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ARROW POISONS: THEIR HISTORY, SOURCES, AND CONSTITUENTS.*

BY

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AT the present time, except in the darkest places of the earth, the gun has completely ousted the bow as an instrument of warfare and of the chase. Even into those places which, by comparison with the darkest, we may call dark and darker, the enterprise of traders has introduced guns and gunpowder, and as soon as this happens it becomes the ambition of every savage to be the proud possessor of a weapon which at once gives him a superiority over his neighbour as a fighter and hunter. As with ourselves, superiority, or at least equality, of armament is a necessity for self-preservation and national existence, a state of matters which the savage is as quick to appreciate as his most civilised brother can possibly be. As a result, we are within measurable distance of a time when the bow and arrow will have disappeared as a serious weapon of offence and defence except in the most inaccessible parts of the world. This has already happened in many countries, in some parts of Africa within living memory, while in others we can observe the process going on. Already in certain nations and tribes skill with the bow is a thing of the past, the making of bows and arrows is a neglected art, the preparation of poisons to render them more deadly is no longer practised, and in many cases will have been forgotten before we have become accurately acquainted with their ingredi-

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ents. Nevertheless, the bow and arrow have had a long and fateful career, and their history is intimately bound up with the fortunes of great nations.

The battles of Hastings, Cressy and Poictiers, not to mention others nearer home, were decided by superior archery, while English and Scottish kings and parliaments have in the past frequently taken measures, and enacted stringent laws with the view of developing and improving the national skill, and of ensuring throughout their realms a sufficient supply of well-made bows and arrows.

The arrow is a weapon of the greatest antiquity, as cave remains, the oldest sculptures, and its use at the present day by the most primitive tribes all go to show. Nor was it a weapon to be despised. The range of the English archer was from 120 to 360 yards, his accuracy was deadly, and the force such that the arrow easily penetrated an inch thick plank. Stanley, after an encounter with the Avisibbas, in which he lost several men, found that with one of their bows he could easily drive an arrow through both sides of a large biscuit box, and that he was able to shoot another over a high tree 200 yards distant. He adds that at short range such an arrow will go completely through a man, and it is said that in his palmy days the North American Indian occasionally drove one through a buffalo. Few of the tribes with which we are acquainted are capable of using them with deadly effect at longer ranges than from 50 to 100 yards, but their penetrating power is very great, especially if they have a heavy shaft, and they make a dangerous punctured and incised wound. The English archer drew the shaft to his ear and took deliberate aim, but savages, especially in the excitement of battle, hold both arms more or less extended and only draw the bow-string a certain distance towards the body. A number of arrows are held in the bow hand with a reserve in the quiver, and under these conditions they are able to fire off about six per minute with good aim. If the archers are numerous, therefore, a shower of arrows is not an exaggerated metaphor.

The typical arrow consists of three parts, the head made of iron, bone, flint or other stones, the shaft, in the fashioning of which great skill is necessary to have it straight and true, and some sort of clamp or cord to unite these. Many, however, consist of a simple wooden shaft sharpened at one end and hardened by fire,

and the small darts used for killing birds and lesser game are always of this description. The head itself is often barbed, or barbs are placed behind it or are cut in the wood to prevent extraction, and some of these look truly murderous weapons. As nowadays with gunshot wounds, so to the ancient surgeons arrow wounds were of supreme interest, and such authors as Hippocrates, Celsus, and even Ambroise Paré devoted a large space to the consideration of their effects and proper treatment.

The practice of smearing arrow-heads with poison to enhance their deadly effects must be very ancient, although until quite recent times the accounts given of it have been very vague and meagre. Lagneau states that in cave remains of the palæolithic period in France, arrow and spear heads have been found made of bone and marked with depressions for containing poison. These, he thinks, were certainly used to destroy such large animals as the bison and reindeer, and were probably also employed in warfare. To the Greeks arrow poisons were well known. Their word "toxicon"—whence we derive "toxicology"—was a poisonous substance into which the arrow—"toxon"—was dipped. Hercules is fabled to have used poisoned arrows, Homer mentions them in the 'Odyssey,' and Alexander the Great, in his conquest of Asia, met with peoples who employed such missiles against his troops.

