anthropology*, No.7, 1948, p.56.

But their ingenuity is also undoubted in so far as they have cared to exercise it. Probably the supreme example of this is the boomerang. These weapons are also found in other parts of the world, and even in prehistoric sites.³³ As a weapon, it is remarkable: and it has quite justly been called the first 'guided missile.' Of course, all thrown objects are 'guided' in a sense; but the boomerang can be so controlled in the hands of an expert that it will do extraordinary things in the air, and return to the sender if it misses the target -- a great saving of effort, and a real advantage in war!

George Farwell recently authored an official Australian Government paper on this device, in which the design of the weapon is carefully considered. It is a much more complex affair than would appear to the casual observer. Its response to controlled flight is outlined by the author who then explains how this is possible. It is a technical achievement of no mean order, and one wonders what was going on inside the native's mind who perfected it. Even if its special construction features were purely accidentally discovered at first, it is still true that the inventor discovered his discovery. This is not merely a play upon words. As we shall see subsequently, Indo-Europeans are still making notable discoveries and not recognizing them for what they are. Of the boomerang, Farwell writes:³⁴

There are sound reasons for its design features. The undersides of the arms are flat, the upper have a slight camber, a factor which provides lift. There is also a twist from the horizontal at the outer end of each arm, one upward, the other down, perhaps not more than two degrees in all. It may seem unreal to discuss a prehistoric weapon in terms of aerodynamics, but therein lies the remarkable achievement of the aborigine. His practical mind and acute observation anticipated certain ideas of the 20th century aircraft designers.

Sir Thomas Mitchell, the explorer, made the characteristic twist of the boomerang the basis for a new type of ship's propeller, which he patented 100 years ago. Early in this century G. T. Walker of Cambridge University, spent no less than ten years of research into the boomerang's properties, evolving certain theories on gyroscopic flight.

33. Boomerangs: these have also been reported from Egypt at Badari by Vere Gordon Childe, (*New Light on the Most Ancient East*, London, Kegan Paul, 1935, p.65), and in Europe by Herbert Wendt, (*I Looked for Adam*, London, Weidenfeld and Nicolson, 1955, p.356).

34. Farwell, George, "The First Known Guided Missile," reprinted in the *Globe and Mail*, (Toronto, ON, Saturday, Aug., 29, 1953, p.17), as a feature article, from the Australian Government publication, *South West Pacific*.

Farwell then elaborates somewhat on the dynamics of its flight and gives some examples of feats which the natives can achieve with very little effort. He presumes that it was perhaps by observing the flight of falling leaves with their curled up edges that the natives came to the idea. This sounds rather weak to me. At any rate, they created a very ingenious weapon, and we have found no way to improve it yet.

George Sarton uses this weapon as an illustration of "the uncanny ingenuity of 'primitive' people." To this he adds the elastic plaited cylinder of jacitara palm bark, called a tipiti, which is used to extract the poison cyanide from the Manioc to which reference has already been made. As a third illustration he refers to the prehistoric Chinese pottery vessels which took the form of a tripod, the legs of which were hollow and formed the containers.³⁵ It thus anticipated by thousands of years the modern trisection aluminium wares! It is illustrated roughly in Fig. 5. The legs straddled the fire. The shape, of course, permitted cooking three separate dishes at one time

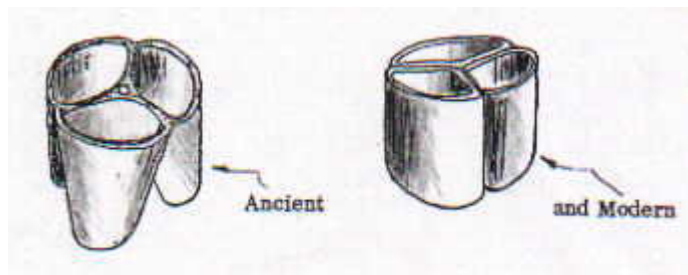


Figure 5.

Ingenuity: in medical skills

In the Peruvian Andes, living at an elevation of 14,000 feet approximately, are the Aymara -- believed to be the remnants of the creators of the Inca Empire. They

are a rather impatient and ill-tempered people according to some observers, possibly by reason of the rarefied atmosphere in which they live, and possibly on the same account they do not care to exert themselves much to improve their condition -- although obviously this was not true in the past. But they have developed their medical skill quite extensively, and so organized the Profession that there are specialists in the various fields who refer patients to one another as seems necessary.³⁶ Like most primitive people, they mix magic with their medicine: but they evidently realize that the magic has a psychological value as much as anything. This is true of other such native people. A. P. Elkin has written on this point at some length and is convinced that the Witch Doctor is often a man, as he put it, of "High Degree" by which he means relatively a Ph.D. in the context of his own culture. ³⁷ The relationship between magic and medicine, and indeed Science in general, is considered later. In the meantime it is becoming increasingly apparent that the non-Indo-European far anticipated us in their medical practice, as well as in the field of Psychology. I think this is particularly true in certain areas, such as in the problem of dealing with fear. Speaking of African medical skill, Grantly Dick Read points out: ³⁸

35. Sarton, George, *A History of Science*, Cambridge, MA, Harvard University Press, 1952, p.5.

36. Tschopik, H., Jr., "The Aymara," in *Handbook of South American Indians*, published by the Bureau of American Ethnology, 1946, vol. 2, Bulletin 143, p.501-573.

