Strophanthus hispidus: its Natural History, Chemistry, and Pharmacology. By Dr Thomas R. Fraser.

(*Abstract.*)

(Read February 4, 1889.)

A. *Natural History.*

In February 1870, the author made a communication to this Society on the Kombe Arrow-Poison of Africa, a product of the *Strophanthus hispidus* plant. In that communication the nature of its action on the various structures of the body, and the chemical composition of the seeds of the plant, which are the most active part, were described. It was pointed out that the action is chiefly exerted upon the heart and upon the muscles of the body, and that the seeds contain a crystalline active principle of the nature of a glucoside, to which the name Strophanthin was given.

From the examination then made of the action of the seeds of this *Strophanthus*, as well as of its active principle, strophanthin, it was anticipated that Strophanthus would prove to be of great value in the treatment of disease, and especially of disease of the heart; and a few years later the author employed it for this purpose in a small number of cases.

Various circumstances, such as the difficulty in procuring sufficient supplies of the seeds, prevented the author from making the number of observations that appeared to be necessary before the value of Strophanthus in the treatment of disease could be properly estimated; and it was not until 1885 that sufficient evidence had been obtained to authorise any public announcement on the subject.

In the interval of fifteen years which elapsed between the first communication to this Society and the communication of 1885 to the British Medical Association, the subject attracted so little attention that only two papers were published on it.

One of these papers dealt with the physiological action, and confirmed the statements made in the communication to this Society. The second paper dealt only with the chemical composition of the Strophanthus seeds, but the chief statements it contained, such as that the active principle is not a glucoside, have since been amply shown to be erroneous.

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Subsequently, however, to the communication of 1885, upon the therapeutical applications of the substance, the literature of the subject has rapidly increased, and it now embraces about a hundred separate papers, the greater number of which deal with its uses in the treatment of disease.

Until 1885, also, Strophanthus, elsewhere than in Africa, was a mere curiosity, represented in a few museums in Europe by specimens of its flowers and fruit. Since that time, it has become a not inconsiderable article of commerce, several tons of the seeds having been exported from Africa by London merchants alone, in order to supply the requirements of medical practice.

In the present paper it is proposed to give an account of the observations that have been made by the author on the natural history, chemistry, and pharmacology (or physiological action) of Strophanthus, but to-night only the first of the above subdivisions of the subject would be dealt with.

In nearly every narrative of exploration in uncivilised tropical regions, accounts are given of poisonous substances, which in many instances are stated to possess remarkable properties. Usually these poisons are of vegetable origin, and nearly all of them may be included in the two great divisions of Ordeal and of Arrow poisons. Among the most interesting of the Ordeal poisons are the *Physostigma venenosum* and the Akazga or Akaja of West Africa, the Sassy or Muave of wide distribution over Africa, and the *Tanghinia venifera* of Madagascar; and of the Arrow poisons, the *Antiaris toxicaria* and *Strychnos Tieuté* of Java, the *Aconitum ferox* of China, and the famous Wourali or Carare poison of South America.

It is to the enterprise and observation of explorers and travellers that we are indebted for the first knowledge of the Strophanthus Kombe-poison. The first specimens of the plant that reached Edinburgh appear to have been a few ripe follicles sent to Sir Robert Christison early in 1869, by the Rev. Horace Waller, who had been a member of the Oxford and Cambridge Universities' Mission of 1861–62, superintended by the late Bishop Mackenzie, with whom had been associated, during the operations of the Mission in the country between the river Shire and the lake Shirwa, the famous traveller Livingstone and the enterprising botanist Kirk, at that time H.M. Consul at Zanzibar. Mr Waller informs me that,

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at his suggestion, the follicles were brought to this country by Mr E. D. Young, R.N., when he went to Africa, in 1867, to clear up the story of Livingstone's murder.

Sir John Kirk had previously discovered that the Kombe poison is prepared from the seeds contained in these follicles. In a letter received from him (31st October 1888), he thus describes the discovery:—"I had long sought for it (the source of the Kombe poison), but the natives invariably gave me some false plant, until one day at Chibisa's village, on the river Shire, I saw the 'Kombe,' then new to me as an Eastern African plant (I had known an allied species at Sierra Leone (1858), where it is used as a poison). There, climbing on a tall tree, it was in pod, and I could get no one to go up and collect specimens. On mounting the tree myself to reach the Kombe pods, the natives, afraid that I might poison myself if I handled the plant roughly or got the juice in a cut or in my mouth, warned me to be careful, and admitted that this was the 'Kombe' or poison plant. In this way the poison was identified."

Livingstone, in his *Narrative of an Expedition to the Zambesi and its Tributaries* (1858–1864), states that the tribes inhabiting the Mikuru-Madse, a tributary of the Shire river, use this poison for arrows, with which they kill buffaloes and other game. "Poisoned arrows are made in two pieces. An iron barb is fastened to one end of a small wand of wood, ten inches or a foot in length, the other end of which, fined down to a long point, is nicely fitted, though not otherwise secured, in the hollow of the reed, which forms the arrow shaft. The wood immediately below the iron head is smeared with the poison. When an arrow is shot into the animal, the reed falls to the ground at once, or is very soon brushed off by the branches, but the iron barb and poisoned part of the wood remain in the wound. If made in one piece, the arrow would often be torn out, head and all, by the long shaft catching in the underwood, or striking against trees."