Ovid, who lived on the shores of the Black Sea during his banishment from Rome, speaks of the bile and blood of vipers as being used to poison weapons, while Horace, in his ode to Aristius Fuscus, enumerates poisoned arrows among the evils which the man of upright life and free from crime need not fear. The widespread nature of the idea, however, may be better grasped from the prevalent belief that pestilence was due to arrows shot by one or other of the offended gods, while even such an impalpable thing as love was conveyed into the heart by means of Cupid's darts. The Scythians were well known to use arrow poisons, and they and the tribes of the Caucasus were commonly supposed to employ viper poison mixed with putrefied human blood serum.

As regards the use of poisoned arrows and other weapons in Europe, Aristotle and Strabo mention the practice as common among the Celts. In hunting, the Gauls are stated (Pliny) to have employed arrows dipped in hellebore juice, and before eating the animal to have cut out the part around the wound, a practice

similar to that of African and Asiatic peoples at the present day. Celsus states that the poison used by the Gauls was not deadly if swallowed, and remarks that in this respect it resembles the venom of serpents. If this be correct, it points to the use of snake poison rather than of hellebore, but both may have been employed. In ancient Germany similar customs seem to have been in vogue, for Quintilian (A.D. 388), having crossed the Rhine with his troops, was met in battle by the natives with arrows which caused mortal wounds, no matter which part of the body they struck.

Public opinion, however, in Europe early turned against the use of poisoned weapons, for in the fifth century we find the Salian Franks making it a crime to use such arrows, and in the seventh century the Bavarians passed a similar law. Up to the seventh century poisoned arrows were common among the Dacians and Dalmatians and along the shores of the Danube. As late as the thirteenth century, at least, poisoned daggers and swords were used in Europe for assassination purposes, and very much later, even to the sixteenth century, poisoned arrows and other weapons were well known in Spain. These, however, were probably prepared by experts in poisons, and their use was not common among the people.

There is also contemporary evidence that during the later middle ages poisoned arrows were occasionally employed for killing large wild animals in the remoter districts of France and in Switzerland.

It is very difficult at the present time to determine exactly what poisons were employed in Europe, as the meaning of many of the names has become totally lost. The different species of poisonous hellebore—*H. niger*, *Veratrum album*, *V. viride*—were certainly used, as was also aconite, and probably belladonna, besides the venom of the viper and other snakes. But none of the other plants named by different authors can be identified, the descriptions being for the most part rather vague, and probably derived from hearsay evidence only.

In the sixteenth and seventeenth centuries it became widely known in Europe that the aborigines of South America and Western Africa were in the habit of employing poisoned arrows in warfare and in hunting, and now for a long time past these poisons have been objects of great interest to explorers and pharmacologists. A very large number of the different poisons used by tribes all over the world have now been more or less care-