37. Elkin Adolphus P., *Aboriginal Men of High Degree*, being the 1944 Queensland University John Murtagh Macrossan Memorial Lectures, published by Australasian Publications, 1946.

38. Read, Grantly Dick, "*No Time for Fear*," as reviewed by W.A.Deacon in the Saturday Review of Books, *Globe and Mail*, Toronto, ON, Aug., 11, 1956.

They had cures for diseases which modern science still finds difficult to heal -
- and sometimes the knowledge of a good witch doctor could be of very good use
to modern psychology.

Frequently, of course, they did not reflect much upon the psychology they used -
- but it was always very practical in its application, and it represented a kind of
deep wisdom which modern physicians sometimes lack.

There are often amusing and revealing illustrations of this. In two areas in
particular they explored widely -- in person-to-person relationships, especially with
near relatives, and in dealing with the supernatural. For example, they insist as a
rule that a man go to live with his wife's people. There are a number of very good
reasons for this, not the least of which is the fact that they recognized that most
emotional tensions revolve around the lady of the house. When a man goes to his
wife's home, the lady of the house 'gains' a son. If, however, the wife goes to the
husband's house to live, the lady of the house 'loses' a son! This is a serious thing --
the root of much jealousy and causes emotional tensions which they sought to
avoid.

As an illustration of the second area in which Psychology is applied, one can
cite a case that occurred in a Pueblo village after the last war. Many young Hopi
volunteered for service overseas. This often badly confused their traditional
cultural behaviour patterns. One anthropologist noting this, suggested to a young

Hopi veteran that he'd still be afraid to sleep in one of their ancient cemeteries. He laughingly denied this. So he, and an old villager, agreed to the test. The old man selected a spot to sleep, performed several little rites, sprinkling seed around his bed and urinating on the seed. With a brief prayer, he then lay down and slept like a child. The young man no longer believed in such things -- neither the spirits (so he said) nor the 'magic.' He tossed and turned, quite unable to sleep -- pretending to be unafraid and having no longer any accepted means to offset the fears he denied. He finally got up and returned to the village! A. P. Elkin gives many instances of this kind of thing in Australia, and says that he often spoke to the old men about their faith in the magic they used and was surprised to find how clearly they understood its psychological value. Some of the witch doctors were Ph.D.'s in Psychology, rather than doctors with an M.D., according to Elkin.

But even in the use of drugs that do actually work chemically the non-Indo-European has been far ahead of us. Aldous Huxley speaks of the use of such drugs and tranquilizers and other remedies for anxiety: ³⁹

Certain chemical compounds produce certain changes of consciousness and so permit a measure of self-transcendence and a temporary relief of tension. Thus, the so-called "tranquilizing drugs" are merely the latest addition to a long list

39. Huxley, Aldous, "History of Tension," *Scientific Monthly*, vol.87, July, 1957, p.4, 5.

of chemicals which have been used from time immemorial for changing the quality of consciousness and so making possible some degree of transcendence. Let us always remember that, while modern pharmacology has given us a host of new synthetics, it has made no basic discoveries in the field of the natural drugs; it has merely improved the methods of extraction, purification, and combination. All the naturally occurring sedatives, narcotics, euphorics, hallucinogens, and excitants were discovered thousands of years ago before the dawn of civilization. This surely is one of the strangest facts in that long catalogue of improbabilities known as human history. Primitive man, it is evident, experimented with every root, twig, leaf and flower, with every seed, nut and berry, and fungus, in his environment. Pharmacology is older than agriculture. There is good reason to believe that even in Palaeolithic times, while he was still a hunter and food gatherer, man killed his animals and human enemies with a poisoned arrow. By the Stone Age he was systematically poisoning himself. The preserved heads of poppy in the kitchen middens of the Swiss Lake dwellers shows how early in his history man discovered the techniques of self-transcendence through drugs. There were dope addicts long before there were farmers.

As an example of the extent to which such people go, it may be mentioned that the Jagga even developed truth serum. ⁴⁰

Claude Levi-Strauss underscores another aspect of this psychomedical contribution: ⁴¹

The West, for all its mastery of machines, exhibits evidence of only the most elementary understanding of the use and potential resources of that super-machine, the human body. In this sphere on the contrary, the East and Far East are several thousand years ahead; they have produced the great theoretical and

practical summae represented by Yoga in India, and Chinese 'breath techniques,'" or the visceral control of the ancient Maoris. . . .

In all matters touching on the organization of the family, and the achievement of harmonious relations between the family group and the social group, the Australian aborigines, though backward in the economic sphere, are so far ahead of the rest of mankind that, to understand the careful and deliberate system of rules they have elaborated, we have to use all the refinements of modern mathematics. . . .

