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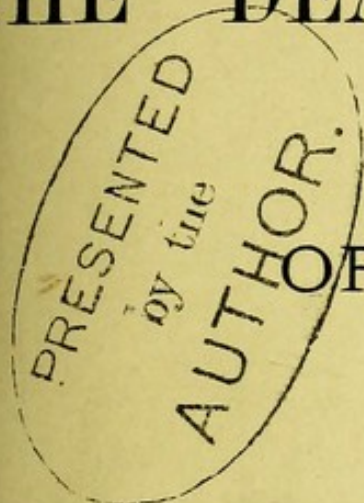
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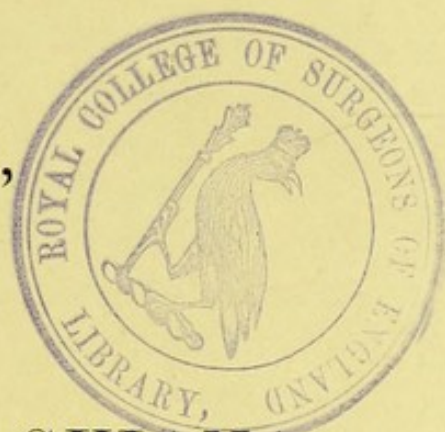
ON THE URARI:

THE DEADLY ARROW-POISON



OF THE MACUSIS,

AN



INDIAN TRIBE IN BRITISH GUIANA,

BY RICHARD SCHOMBURGK, DR. PHIL., DIRECTOR,

KNIGHT OF THE IMPERIAL ORDER OF THE CROWN, OF THE ORDER OF MERIT OF PHILIP
THE MAGNANIMOUS, AND THE ORDER OF THE CROWN OF ITALY; MEMBER
IMPERIAL CAROL. LEOPOLD. ACADEMY, AND HON. MEMBER AND
MASTER OF THE F.D.H., FRANKFORT O/M., ETC., ETC.

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ON THE URARI:

THE DEADLY ARROW POISON OF THE INDIAN TRIBES OF BRITISH GUIANA.

The great and unfortunate Sir Walter Raleigh was the first who brought to Europe exact information of the existence of the dreadful and swiftly operating extract called "*Ourari*," which was used by the natives on the Orinoco and Rio Negro for the purpose of poisoning the arrows they used in war and for hunting. Though a great deal of attention had been paid, since the information was first received, to distinguish the true from the untrue in the mysterious accounts which were circulated concerning the ingredients used in the preparation of the "*Urari*," yet it had no success, even up to recent years. The accounts of older travellers and missionaries, like Hartzink, Gumilla, Gili, and others, outvie one another in the fabulous and mysterious. The former related that, to try the strength and quick operation of the *urari*, the Indians shot their arrows dipped in *urari* into a young tree. If the tree died in the space of three days, the poison had the required strength. Other fabulous accounts need not be mentioned.

In the beginning of the nineteenth century it was Alexander von Humboldt who gave us the first authentic accounts concerning the preparation of this dreadful poison, having been present at the manufacture of the same in Esmeralda, on the Upper Orinoco. Later travellers were dissatisfied with the simple process as stated by Humboldt, and again sought to invest the preparation of the *urari* with greater mystery. It was maintained that the vegetable extract was only the medium of the deadly poison, and that the *urari* actually received its life-destroying power by the addition of the fangs of the most venomous snakes, poisonous ants, and cayenne pepper. None of these travellers had been present at the preparation of the *urari*, and none, of course, had seen the ingredients composing it. Such accounts are only supported by the communications received from the Indians, whose interest it is to represent the preparations as difficult as possible.