fully examined physiologically, the botanical sources of many of them have been accurately determined, and the plants have even in some cases been grown in Europe, while we have also, as regards a few of them, detailed accounts by Europeans of the exact methods of preparation in use among the savages. Such information has proved very difficult to obtain, as the secret is always most jealously guarded, and in some tribes is only known to certain families or chiefs, who pass it on to their successors. Some of the poisons are still quite unknown to us and others very imperfectly so, but in their mode of preparation and in the kind of ingredients commonly used there is a certain family resemblance all over the world. Thus we find that snake poison, poisonous insects, poisonous fish, and other animals are commonly employed, while plant juices or watery decoctions, inspissated to the consistence of thick tar by heat, form the basis or the sole ingredient of the majority. Many of them are mixtures of different poisonous vegetable products, some again are mixtures of animal and vegetable poisons, and this complexity of composition often makes it most difficult to determine the real nature of the poison. When freshly made they have generally the consistence of thick tar, and are carefully put up in neatly constructed receptacles made usually of vegetable fibre, or in small calabashes, such as I now show you. In some cases the poison is smeared over the arrow-head, in others it is laid on thickly just behind the head for a distance of two or three inches. Among all savage tribes the head is very loosely attached to the shaft, so that the poisoned portion cannot be drawn or knocked out, but remains firmly fixed in the tissues, no matter what happens to the rest of the arrow. In the case of wooden arrows the shaft is sometimes partially cut through near the poisoned end, so that attempts at extraction by man, or violent contact with bushes in the case of an animal which has been hit, snap it off short, and leave the poisoned part in the wound. I also show you some darts from Borneo, made of wood and poisoned at the point, these being shot through a blow tube. It is very noticeable that the quivers both for arrows and for darts are most carefully made with a cover for the poisoned heads, so as to avoid any accidental wounding of the owner or his friends. When carried in an open quiver they are either put head downwards or each head is wrapped in a separate leaf.

The poisons used by different tribes differ much in deadliness,

and even the same poison is not always equally effective. The active principle may tend to decompose, and thus the virulence is lessened; if the poison be fresh and moist it is rapidly absorbed from the wound and is speedily fatal, but if old and dried it dissolves much more slowly in the body fluids. Its action is thereby more slowly developed, and if it can be removed in time the wounded man may recover. Some of them must retain their virulence unimpared for a very long time, as Lewin found a Bushman arrow-poison still active which had lain for ninety years in the Museum for Anthropology at Berlin.

After this slight introductory sketch we may now glance at some of the more interesting or better-known poisons which are at present in use in different parts of the globe, and I shall first consider two of animal origin as being distinctive in their character and of great interest in their action. One of these is the arrow poison of the Kalahari Bushmen (S.W. Africa). The Bushmen live in scattered tribes over the whole of S. Africa from the Cape to the Zambesi, and as they use local poisons for their arrows, these differ a good deal in different districts. In the Kalahari district Livingstone states that the natives were seen applying to their arrows the entrails of a small caterpillar, which they termed 'Nga. When the caterpillar is drawn over a small sore it causes the most excruciating agony, and men wounded with the arrows die slowly in violent delirium. Baines gives a more detailed description. There was brought to him a small bagful of the cocoons of an insect, brown in colour, oval, and about half an inch long. On breaking the cocoon a small cream-coloured grub was found coiled up inside. The Bushmen squeeze the grub gradually between the forefinger and thumb, when a colourless fluid exudes, which is smeared over the arrow-head. It is then almost imperceptible and no mixture is used. The insect is a small beetle, the *Diamphidia locusta*, which deposits its eggs on the leaves of a large tree on which the caterpillars feed, and then in due time they drop on to the earth and form their cocoons. Boehm has recently investigated the chemistry and action of the poison. He found that it is an albuminous substance very soluble in water, the solutions becoming rapidly decomposed under the action of putrefactive organisms and losing their poisonous properties. By precipitating the toxic albumin with alcohol or ammonium sulphate and drying the precipitate, he obtained it as an amorphous

greyish powder, which retained its poisonous properties for an indefinite time. His pupil, Starcke, made experiments with it on animals, and found that its action had a generic resemblance to some of the snake poisons. Like them, it is not poisonous when given by the mouth, but injected under the skin it causes great local irritation sometimes ending in ulceration or abscess, nervous depression, and bloody urine. Death was slow, occurring from some hours to several days after administration. It somewhat resembles, therefore, abrin, snake poison, and other toxic albumoses which have been more minutely studied than it has.

Although its action is sure, it is not very rapid, and Baines states that animals after being wounded sometimes require to be followed up for a whole day. As regards an antidote, he says, the natives use a root which is chewed, and then rubbed on the wound and fat applied, but Livingstone makes a much more interesting statement, namely, that the grub taken by the mouth is considered the best cure. This bears out what we already know accurately about the immunity obtainable from the effects of abrin, ricin, and snake poison.