The Australians with an admirable grasp of the facts, have converted this machinery into terms of theory, and listed the main methods by which it may be produced, with the advantages and the drawbacks attaching to each. They have gone further than empirical observation to discover the laws governing the system, so that it is no exaggeration to say that they are not merely the founders of modern sociology as a whole, but are the real innovators of measurement in the social sciences.

40. Truth serum: referred to by Robert Lowie, *Social Organization*, New York, Rinehart, 1948, p.168, 169.

41. Levi-Strauss, C., "Race and History" in the series *The Race Question in Modern Science*, UNESCO, Paris, 1952, p.27.

Not all sociologists would agree with Levi-Strauss, of course, but there is no doubt that the social aspect of human relationships have here been subjected to unusual scrutiny. It seems almost a rule, in fact, that the simpler the culture in its materials, the more elaborate its formalized social structure is apt to be, including its rituals. And conversely, the more complex the civilization, the less formal its social patterns are likely to be. Ralph Linton speaks of one occasion in an Australian tribe, where it happened that the regulations had become so involved that a time came when it was found nobody could properly get married any more!⁴²

All the American Indians had an extensive medical knowledge. Their surgical skill was remarkable, and like non-Indo-Europeans in many other parts of the world, ancient and modern, they practiced such delicate operations as trepanation with remarkable success.⁴³

Such extremely delicate surgery implies the use of some kind of anaesthetic. Robert Lowie reminds us that we owe this very fundamental discovery to the South American Indian. As he says, "What is absolutely certain is that our local anaesthetics go back to the Peruvian Indian's coca leaves, whence our cocaine."⁴⁴

Another important invention from the same source is the enema. Robert Heizer, in an issue of a well-known publication which was devoted to the history of this instrument, states that:⁴⁵

The medical practices of the Indians of North and South America prior to the shattering of their cultures by Caucasian wars and exploitation, were truly amazing in their magnitude and excellence. Our fractional knowledge of these attainments derives from early historical records, ethno-botanical works by botanists and pharmacologists, and from intensive study of skeletal materials by trained observers. Included in the roster of medical techniques was the

administration of enemas and lavements by means of a number of instruments -- bulb and piston type syringes and clyster tubes.

42. Linton, Ralph, *The Study of Man*, New York, Appleton Century, Student's Edition, 1936, p.90.
43. Popham, Robert, "Trepanation as a Rational Procedure in Primitive Surgery," *University of Toronto Medical Journal*, vol.31, no.5, Feb., 1954, p.204-211.
44. Lowie, Robert, *An Introduction to Cultural Anthropology*, New York, Farrar and Rinehart, 2nd edition 1940, p.336.
45. Heizer, Robert, "The Use of the Enema by the Aboriginal American Indians," *Ciba Symposia*, vol.5, Feb., 1944, p.1686, 1690 (illustration)

Nordenskiöld, speaking of the American Indian as an inventor, refers to such enema syringes, one of which he illustrates.⁴⁶ The illustration, Fig. 6, is taken from his work, and shows how little we have been able to improve upon it! Even the decorative scheme is in excellent taste, and the mode of manufacture was copied exactly when Indo-Europeans first began to exploit the native development of rubber latex.

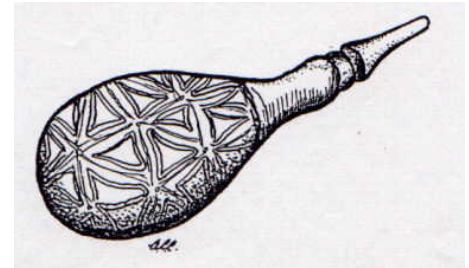


Figure 6.

The same writer also mentions the invention of tweezers for medical purposes for which he gives the credit to the Araucanians, another Peruvian tribe. The Jivaro Indians use the pincers of living ants for the purpose of suturing wounds -- a most extraordinary procedure that has been observed in other parts of the world also. ⁴⁷ The skin is drawn together, the small ant so applied that it seizes the suture and holds it tightly closed in its strong mandibles, and then the animal's body is quickly snipped off! So the series of fine pincers along the wound hold the skin lesions together till healing takes place. Erwin Ackernecht in writing of this interesting technique, concludes that it is a witness to "the great inventive power that the 'savage' develops in all those fields that he deems worthy of interest."⁴⁸

Ingenuity: its diversity

We have mentioned rubber enemas. According to Nordenskiöld, there appears to have been a secondary development arising out of it: the making of hollow rubber balls for games. ⁴⁹ Such balls were made by forming a core of clay or some such material and then dipping this repeatedly in a solution of latex allowing each coating to dry before applying the next one. When the skin was thick enough, a small round hole was cut through the rubber to the clay core and the latter was removed through the hole, a small amount at a time. The hole was then plugged with another wad of latex, in a semi-hard condition, and the whole redipped once more in latex thus sealing the air inside the ball. Solid balls were also made, which weighed as much as 25 pounds. These were used in the well known games played

by the Maya in such open courts as have been found at Chichen Itza, Mexico, and elsewhere.

46. Nordenskiöld, Erik, "The American Indian as an Inventor", *Journal of the Royal Anthropological Institute*, vol.59, 1929, p.273ff.