To test the respective value of these different accounts, my late brother, Sir Robert Schomburgk, felt induced, on his first expedition to the interior of British Guiana, to give this subject his closest attention. Already, on the

Upper Rupununi, he was fortunate enough to see a part of his wish fulfilled, in obtaining at least a botanical knowledge of the dangerous plant which forms the main ingredient in the preparation of the *urari*. In the Wapisiana settlement, Aripai, on the Rupununi, in 3° N. latitude, he was informed that the plant was found growing in the Canuku Mountains, about one and a half days' journey distant from Aripai. Accompanied by some Indians he went to the place. After a wearisome march they reached the mountains near Mamesna, a Wapisiana settlement, where they stayed all night, and where to his great joy he found an inhabitant who not only was well acquainted with the place where the plant grew, but who also understood the preparation of the *urari*. He was quite willing to bring him bark and branches of the plant in any quantity, but refused to guide my brother to the place where the plant was growing. Only large presents at last induced him to act as a guide. The next morning they set out, and after great difficulties—the road winding through a very stony country—they discovered the first plant. Although this neither showed flowers nor fruit, my brother recognised in it a new species of *Strychnos* (which he named (*Strychnos toxifera*). No persuasion could induce the Indian to prepare the *urari* in the presence of my brother.

During my brother's second expedition up the Essequibo, he had an opportunity of visiting the region of the *urari* plant. During his stay in Pirara, a Macusi settlement, lat. $3^{\circ} 33'$ N., long. $59^{\circ} 16'$ W., he was informed that near the Canuku Mountains a Macusi Indian was living, who was known as the most renowned preparer of the *urari* in the whole tribe. He inquired for him, and he was successful in persuading him to prepare the poison in his presence. In the company of the poison-maker he first made an excursion to the western part of the Canuku Mountains, where it was said the plant was also in existence, not only to get from thence the materials to prepare the deadly extract, but also to endeavour to see the plant in flower. The Ilamikipang was about eighteen miles in a south-easterly direction from the place he was staying at.

Under difficulties like those which I experienced afterwards, they reached the first plants; and although he found them without flowers, he saw the fruit, which confirmed his supposition of its being a *Strychnos*. After collecting some of the necessary bark of the *urari* plant, only taken from such plants as were in full sap, they returned to Pirara. The preparation of the poison was delayed for some days, as the preparer of *urari* stated that to enable him to produce the poison he had to subject himself to a strict fast. During that time a notorious chief, named Kanaima, from the Rupununi, arrived in Pirara, who persuaded the preparer of the *urari* to withdraw his promise to prepare the poison in the presence of my brother. The Indian with great energy asked my brother to return the bark of the *Strychnos*, to which request my

brother of course did not accede, taking the *urari* bark to Fort San Joaquim, a Brazilian fort on the River Rio Branco, to which place the expedition moved from their former camp in Pirara. Here my brother undertook to make an experiment himself to extract the poison from the bark of *Strychnos toxifera* alone. For that purpose he took two pounds of the bark, which he pounded, put it into a pot, adding to it a gallon of water. He let this remain for twenty hours, putting half of the extract—which already had assumed a brown color—into another pot, boiling it over a slow fire until it got to the consistency of treacle, and during this process the remaining extract was added. Two fowls were wounded, and the poison was inserted—in the foot of one, and in the neck of the other. The effects of the poison appeared after the lapse of five minutes; but the second—wounded in the neck—died in twenty-seven minutes, and the other in the twenty-eighth after the wounds. This was a sure proof that the *Strychnos toxifera* alone, and without the admixture of other ingredients, contains its deadly properties, and that any other additions are not essential to the strength of the *urari*. The boiling-down of the poison was finished in seven hours, while it takes the Indians more than forty-eight hours, which accounts for the slower effect taken by the poison which was prepared by my brother; the continued boiling, of course, concentrating the extract. The color of my brother's extract was a light brown, while that of the Macusi Indians was almost pitch-black, probably from the admixture of other ingredients.

This vegetable poison is known by several tribes of the Indians between the Amazon River and the Orinoco; but almost every tribe differs, not only in its preparation of the same, but also in the ingredients used. This difference in preparation is the reason why, with almost every tribe engaged in the preparation of the *urari*, the strength and time in which the poison operates are different.