According to Steedman and Burchell, who both give very detailed accounts, other Bushman tribes use vegetable poisons from the *Amaryllis disticha*, various species of *Euphorbium*, and *Acokanthera*, alone or mixed with snake, spider, and beetle poisons. Burchell says there is no chance of surviving after a wound if the poison be fresh and well-made, but that quite superficial wounds may be scraped and scarified with a successful result. A Hottentot also told him that habitual eaters of snake poison do not die from the wounds of the poisoned arrows, and no doubt this would prove a protection against the animal venoms, but scarcely against the vegetable ones.

The Choco Indians, in Columbia, South America, also use a peculiar poison, derived from a tree-frog, the *Phyllobates chocoensis*, which they hold on a stick near a fire, when the heat causes the glands of the skin to secrete the poisonous fluid. Our common frog secretes an irritating fluid from its cutaneous glands ; so does the toad, the active principle of the latter having been named phrynin, and being known to act as a heart poison. The Choco Indian poison is innocuous when given by the mouth ; a few experiments have heen made with it in France, but its exact action remains rather doubtful. It is capable of killing large carnivora.

Of the vegetable substances used for poisoning arrows those which paralyse the heart after the manner of large doses of digitalis occupy a foremost place as regards deadliness and widespread use. As you are doubtless aware, digitalis and bodies of the same pharmacological group, of which there are many, paralyse the heart muscle, at first causing irregular and feeble action followed by complete stoppage and death. The final effect is preceded by great muscular feebleness and breathlessness. The physiological action of all these substances has been carefully and successfully studied, but no antidote has yet been found, and so if one absorb a sufficient amount of the poison death is certain to occur within a short time.

The most deadly are the arrow-poisons derived from the root wood of different species of *Acokanthera*, trees about 15 feet high —*A. Schimperi*, *A. Deflersii*, and *A. Ouabai*. From these is prepared the deadly arrow-poison of the Somalis, known now for a long time and very fully described by Burton ('First Footsteps in East Africa' 1856). The poison is known as Waba, Wabayo, or Ouabaio. It is a thick, tar-like, watery extract, the active constituent in which is a glucoside known as ouabain (Arnaud), and it is made by splitting up the root into small pieces, boiling these with water, inspissating the juice, and then adding usually snake-venom or other poisonous vegetable extracts. Burton says that cattle eat the leaves of the tree only if very hungry, and that the berries are edible.

Besides the Somalis, the Wa Nyika, Wakamba, the Massai, Wa Nyamwesi, and many tribes of Eastern and Central Equatorial Africa use practically this same poison, although there are many minor differences in its composition among these different peoples. Many of the prepared poisons contain very irritating substances, which are productive of severe local symptoms in the wounded. Boehm states that the poisonous dose for a dog per kilo. of its weight is about 1/140th gr. echujin, 1/260th gr. strophanthin, and 1/430th gr. ouabain, which gives some idea of their extreme toxicity. Fitzgerald ('Travels in British East Africa,' 1898) relates of the Waboni, that each arrow-head has its owner's special mark, and is so made that it cannot drop out, and this enables them to identify the killer of big game, as elephants often live for several days after they have been hit. In German South-West Africa, the Ovambas also use a heart poison derived from a species of *Adenium*, while the *Strophanthus* is

widely used on the Congo, on Lake Nyassa, the Zambesi, Gaboon, Guinea, Cameroons, and Senegambia. Various *Euphorbias* and other imperfectly known plants are also largely employed.