47. Ants used for suturing: see E. A. Underwood, reviewing Lewis Cotlow, *Amazon Head Hunters* (London,, Robert Gale, 1954) in *Nature*, vol.175, Feb., 19, 1955, p.318.

48. Ackernecht, Erwin, in *Ciba Symposia*, vol.10, July-August, 1948, p.924, in a note under the title "An Ingenious Device for Stitching Wounds." The same author has a paper entitled "Primitive Surgery," (*American Anthropologist*, New Series vol.49, January-March, 1947), in which he gives a bibliography on the subject of 204 references.

49. Rubber balls: this is the opinion of E. Nordenskiöld, "The American Indian as an Inventor", *Journal of the Royal Anthropological Institute*, vol.59, 1929, p.298.

An article in a rubber journal recently pointed out that these balls are only one example of the use made by the American Indian of this plastic material ⁵⁰. He also made watertight shoes, flasks, ponchos, and dolls. The same article states that:⁵⁰

The development and use of natural rubber by the American Indian is impressive, for in 300 years his "civilized" conquerors made little improvement in the ancient method of rubber manufacture.

The natives used a certain sap of a vine (*Iponoea bona-nox*) or from a liana (*Catonyction speciosum*) to coagulate the latex. Certain trees have the latex in a form which is rubber in suspension in water. The water can be evaporated and the rubber remains, without any need for a catalyst.

The story of Charles Goodyear's efforts to take over the development of rubber from the natives of Brazil and exploit it in America and elsewhere, is well known. The problem was to treat it so that it would retain its structure even in hot weather. Their own rubber served the Indians well enough, especially since they had the secret of curing it by using local products as catalysts. Goodyear, again and again, brought himself, his family, and his backers to the point of ruin and bankruptcy because he could not cure the stuff out of which he was trying to make raincoats, mail bags, and overshoes. As soon as warm weather came, his products turned into a sticky useless mess! Of course he finally discovered how to cure by vulcanizing, using sulfur as a catalyst. ⁵¹ But it seems probable that many of his heartbreaks never would have occurred if he had gone back to the originators of rubber articles and asked them to teach him what they knew first.

Moreover, it is very doubtful if Goodyear or anyone else of his cultural background would have seen, in the Brazilian forest, what the natives had seen, i.e., a natural product requiring only to be treated with another natural product to supply a remarkably versatile and useful material.

In the matter of Textiles, we have been borrowers in almost every detail. It is considered by G. P. Murdock that the Central American Indian excelled here also:

⁵²

In skill and technique in the textile arts the ancient Peruvians have had no equal in human history. They wove plain webs, double faced cloths, gauze and voile, knitted and crocheted fabrics, feather work, tapestries, fine cloths interwoven

50. Anonymous article in *Rubber Age*, November, 1956, p.365.

51. Charles Goodyear: see on this, H. Stafford Hatfield, *The Inventor and His World*, Harmondsworth, UK, Penguin Books, 1948, p.41-44.

52. Murdock, G. P., *Our Primitive Contemporaries*, New York, Macmillan, 1934, p. 428, 429

with gold and silver threads -- employing in short, every technique save twilling known to the Old World, in addition to some peculiar to themselves. . . . They employed methods identical with those used in the famous Gobelin and Beauvais tapestries; they nevertheless in harmony of colours, fastness of dyes, and perfection of technique, far surpassed the finest products of Europe.

C. Langdon White says that the best of their fabrics were from the wool of the vicuna, softest of all animal fibres, with 270 threads to the inch as compared with 140 threads otherwise considered to be outstanding.⁵³

MD.C. Crawford writing in 1948 before certain very recent developments underscores this achievement of the Indian. He made a particular study of this aspect of their art and skill, and concludes: ⁵⁴

As a matter of fact, Europe has never produced a single original natural textile fibre or any dye except perhaps wool. She has not contributed a single fundamental or original idea to the basic mechanics of textiles, nor a single original and fundamental process of finishing, dyeing, or printing. . . .

In the broader world history of textiles and cloth, the ingenious English inventions of the 18th century (led by Kay's fly-shuttle) are but incidental mechanical modifications and developments of older ideas which grew out of the social conditions in England, and were directly due to the importation of cotton and silk fabrics from the Far East during the 16th and 17th centuries. No new basic principles either in spinning, weaving, or fabric construction, nor new methods of decoration, dyes, colours, or designs, are involved in the English machines. The ancient principles of twisting and elongating masses of fibre into yarn, the principle of interlacing one set of filaments held in place between parallel bars of a second set of filaments, remains undisturbed. No new raw materials are involved: flax, hemp, wool, cotton, and silk, remain the principle fibres. And for colour the dyes of antiquity were still employed. As a matter of fact, all the dye raw materials of antiquity, both from Asia and America, were still mentioned In English dyer's manuals in the late part of the 19th century, and years after Perkins' experiments with coal tar derivatives in 1856.