I have already observed that the existence of the most vigorous plants of the *Strychnos toxifera* is limited to some localities within the territory which is inhabited by the Macusi Indians, and that may also be the cause why these Indians are everywhere considered to be the preparers of the strongest poison. The arrow-poison of the tribes on the Amazon, Rio Negro, and Orinoco, which came into our possession through chance, operates after the lapse of from three to seven hours; that of the Macusis produced the death struggles in as many minutes. The renowned strength of the *urari* of the Macusi Indians brings whole caravans of Indians from the Rio Negro, Orinoco, and even from the Amazon River, to the Canuku Mountains, to exchange the *urari* with the inhabitants for other articles.

Von Martius gives us an account of the preparation of poison by the tribes of Juris, Passes, Tecunas, and others on the Amazon and Yupura.

The traveller Poeppig gives a description of the vegetable poison in Peru and Chili, and Humboldt of the same as prepared in Esmeralda, on the Orinoco. Every one of these tribes use, according to the accounts, quite different ingredients.

My brother, on a visit to the mission of Esmeralda—lat. $3^{\circ} 11'$ N., long. $66^{\circ} 3'$ W.—which was so flourishing when Humboldt was there—found only one family remaining. The old patriarch told him that he had exchanged his arrow-poison with Indian tribes inhabiting the territory near the Rivers Paramu and Ventuari, especially from the Guinaus and Maiongkongs. Both tribes which had been visited by my brother call the arrow-poison “Cumarawa” and “Makuri;” but even these tribes prefer the *urari* prepared by the Macusis to their own, the latter having the quickest operation.*

During my brother's stay amongst these tribes he convinced himself that the main ingredient for the preparation of the poison, they used either the bark of *Rouhamon guianensis* Aubl. or *Strychnos cogens* Benth. Though their poison is similar to that of the *urari* of the Macusis, as far as color and consistency is concerned, yet, as I mentioned before, it is a great deal inferior in respect of strength. When my brother showed the Guinaus and Maiongkongs some dried specimens of *Strychnos toxifera* which he had in his herbarium, it seemed to be quite unknown to them; but when he showed them the specimens of *Rouhamon* and *Strychnos cogens* they immediately recognised in it the plants used by them for the preparation of their arrow-poison.

In British Guiana the preparation of the *urari* is known only to a few tribes. Von Martius, who says the same of the tribes of Brazil, states as a reason that those plants which contribute mostly to the preparation of the deadly extract certainly appear sporadical, that is the cause why the preparation of the *urari* is only known to certain tribes where the plant grows. As far as the inhabitants of Guiana are concerned, this statement does not seem correct, as I have found not only the *Strychnos toxifera* on the River Pomeroon, but also another kind of *Strychnos* on the Barama and Waini, a territory which is inhabited by the tribes of Warraus, Caribees, and Arawaks, which tribes do not use the arrow-poison, nor do they know anything of the properties of the plant. In British Guiana only those tribes which carry the blow-pipe as a weapon know the use of the *urari*.

During my brother's stay in Pirara, in 1837, he was as little successful in being present at the preparation of the poison. Leaving the village he asked Mr. Youd, the missionary, to try to persuade the maker of the poison in the Canuku Mountains to boil the *urari* in his presence and to communicate

*The articles of exchange which the Macusis take are the celebrated and dangerous blow-pipes, which are made out of a remarkable giant reed (*Arundinaria Schomburgkii*) which is found on the River Paramu; it grows to an enormous height, and the joints or knots appear at distances from sixteen to eighteen feet apart.

to him the process. Mr. Youd succeeded in persuading the poison-maker to boil the poison in Pirara, in a hut erected for the purpose in the front of the missionary's house, which enabled Mr. Youd to watch the process. My brother was again successful in witnessing the preparation of the *urari* on his third visit to Pirara. The experience gathered by these witnesses agrees in every respect with that obtained by myself, which may have arisen from our seeing the preparation made by the same individual.