Mr. Crawford Angus gives a graphic account of the poisons used in Azimba and Chapitaland, in Central Africa. I am indebted for it and for the photograph of the arrows to Dr. R. W. Felkin. The natives use an arrow, the slightest scratch of which causes death, the poison being known only to certain chief men, who collect it and serve it out to the others. He saw a man very slightly wounded in the lip, and in fifteen minutes he fell down, twitching violently; in six hours the arms and neck began to swell, and he died in twelve hours in great agony. Large quantities of these arrows are kept in covered bins in the villages, which are opened on a war alarm and the arrows served out. The arrow-heads are made so brittle that if they miss their mark they shatter against the ground, and so cannot be picked up and used against their original owners.

Stanley describes some of the wounds received by members of his expedition as being "mere needle-point punctures," and yet proving fatal. Some of the wounded died at once, others more slowly, and a few of tetanus later on. Some of the cases recovered. Very careful cleansing of the wound and cauterising was the treatment adopted.

The arrow poison of the Pigmies is a mixture of a cardiac poison and strychnine poison, with some others. It is very deadly, and one arrow will kill an elephant, but Stuhlman states that in man, if the head be at once extracted and the wound scraped and washed, fatal consequences are frequently averted.

Another set of arrow poisons which have a similar action on the heart are those made from the juice of the famous upas tree, the *Upas Antiar*, growing in Borneo, Java, and adjacent parts. It is a very large forest tree, and the poisonous sap is obtained from incisions made into the bark. I show you some of it preserved with alcohol, and also the active principle—a crystalline glucoside called antiarin—which I isolated from this very specimen. It is extremely poisonous, and experiments which I made with it showed that 1/6400th gr. was sufficient to kill an ordinary sized frog in comparison with 1/4500th gr. strophanthin and 1/2600th gr. urechitin. The sap is known as Ipoh Kayu (tree poison) among the natives. It kills guinea-pigs and other small animals in a few minutes from stoppage of the heart, and has been used

in Cochin-China against the French soldiers, who died in from half-an-hour to several days after receiving their wounds. It is in use throughout the Eastern Archipelago by nearly all the native peoples, pure, or mixed with snake-poison, scorpions, centipedes, other plants and occasionally with arsenic. The different prepared poisons vary greatly in strength, and one old specimen which I examined was quite innocuous.

The most extraordinary stories have been circulated about the deadliness of the upas tree, and seem to have been believed widely, and even by such an authority as Erasmus Darwin (see the 'Botanic Garden'). These stories are traceable to an account of the tree written last century by a Dutch surgeon named Foerscher, in the service of the Dutch East India Company, whose account was copied as genuine into a number of the current periodicals of the time, and thus obtained a wide circulation. On reading it, however, one is forcibly reminded of the style of Swift, in describing the travels of Mr. Lemuel Gulliver to Laputa. As it is rather amusing I may perhaps be allowed to give some extracts from his account: "I shall now only relate simple unadorned facts, of which I have been an eye-witness. In the year 1774 I was stationed at Batavia, and during my residence there I received several different accounts of the Bohon upas, and the violent effects of its poison. They all seemed incredible to me, and I resolved to investigate this subject thoroughly, and to trust only to my own observation. . . . I had procured a recommendation from an old Malayan priest to another priest, who lives on the nearest habitable spot to the tree, which is about fifteen or sixteen miles distant. The letter proved of great service to me in my undertaking, as that priest is appointed by the Emperor to reside there, in order to prepare for eternity the souls of those who for different crimes are sentenced to approach the tree and to procure the poison. Malefactors who for their crimes are sentenced to die, are the only persons who fetch the poison. After sentence is pronounced on them by the judge, they are asked in court whether they will die by the hands of the executioner, or whether they will go to the upas tree for a box of poison. . . . They are afterwards sent to the house of the old priest and remain some days, during which time the ecclesiastic prepares them for their future fate by prayers and admonitions. When the hour of their departure arrives, the priest puts on them a long leather cap with two glasses before their eyes,

which comes down as far as their breast, and also provides them with a pair of leather gloves. The worthy old ecclesiastic has assured me that during his residence there for upwards of thirty years he had dismissed above seven hundred criminals in the manner which I have described ; and that scarcely two out of twenty have returned. He showed me a catalogue of all the unhappy sufferers, with the date of their departure from his house annexed, and a list of the offences for which they had been condemned. I was present at some of these melancholy ceremonies." He goes on with great detail in the same strain, and may be compared as a historian to a mixture of Defoe and Swift, but several people have been at the trouble to gravely refute his statements.