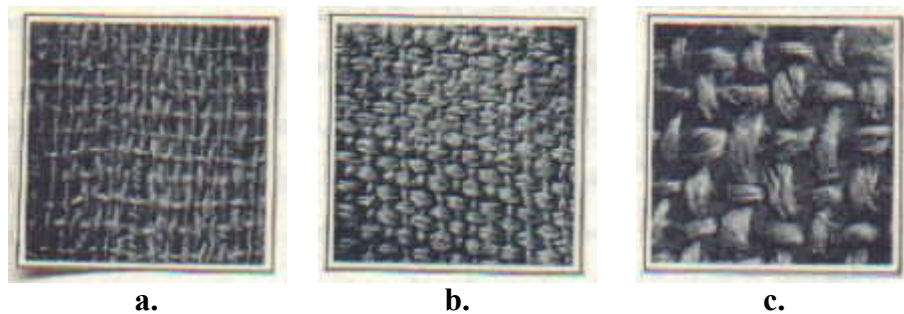
Silk of course came to us from China, felt from Mongolia, ⁵⁵ materials made from pulps were developed in Polynesia (tapa cloth, etc.). These last are coming into their own in our day, the capacity for greater production being about our only claim for credit. And even here, the claim may be somewhat premature, because considerable difficulty has been experienced thus far in the manufacture of such materials on a large scale. The native products are hand made of course. Moreover their methods of decoration, by tie-dyeing, batique, and silk-screen, are simply not applicable to mass production methods at present. We do not have time for tie-dyeing.

53. White, C. Langdon, 'Storm Clouds over the Andes,' *Scientific Monthly*, May, 1950, p.308.

54. Crawford, M.D.C., *The Conquest of Culture*, Fairchild, New York, 1948, p.184, 185.

Moreover, as we shall see when we come to consider the textile 'industries' of ancient Sumeria, virtually the whole concept of mechanization, of large mills and hundreds of specialized workers each doing a single kind of operation, was well developed at least five thousand years ago in the Middle East.

Meanwhile the Egyptians succeeded in weaving such fine fabrics that they are still equal to our own best products woven by the very latest mechanical means. Some of the garments associated with King Tutankhamen's tomb have 220 threads to the inch as shown in Fig. 7. Common handkerchiefs today, of linen, show only about 60 to 70 threads per inch and good linen cloth for such purposes seldom has more than 100 threads per inch, or less than the Egyptian prototype.



a. b. c.

These samples of fabric were taken from Tutankhamen's tomb. They are three different pieces of material, (a) being a dark cream color with a light filmy texture, (b) a dark brown, almost black, with two threads one way, and one the other way, and (c) is a dark brown of a coarser weave.

These photographs were taken with a microscope, thus emphasizing the size of thread and concealing the fine texture of the cloth. Magnification was 15 x. Sample (a) reveals about 220 threads to the inch.

Figure 7.

Their pottery has always been a source of amazement, whether in the New World or the Old. Chinese pottery has long been prized for its beauty in form, colour and texture. Central American pottery is remarkable for its complete freedom of form, and for its ingenuity also. In an environment where evaporation rates are high, it is desirable to cut down the size of the opening at the top. But this makes pouring more difficult. The air rushing in suddenly causes the water to flow out unevenly, and to spill easily. But in many places water is too precious to be wasted in this way. The Peruvians and the Maya overcame this by putting two spouts on the pot so that one became both a handle and a separate air inlet. The

variations of this theme were both ingenious and aesthetically pleasing. Not content with this, they even went further and so designed the passages that when water was poured out, the air rushing in caused a whistle to blow. In some cases it is difficult to see why this was done, unless it was to warn the adults when the children were robbing them of a rather precious commodity! Other types seem clearly to have been whistling 'kettles' -- a further effort to conserve waste by warning the lady of the house that the water was boiling away. ⁵⁶

Many of their vessels are shaped as heads, faces, animals, and even whole people. And these reproductions were not approximations. They were so lifelike in many cases that they must surely have been actual portraits. Their artistry and skill seem to have known no limits.

The same is true of Middle East pottery. In Minoan Crete the wares are of such delicacy that it seems they must be copies of originals made in hammered metal. Even the 'rivets' are indicated sometimes. They also reveal that the metal prototypes were sometimes formed by a process akin to deep drawing as we technically understand it now. Some of the pottery from the earliest levels at Tell Halaf and Susa is astonishing in its complete freedom of form and unbelievable delicacy. We shall refer to this subsequently.

56. Whistling kettles: on this see, T. Athol Joyce, "Marvels of the Potter's Art: In South America" in *The Wonders of the Past*, edited by Sir John Hammerton, London, Putnam's, 1924, vol. 2, p.464, 465.

Ingenuity of the Incas and Mayans

The fame of the Central American Indians in the matter of road building has been well reported. Cement pavements and other types of surfaced roads; suspension bridges spanning up to 450 feet, anchored at each end by massive stone pillars and capable of carrying cattle and pack animals, were built in some of the most rugged country in the world. These bridges were often 6 to 8 feet wide. The ropes by which they supported these slender structures are known to have been up to 12 inches in diameter. ⁵⁷ One of the most famous builders was the Inca, Mayta Capac, who is generally dated from 1195 to 1230 A.D.