I now made my own observations. I found at the Canuku Mountains the same renowned *urari* preparer who served my brother as a guide to the regions of the *urari* plants, and whom I engaged also as my guide. Under the same difficulties we reached the plants, which, to my great disappointment, showed neither fruit nor flower. We collected a great quantity of the bark of the plants, as the Indian had promised, after our return to the village, to prepare the *urari* in my presence. To my great consternation the old poison-boiler tried, when I reminded him of it the next morning, to evade his given promise with all kinds of excuses; pretending to be sick, complaining of headache, and wishing to put off the boiling for some days. The cunning Indian knew too well from experience that such pretended refusal would secure to him a greater reward, and to gain my purpose I had to add to the payment already promised some more powder and knives.

At last my long cherished wish to witness the preparation of the *urari*, of which so many fables had been told (as there always will be about anything enveloped in a certain mystery), was to be fulfilled, and I found the process, except a few unimportant ceremonies, as simple as possible. The small hut, which on my arrival in the village I supposed to be the laboratory of the chemist, was really the *urari* house. The Indian began first to take the bark from the *Strychnos* which we had brought from the Ilamikipang, then produced the other ingredients, which it seemed he had in store, and separated the required quantities. I am sorry to say that from the barks he used beside the *Strychnos*, I could not ascertain the botanical names of these plants, which he called Tarireng, Wakarimo, and Tararemu; but to all appearances they also belonged to a species of *Strychnos*. When I asked him where they grew, he answered, far, far away in the mountains; it would take him five days to get there. The preparation of the several ingredients would be according to the weight, as follows:—Bark of *Strychnos toxifera*, 2lbs., from Yakki (*Strychnos Schomburgkii*), $\frac{1}{4}$ lb.; Arimaru (*Strychnos cogens*), $\frac{1}{4}$ lb.; Wakarimo, $\frac{1}{4}$ lb.; the root of Tarireng, $\frac{1}{2}$ oz.; the root of Tararemu, $\frac{1}{2}$ oz.; the fleshy root of Muramu (*Cissus spec.*); four small pieces of wood of a tree of the species of *Xanthoxyleae*,* called Manuca.

*Manuca is the strong bitter wood of a tree of the *Xanthoxyleae*. The bark and the root are used as an effective remedy against syphilitic sickness on the Rio Negro, Amazon, and Rio Branco.

Having finished the preparations, he went to his hut and returned with a new earthen pot, holding about four quarts, and two smaller ones, also quite new, formed like flat pans. He then went into the *urari* house and put down the vessels. In the first the poison was to be boiled, in the others it was to be exposed to the sun for condensation. The great strainer or funnel, made out of palm leaves, was cleaned, and fresh silk-grass put into it to strain the fluid; the great block of wood dug into the ground to serve as a mortar, was cleaned, and in it the several ingredients were crushed. The *urari* preparer, after having arranged everything, built a hearth with three stones, and laid the wood ready to light the fire, and went away to fetch (as I was afterwards informed, for I had not exchanged a single word with the preparer of the poison, and got all the information from my companions) the utensils to light the fire, though there was a large fire burning close by us, but which was of no use, being lighted by profane hands. Neither dare he use any water except that brought in the pot to be used for the operation; in fact no other implement could be used but such as has been made by the cook; neither would he have assistance from any of the inhabitants. Any transgression of the sacred rules would nullify the operation of the poison. In addition to the fleshy root of the muramu, he crushed the several different kinds of bark, but each one singly, in the mortar, lighted the carefully piled-up wood, and then threw first into the pot—which holds about seven quarts, and which was filled with water—the bark of the *Strychnos toxifera*. As soon as the water began to boil the Indian added at certain intervals a handful of the other ingredients except the muramu root. In doing so he bent his head over the pot, strongly blowing into the mixture, which he said afterwards was adding considerably to the strength of the poison. During the process he only kept as much fire as was necessary for slow boiling, carefully skimming the foam collecting on the extract.