Aconite root (*A. ferox*), under the name of Bis, Bish, Bikh, and sometimes called tiger poison, is used as an arrow poison in Nepaul and along the eastern frontiers of our Indian Empire, and on the French and Chinese frontiers also most probably. It is very active, but the effects of aconite are so well known that I need not linger over them here.

We come lastly to the different species of *Strychnos*, which are so largely used in South America, in the East Indian Archipelago, and to a much more limited extent in Africa for preparing these poisons. The most famous of them is the *Curare*, first brought to Europe in 1595 by Sir Walter Raleigh. Under various names it is used over the immense tract of country comprised in the basins of the Amazon and Orinoco and their tributaries. A very minute and interesting account of its manufacture has been given by Humboldt, from which it appears that it is a concentrated extract made with cold water from the bark of several species of *Strychnos*, and that this is mixed with other poisonous and non-poisonous ingredients to increase its efficacy and consistence. It is not poisonous when swallowed owing, it is said, to the slow rate at which it is absorbed, and Humboldt says that the Indians lick it off their fingers and use it as a stomachic tonic. Its harmlessness when given by the mouth has been frequently confirmed by exact experiment. But when injected subcutaneously it proves rapidly fatal by paralysing the ends of the motor nerves in muscle, so that movement becomes impossible and death takes place from the respiratory muscles ceasing to act on the chest wall. A large dose kills in a few minutes, and there is no antidote known. Besides this action on the nerves, which is due to curarin, it has a

paralysing effect on the heart, due to a second active principle, discovered by Boehm and named by him curin.

In the Malayan Archipelago the *Strychnos* or *Upas Tieute* furnishes a sap largely used for poisoning arrows, and the active principles being strychnine and brucine we get the well-known convulsant effect of these substances in animals or men struck by the arrows.

I have, however, examined the root-bark of two species of *Strychnos* used as an arrow poison by the natives of Perak in the Straits Settlements, and found that both had a marked digitalis-like action on the heart, as well as a curare-like action on the motor nerves (*Lab. Rep. Roy. Coll. Phys. Ed.*, vol. vi.). These are mixed with a third substance called "prual," which paralyses the muscles. When these different ingredients are mixed they form a most efficient means of dealing death, seeing that they paralyse simultaneously the heart, the motor nerves, and the voluntary muscles.

In conclusion, I may just mention two other poisons, neither of which is perhaps thoroughly authenticated. The Ainos in Japan are said to use a preparation made from aconite and tobacco, while the natives of the New Hebrides are stated to smear their arrows and spears with damp earth containing the tetanus bacillus, so that a cut infects their victim with this disease. It is more probable, perhaps, that the wounds inflicted by these weapons sometimes become infected with the bacilli through the ordinary channels. The North American Indians do not use arrow poisons, nor do the aborigines of Australia, so far as is known.

In spite of the large number of arrow poisons which are known to us, the toxic actions are not very numerous, and can be roughly classed under five headings (although this does not include all, especially locally irritating substances): (1) Those which act on the heart and muscles, like digitalis; (2) those which act on the nerve-endings, like curare; (3) those which act on the nervous system and heart, like aconite; (4) those which act on the spinal cord, like strychnine; and (5) those which have an action something like snake poison.

In addition to my own specimens I have received samples of arrows and poisons from Mr. E. M. Holmes, Dr. Woodhead, Dr. Felkin, and Professor Balfour, and to these gentlemen I have to express my sincere thanks for their kindness.

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