Although they used wheels on toys, for some reason they did not employ wheeled vehicles. At least there are no remains of them, nor pictures, nor references in their traditions or literature. Yet they did use road-rollers weighing up to 5 tons! ⁵⁸ One of these is illustrated in Fig. 8 In Fig. 9 is shown a reconstruction of a suspension bridge. Moreover they had extensive postal systems along these highways, and an excellent quality of paper for writing letters and keeping records.

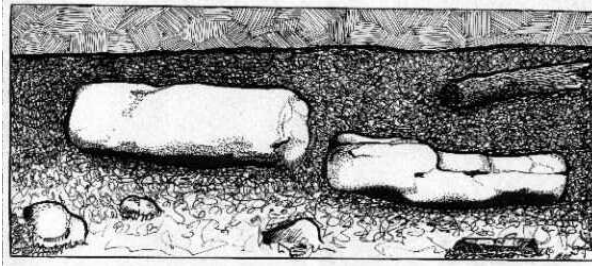


Figure 8.

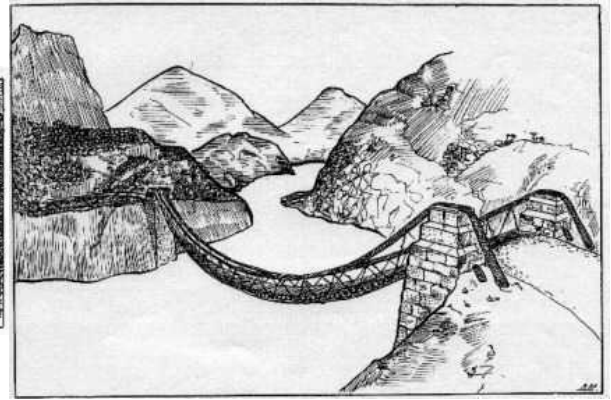


Figure 9.

Archaeologists have discovered that the Maya were making true paper approximately 3000 years ago.⁵⁹ Before these artisans disappeared, the Aztecs had learned the secret. This same process was handed down from generation to generation and today is used by the Otomi Indians in Mexico. The inner bark of the fig tree is soaked in running water until the sap jells and can be scraped off. The fibrous residue is then boiled in lime, washed once more, and laid on a flat wooden surface like a bread board, where it is pounded to a pulp. The pulp is left on the board and sun dried. The ancient Aztecs went one step beyond the 20th century Otomis. Their process was identical up to this point, but after the paper was dry they sized it, then calendered it with hot stones to produce surfaces readily adaptable for printing. They then printed on it with a crude kind of moveable type!

Although many of these original developments have long since been lost sight of, there still remains sufficient on record to suggest that in Central America a stage of technical excellence had been achieved and natural resources exploited, mathematics developed (including the use of zero and a place system for numbers) the development of a literature (among the Maya at least), and a leisure class, that the advance into Science should

57. Ropes: see Alexander Goldenweiser, *Anthropology*, New York, Crofts, 1937, p.402, and Victor W. von Hagen, *Realm of the Incas*, New York, New American Library, 1957, p.186, 187 for illustrations.

58. Road rollers: see Marshall H. Saville, "The Ancient Maya Causeways of Yucatan," *Antiquity*, vol.9, March, 1935, p.73.

59. Paper in South America: see Victor W. von Hagen, "The First American Papermakers," *The Paper Industry & Paper World*, December 1944, p.1133.

have been made. Gilbert Lewis says: ⁶⁰

Probably the most remarkable achievements of the American Indians, were in the fields of arithmetic, astronomy, and the Calendar. Two of the greatest inventions of arithmetic, the zero and the sign of numerical position, were regularly employed in America long before they are known to have occurred elsewhere. . . .

It may be noted that few apparently unrelated items which I have discovered in the literature may, when put together, suggest the possible use of astronomical instruments in early America. Both in Mexico and in Peru concave mirrors were found, articles that had not been seen in Europe at the time of the Conquest. In

Peru, these concave mirrors were employed in a solar rite. Periodically all old fire was extinguished and a new fire was started by the priests who, with these mirrors focused the rays of the setting sun on a wisp of cotton. Among the Aztecs new fire was produced at night by the fire drill. However, that they had recollections of a practice akin to the Peruvian is suggested by the name of one of their chief gods "Smoking Mirror."

Speaking of Peruvian surgery, J. Alden Mason, quoting the well known paleopathologist R. L. Moodie, says: ⁶¹

I believe it to be correct to state that no primitive or ancient race of people anywhere in the world had developed such a field of surgical knowledge as had the pre-Columbian Peruvians. Their surgical attempts are truly amazing and include amputations, excisions, trephining, bandaging, bone transplants (?), cauterizations and other less evident procedures.

He then speaks of the use of anaesthetics and possibly hypnosis. He remarks that some skulls show the result of operations on the frontal sinus. Their 'operating rooms' were first cleared and purified by the sprinkling and burning of maize corn-flour, first black and finally white.

Mason considers that it is literally impossible to exaggerate the technical achievements of these Peruvian highlanders in the field of textiles. He holds that it is not the view merely of enthusiastic archaeologists, but of textile manufacturers themselves. Their skill he terms 'incredible.' They even had invisible mending in place of patching. The Aymara still do! In metallurgy they were not far behind.