Within the next twenty-four hours the old man left the fire only for one moment—keeping the mixture at an equal heat. After the lapse of twenty-four hours the extract became thick, and was reduced by the boiling to about a quart, and had assumed the color of a strong decoction of coffee. The old cook then took the extract from the fire, and poured it into the strainer above mentioned; the extract trickling slowly into another flat vessel, left the remainder in the silk-grass. After exposing the strained extract to the sun for about three hours, he added the slimy juice pressed out of the root of muramu, which had previously been soaked for a short time in the boiling poison, and then had been pressed out. The poison immediately exhibited a remarkable alteration, curdling to a jelly-like substance. After this peculiar process, he poured the poison into earthen vessels, flatter than those before mentioned, for the purpose of bringing the poison to a consistence equal to

that of thick treacle by exposing it to the sun. Afterwards the poison was poured into the peculiar small calabashes or small half round earthen vessels, manufactured only for that purpose, where it ultimately changed to a hard substance. On the third day the poison was ready; when the cook, satisfied with the product, tried the strength of the poison in my presence, for which purpose he caught some lizards. He dipped the point of a pin which I gave him into the black treacle-like substance, let the poison get dry, and wounded one of the lizards in one of the toes of the hind foot, and then let it run. After the lapse of nine minutes the peculiar symptoms of the poison made their appearance, and one minute after that the slightly wounded animal was dead. A second and third were wounded on the tails, when the poison operated in the same time. He had chosen the lizards for the trial, maintaining that the operation of the *urari* with a warm-blooded animal takes only half the time which is required for a cold-blooded animal. A rat caught by a boy confirmed that assertion, and died in the fourth minute; a fowl, which I had bought for my dinner, died in the third minute. Each of these animals was but slightly wounded. The Indians maintain that the poison, even if kept well, and especially dry, will retain its life-destroying power only two years. Should the poison lose its power, they restore it by adding a little juice of the poisonous manihot root (*Manihot utillissima*). After pouring some of the manihot juice into a calabash containing the *urari*, they dig it into the ground, covering it with earth, and let it remain there for a day and a half. The manihot juice is then mixed with the poison, when it regains its former strength. The truth that after a certain lapse of time the poison would need a longer time to take effect, I have seen confirmed by my own experience with the *urari* manufactured in my presence.

I brought some of the *urari* with me to Berlin, and made several experiments with it, when I found that it frequently took from fifteen to twenty minutes, according to the tenacity of life, before death took place. I am sorry to say that as yet a really correct analysis of the poison has not been made, though the renowned chemist, Professor Heintz, of Berlin, has spent much time in trying to ascertain it. A commission of scientific men was appointed by Government to report on the effects of this poison, and many experiments were made, from the frog up to the horse.

A great deal has been fabled about the preparation of the *urari* by travellers, who pretend that they have seen poisonous fangs of snakes, ants, and capsicums used as ingredients. Of this I have never observed an instance, at least among the Macusis—the poison prepared by them being known as the most renowned and the quickest in operation between the Amazon River and the Orinoco. The old *urari* preparer, to whom I spoke

about it, replied that none of these things were necessary to make the poison efficient, and that he never added any of the above-mentioned ingredients; also denying that the addition of these things would quicken the operative power of the *urari*. The most difficult task for the cook is that before and during the preparation of the *urari* he has to observe a strict fast. A further inexorable law demands that during the preparation no woman or girl, and above all things, no pregnant woman must come near the *urari* house; it would be even injurious to the making of the poison if the wife of the cook should be pregnant. He begged of me not to eat any sugar-cane during the preparation of the *urari*—an interdiction which originates in the belief of the Indians that sugar is a remedy for being poisoned by *urari*. They, therefore, believe that if an Indian eats sugar near the place where the poison is prepared it must inevitably lose its destructive power. The fire underneath the boiler must not be extinguished altogether. Should one of these commands be disobeyed the science of the preparer would be of no use, and the poison lose all its power. The cook also imagines that for a few days after boiling the *urari* he is sick.

Mr. Youd, the missionary in Pirara, told me that the Indian, who prepared the poison in his presence, began with it on a Friday, and when he commanded him to leave off the boiling on Sunday, which he did very unwillingly, he would, notwithstanding, keep glowing coals beneath the boiler. On that day he did not go to hear Divine service, but sat outside the church near the window. Had he mixed with the congregation on that day the *urari* would have lost all its power.