Mr John Buchanan thus describes the method followed in preparing the poison:—"A man breaks a follicle and puts the seeds with the wool attached into a pot. He then takes a small piece of bamboo, which has two thin splints inserted crosswise in the end, and he revolves this speedily by rubbing it between his hands. The seeds are thus put into motion, and fall to the bottom of the

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pot, and the wool rises and comes out at the top, and is carried away by the least breath of wind. The seeds are then put into a small mortar and pounded into a paste, which is then ready for use. It is common to mix the milky juice of a Euphorbia with it to make it stick to the arrow."

This arrow poison has also been found at the western side of Africa, where it is known as the "Inée" or "Onage," and the poison has been traced to a *Strophanthus*, which is probably the species *hispidus*, although the flowers do not appear to have been yet obtained.

Only a few poisoned arrows have reached this country from Africa, owing, no doubt to some extent, to the difficulties of carriage, but certainly much more to the reluctance of the natives to place poisoned arrows in the possession of Europeans. The author had, however, been able to examine arrows of eight different forms obtained from various parts of Africa. Two of them were arrows known to be poisoned with Strophanthus. Of the others, either no knowledge of the poison existed, or it was believed to be derived from plants other than Strophanthus.

Microscopical, chemical, and physiological examination showed that the poison of six of the eight arrows consists principally, if not entirely, of a substance made with the seeds of *Strophanthus;* and it is an illustration of the extensive use of this poison that these arrows should have been obtained from districts so widely separated from each other as the river Gambir, the Tanganyika lake, and the Zambesi river.

Of the other two arrows, one, originally poisoned on the arrow-head, was found to be inert; and the other, obtained in the Wanika country, was found to be poisoned with a substance acting like Strophanthus, but not giving its chemical reactions, nor exhibiting, on microscopic examination, any structure that could be identified with the structures in the seeds of Strophanthus. It is probable that the poison of the last arrow has been derived from a wood or root.

Decandolle, in 1802, first described the genus *Strophanthus*, and gave it this name because of the twisted, thong-like prolongations of the lobes of the corolla (στροφος, a cord, and ανθος, a flower). About twenty species are at present known, eight of which are found in Africa, and the others in India China, Malacca, and Burmah.

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Strophanthus Kombe is not included in this enumeration, as Professor Oliver, after an examination of further and more complete specimens of the flowers and leaves, now regards it as "a variety, a geographical race, of *Strophanthus hispidus.*" The species *hispidus* has been found only in Africa, and is widely distributed over its tropical and subtropical regions.

Mr Buchanan has at various times sent specimens of the root, stem, branches, leaves, flowers, and fruit, and has thus supplied materials for a description of the different parts of the plant.

These parts were exhibited and described, and also a young growing plant, reared from seed by Mr Lindsay, of the Royal Botanic Garden of Edinburgh.

In reference to the fruit, it was pointed out that it consists of two follicles, united at the ventral surfaces in the young state, but gradually separated, as maturity advances, by a hinge-like movement at their bases, until each separated follicle projects from the fruit stalk, almost at right angles with it. When fully mature, the two follicles form together a nearly straight line, whose extremities are the apices of the follicles.

Each ripe follicle contains three separate structures—the placenta, the seeds, and a large quantity of hairs interposed between the seeds and the endocarp.

As the follicle matures, its ventral or placental surface enlarges by the inverted edges of the carpels, which project united together into the interior of the follicle in its immature condition, splitting up more and more, and so expanding this surface. At the same time, the dorsal surface of the follicle, consisting of the thick and strong pericarp, becomes less rounded, and the placenta, with its still attached seeds, is brought close to the expanded ventral surface. By and by, as maturity advances, and the funiculus of the seeds becomes weakened by drying, the seeds break off from the funiculus, and lie loose in the interior of the follicle.

The follicle ruptures at the expanded ventral surface, which is its weakest portion, and through this rupture the seeds are extruded. The actual extrusion of the seeds seems to be produced by the separation from each other of the hairs of the comose appendages, and especially of the hairs separating the seeds from the endocarp. These hairs, in the green and moist state of the follicles, are in close contact

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with each other; but in the mature dry state they acquire elasticity, and tend to become separated from each other, and they thus press the seeds through the split ventral surface of the follicle.

The hairs separating the seeds from the endocarp seem to possess the additional function of preventing fracture of the long and brittle stalks of the comose appendages, by forming a soft and yielding bed for the seeds during their changes of position before they escape from the follicle; and they thus insure that the seeds shall be disseminated with the comose appendages attached to them.

Drawings and microscopic preparations were exhibited to illustrate the histology of the different parts of the plant.

A description of the results that had been obtained in the chemical and pharmacological examination of *Strophanthus* was deferred to a future meeting of the Society.

A New Type of Dimorphism found in certain Antipatharia. By George Brook, *Lecturer on Comparative Embryology in the University of Edinburgh.*

(Read January 21, 1889.)

A more or less elaborate system of polymorphism is of frequent occurrence in certain groups of colonial Cœlenterata. For example, in many Hydroids certain individuals perform the nutritive functions for the colony, others are specialised for reproductive purposes, and so on. The variously modified individuals are connected together by a general cœnenchyma, which enables the nutriment elaborated by the gastrozooids to be utilised by other members of the colony. Perhaps some of the most interesting and complex cases of polymorphism are to be found amongst the *Siphonophora*.

Amongst the Anthozoa dimorphism frequently occurs in certain groups of *Alcyonaria*, but in these cases apparently the specialisation never results in the formation of reproductive zooids. The modified individuals (*Siphonozooids*) differ from those of typical structure in the absence of tentacles, the great development of the siphonoglyphe, and in other points. They are usually but not invariably sexless, and in certain cases are stated to develop into typical zooids. In the *Actiniaria* the animal is usually solitary;

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