Among their textiles, according to Mason, have been found "twining, plain cloth, repp, twill, gingham, warp-faced and weft-faced or bobbin pattern weave, brocade, tapestry, embroidery, tubular weave, pile knot, double cloth, gauze, lace, needle-knitting, painted and resist-dye decoration and several other special processes peculiar to

60. Lewis, Gilbert, "The Beginnings of Civilization in America," *American Anthropologist*, New Series, vol.49, January-March, 1947, p.8 and footnote.

61. Mason, J. Alden, *The Ancient Civilizations of Peru*, Harmondsworth, Penguin, 1957, p.222.

Peru and probably impossible to produce by mechanical means." It is even possible that they may have watered some crops with coloured liquids to produce naturally dyed fabrics that were indeed sun-worthy!

Nor is this inventiveness limited to Central America, although for climatic reasons this may have been the best environment to encourage high civilizations. The Iroquois had invented 'rifled' arrowheads long before they found themselves face to face with or in possession of rifled fire arms. ⁶² It does not seem likely that the spiralling is sufficient to rotate the arrow rapidly enough that the need for feathers is eliminated. This at least has not proved to be the case with my own sample. Evidently such was not the objective. What is clearly achieved is a far more serious wound. Like the outlawed dum-dum bullets of World War I, the form of the head is such that the arrow does not pass right through (where it could easily

be withdrawn) but buries itself in the flesh and stops there. The energy of the arrow is absorbed as the head 'orkscrews' into the body.

The Aymara of Peru build sailing boats and use them on lakes two and a half miles above sea level -- yet there is scarcely a tree to be found at this elevation. These vessels are made entirely of local bulrushes, and even the sails are mats woven from the same materials. The masts are built up of small pieces of wood spliced together. Provided these vessels are permitted to dry out every little while, they will carry a considerable load. ⁶³

The pre-Inca Indians were master architects, building great monuments and immense fortifications of stones set in to each other by being laid and lapped together right on the spot. How they were erected is still a mystery, for many of the stones are huge. But this certainly is the only genuinely earthquake-proof architecture in Middle America! For an illustration of one of the most famous such fortifications (?) see Fig. 10.

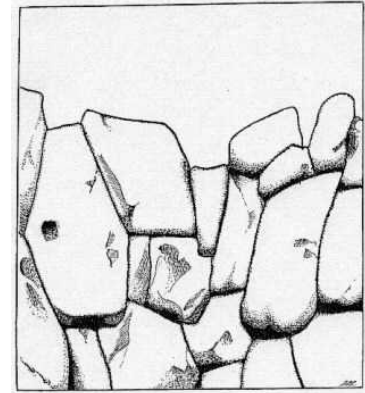


Figure 10.

One of the most surprising things about the great Ball Court of Chichen Itza is its acoustical properties. Recently the Editor of an American magazine visited this court and reported on this unexpected feature. He wrote: ⁶⁴

We climbed to the vantage point of one of the stands for the thrones of the priests at the southern end, while our guide went to the other. We were five hundred feet apart. We talked in low tones no louder than a couple would use sitting in the living room of an average home. We could hear each other perfectly. We reduced our voices to a mere murmur: we could still hear each other perfectly. . . .

62. Rifled arrowheads: I have one of these in my possession. There are several references to them in the literature and some examples in Museums in Canada and the United States. There may have been a family, a kind of Iroquois Krupps, which supplied friend and foe alike -- at a price! Edward B. Tylor refers to them (*Anthropology*, New York, Hill, 1904, p.155), and even earlier, Sir William Dawson, (*Fossil Men and Their Modern Representatives*, London, Hodder & Stoughton, 1883, p.124). There seems to be no doubt about their intentional design.

63. Aymara boats: see Stewart E. McMillin, "The Heart of Aymara Land," *National Geographic Magazine*, February, 1927, p.213-256.

64. Barnhouse, Donald G., "The Editor Visits Mexico's Mayan Ruins," *Eternity Magazine*, May, 1956, p.35.

The General Electric Company, we were told, brought a large group of engineers to Chichen Itza to carry on acoustical experiments in the big ball court.

They attempted to duplicate the court elsewhere but did not get the same acoustical effect because they had not built with limestone.

The tools of the pre-Columbian builders were no less remarkable than their buildings. It is believed now that they may have used glass cutting edges for saws, etc., in place of steel -- the glass being a natural volcanic residue. Recent experiments demonstrate that such tools can be most effective. The idea is suggested by the form of certain fighting weapons. ⁶⁵

They had even developed a specialized form of dental repair, using a kind of Portland Cement filling which has remained firm and intact in tooth cavities for 1500 years! Of this discovery Sigvad Linne remarks, ⁶⁶

The findings (of archaeologists) have revealed to us some of the inventiveness and technical skill possessed by the Indians. The practical aids of these unknown technicians may have been primitive yet it could scarcely have been "primitive peoples of nature" that with such simple means achieved results before which their later born Swedish colleagues sometimes stand in dumb amazement.