The preparation of the poison seems to be free from any danger; even the vapours coming from the boiling *urari* are perfectly harmless; but the fact that the boiling occupies some days, during which time the accumulating scum must be taken off without intermission, and the fatiguing superstitious customs which are connected with the preparation of the *urari*, seem to be the reasons why the operation takes place only once or twice in the year.

A remedy for the wounds received by the *urari* is not at present known; and, though the Indians pretend to know some, they will give no assurance that the effects of their remedies are certain. As one of the remedies they mention the liquid of sugar-cane, or that liquid mixed with an infusion of the leaves of a tree (*Eperua falcata*). Salt is also said to be a remedy; for want of it they use urine. They say that the people poisoned by the *urari* suffer most frightfully, especially from thirst. Several years ago experiments were made in England with an ass to restore it to life after poisoning, and in one case successfully. A she ass was wounded in the shoulder with *urari*, and ten minutes afterwards the symptoms of the death-struggle were at an end. Through a cut in the windpipe atmospheric air

was then conveyed by an artificial contrivance, immediately after the death-struggle, into the lungs, and life, which apparently had disappeared, returned. The ass began to move her head, but as soon as the pure atmospheric air had been withdrawn, the signs of the returning life disappeared also ; yet after the lapse of two hours they were able to discontinue the supply of air. The animal got on her feet, did not show any lameness, and the wound through which the poison was imparted healed easily ; but all the vital functions were considerably disturbed, and it was only after the lapse of a year that those disturbances disappeared.

I here add an anecdote which was related to me. It shows not only the stoic courage, but also the manly firmness, with which the Indian yields to the unavoidable. Two hunters went out with their blowpipes to chase some monkeys. Very soon they found their prey, but one of the Indians missed his mark ; the small arrow rebounded and fastened on the upper part of his arm, and injured it. Without concern he drew the deadly arrow out of his arm, took his blowpipe, broke it into pieces, put down his arrows, sat down on the ground with the exclamation, "I shall not want you again," bid farewell to his companion, and died without uttering a word.

The poison may be swallowed in small quantities without its taking effect, yet people must be careful to have no wound in the lips or mouth. I have often seen the Indians licking their fingers when, in poisoning their arrows, some of the poison stuck to their fingers. I did the same ; its taste is more bitter than that of quinine. My late brother made it quite a practice to use it in small doses, instead of quinine, against fever ; but we prevented his indulging in that practice, making him aware of the great danger to which he exposed himself should there be the smallest wound in his lips or mouth. The effect the poison had on him was a peculiar headache with dizziness, but it saved him from the fever. That was a very dangerous practice ; and that the *urari*, in not very strong doses, taken inwardly, also proves fatal, I found out after my return to Berlin. In one of my experiments, I applied the *urari* to two healthy cats. One I wounded externally, to the other I gave a dose of *urari* internally, and a third cat I wounded in the shoulder and applied strychnine in the wound. The convulsions occasioned by the *urari* poison are quite eclipsed when compared with the tetanus and trismus occasioned by the strychnine. The death occasioned by the *urari* was, in comparison with that caused by strychnine, a falling asleep. After the lapse of eleven minutes the cat to which the *urari* poison was applied externally died ; after twelve minutes the one poisoned externally with strychnine ; and after seventeen minutes the one to which the *urari* poison was given internally. The deaths where the *urari* poison was used externally and internally were accompanied by the same symptoms. Upon dissection of the body of the cat poisoned

with *urari* internally, the stomach, as well as the whole intestines, was found colored by the dissolved *urari*. No wound could be detected either in the mouth, or the roof of the mouth, or throat.

As I had opportunities of observing the operation of the *urari* very nearly every day, I formed a kind of record of the duration of life with different animals and classes of animals, and I found that the highest degree was attained by the sloth. This may have its cause in the peculiar formation of his system of vessels, or in the slow circulation of his blood; yet the operation of the poison with him varied considerably in its duration, and there were never any convulsions, which with other animals always appear as soon as the poison begins to operate, although they are generally very slight. I wounded the sloth on the upper lip, and into the wound—which, by-the-bye, did not bring any blood—I rubbed a very small quantity of *urari*. I then placed it close to a tree, which it began to climb. Having reached the height of about sixteen or twenty feet, all at once it clung to the tree, turned its head first one way, and then the other, tried to progress, but it had lost all power, and and at length let go first one of its fore legs and then the other, but remained hanging to the tree with its hind feet. At last these also grew powerless, and the animal fell to the ground, where it remained without showing any convulsions, and without any of the difficult breathing which commonly takes place, and it died in the thirtieth minute. A similar experiment with a sloth was also made, under the same symptoms, by Mr. Waterton, the well-known traveller in British Guiana.