This is a digression, but one might mention that a recent report from Washington states that there is now evidence of the habitual use of some kind of cleaning agents on the teeth of prehistoric skulls. ⁶⁷ Since the Chinese had by at least 1500 A.D. developed a tooth brush that looks remarkably like its modern counterpart, there is surely nothing new under the sun! ⁶⁸ For a picture of this toothbrush, see Fig. 11.



Figure 11.

65. Glass saws: as reported in *Science News Letter*, July 13, 1957, under the title "Glass-toothed Saw Cuts Wood: An Ingenious Hand-made Tool May Provide a Solution for an Ancient Scientific Puzzle." (Anonymous).

66. Tooth filling: see Sigvad Linne, "Technical Secrets of American Indians," *Journal of the Royal Anthropological Institute*, vol.87, Part II, July-December, 1957, pp.152, 153, 163.

67. Toothpaste: *Science News Letter*, Dec.23, 1956, p.390, in a series of brief notes written anonymously under the heading "Anthropology -Archaeology."

68. Toothbrush: see Curt Proskauer, "Oral Hygiene in the Medieval Occident," *Ciba Symposia*, vol.8, Nov., 1946, p.468. The illustration is from a woodcut in the *Lei Shu Ts'ai Hiu*, a Chinese Encyclopedia.

Nordenskiold adds to the credit of the America Indians the invention of the hammock (New Guinea) ⁶⁹, children's go-carts (North-western Brazil), ⁷⁰ cigar holders, ⁷¹ the chain ⁷² and an ingenious self-acting water-pump (Columbia) which the Spaniards adopted and converted into a bilge pump. ⁷³

It could become just an endless catalogue if we were to go on listing isolated instances of native ingenuity such as the use of the skin of the ray-fish by the Polynesians as a 'sand paper'; ⁷⁴ the use of giant fireflies called *Cucuyo* and tied to the feet by the natives in the West Indies to light their way along jungle paths at night,⁷⁵ and so forth.

Conclusion

So much importance is attached to inventors and their inventions, that they were held in great veneration and quite often were ultimately deified. The only encyclopaedias the Chinese had, originally, dealt with the heroic figures who were famous because they had invented something. ⁷⁶ Indeed in some cultures, this kind of talent is so generally expected of the males that the would-be son-in-law must win his bride by performing some almost impossible task set by the family, which calls forth nothing short of inventive genius! ⁷⁷ Perhaps this is not such a remarkable circumstance in a way, since we are tending to move in the same direction and devote more and more space in encyclopaedias to inventions. Yet scholars and generals, poets and artists, politicians and sportsmen, still share the pages of our history books with equal recognition.

69. Hammocks: Nordenskiold, Erik, "The American Indian as an Inventor", *Journal of the Royal Anthropological Institute*, vol.59, 1959, p.281.

70. Go-carts: Nordenskiold, E., *ibid.*, from North Western Brazil.

71. Cigar holders: Nordenskiold, B., *ibid.*, p.302.

72. Chain: Nordenskiold, E., *ibid.*, p.302, used by a small tribe, the Hurari. in Matto Grasso, and found nowhere else in South America.

73. Bilge pump: Nordenskiold, E., *ibid.*, p. 300.

74. Sandpaper: see Leonard Adam, *Primitive Art*, Harmondsworth, UK, Penguin, 1949, p.162.

75. Fireflies: see Donald C. Peattie, "The Miracle of the Firefly," *The Reader's Digest*, October, 1949, p.102.

76. Needham, Joseph, *Science and Civilization in China*, Cambridge, UK., Cambridge University Press, 1954, vol.1, p.54.

77. Professor T. F. McIlwraith, Head of the Department of Anthropology in the University of Toronto, gave a lecture on the various means adopted by different people to test aspiring husbands. The Arawak of Central Africa adopt this method, as do other widely scattered tribes. An early chapter of Genesis (4:17-21) gives prominence to the first city-builder, the first agriculturalist, the first tent-dweller, the first musician, and the first metal worker. The latter is referred to as Tubal-Cain, which some authorities feel may be the original form of the word *Vulcan*, who was (like many Chinese inventors) subsequently deified.

At any rate, we can see that such an aptitude for invention, and the ability to exploit the natural resources of the environment, was encouraged only so far as the overall economy allowed. There was no leisure, often little security, not much accumulation of wealth, and frequently insufficient 'sophistication' to suggest to such people that they might go further. To a man who can hardly keep food in the larder for his family, idle curiosity is not likely to find much encouragement. These people searched, and found the immediate solution: but they did not have the energy, the need, the time, or the will to re-search and extend the answers they had found once they proved effective enough. They have searched. We *re*-search.

But surely this was not true in China, or Sumeria, or Egypt or Crete, or the Indus Valley, or in Anatolia? Why did not these much more advanced and highly organized Cultures progress further? Why did they not explore their own well-developed technology and proceed to a Scientific Age? The climate was suitable, records were extensive, and natural resources were abundant enough in many cases.

Let us examine their achievements and (since we have the means to do so)

explore their underlying philosophy as revealed in their literature; for, unlike cultures so far considered, they all developed writing very early in their history, and their educated sons left many records of their thoughts, as well as their business documents, and their royal chronicles of inventions and of conquests.

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