I now present the results of an analysis made by Professor Heintz, in Berlin, for which, as it is the first which approaches accuracy, I am deeply obliged to him:—"Herewith I have the pleasure to transmit to you the results of the chemical experiments made concerning the *urari* poison, of which I am sorry to say that they are not quite perfect. The few predominating properties of the active matter contained in it, and especially its incapability to crystalize either by itself or in connection with other matter, prevent its more exact examination, and especially its representation in a pure state. In the examination of the matter it appeared to me most important to show the absence of strychnine, which, notwithstanding the *urari* originates from a species of *Strychnos*, I presumed was the case by the manner of its operation on the organism, which has by no means any similarity with that of strychnine. For that purpose I boiled the watery solution of the *urari* with magnesia, filtered the precipitate, and after it had been washed I boiled it with alcohol. This took up only a very small quantity of matter similar to that of the extract, and did not leave the least signs of strychnine. I then, after the method of Boussingault, tried to exhibit the soluble salt basis, discovered by him in the *urari*. By his direction that part of the poison

soluble in water and alcohol is precipitated by tincture of galls, by which proceeding the poisonous matter connected with tannic acid is precipitated. The precipitate he dissolved in opalic acid, then boiled the solution with magnesia, to remove the opalic acid, as well as the tannic acid. The watery solution he filtered, steamed it, and then with alcohol extracted the poisonous matter, when there remained a little salt of magnesia not dissolved. Again, in my experiments I got a large quantity of precipitate out of the watery solution of that part of the *urari* soluble in alcohol and water by adding pure tannic acid, after the method of Pelarge; yet it did not dissolve so easily in opalic acid, as represented by Boussingault; on the contrary, it was easily soluble in boiling water. I therefore took it damp from the filter and boiled it with magnesia. When the watery solution was evaporated, it left a matter similar to an extract which, mixed with alcohol, will leave some salt of magnesia undissolved. The solution repeatedly steamed formed a brownish-yellow extract, which did not reproduce alcohol, as Boussingault represented; yet it contained the poisonous properties of the *urari* in a high degree. This substance it was impossible to consider as pure, as it could be got as a brown extract. I therefore searched for means of reaction besides the tannic acid, which would precipitate it, and found the same in chloride of mercury and chloride of platinum. The latter precipitate was almost insoluble; the former, on the contrary, dissolved at the washing of it to a considerable extent. I then precipitated the poison, formerly precipitated by tannic acid, and then separated it again from that combination with chloride of platinum, washed the yellow precipitate, decomposed it by heat with sulphuric acid, and steamed off the fluid filtered from sulphate of platina with oxide of lead. From the remaining part the poison could be extracted again with alcohol; yet after steaming it off with alcohol it again formed a yellow-brown extract, which I could not consider pure matter. Therefore I precipitated it again with chloride of mercury, washed the precipitate several times, and separated the organic matter in the same from the chlorine and the mercury, in the same way as I had done formerly with the platinum and chlorine. Yet the matter I obtained from this was again a yellow-brown extract, though the precipitate ley made through the chloride of mercury was perfectly white. From the foregoing you will see that as yet I have not been successful in producing pure the poisonous matter contained in the *urari*; yet in the impure form in which I received it, the smallest quantity was highly effective. A rabbit which I wounded with scarcely three millograms of the matter in his thigh died in seven minutes. This extract contains oxygen gas, which I can prove easily by the method of Lassaigue through natron. It shows with tannic acid, precipitates of chloride of platinum, and chloride of mercury; the former two are yellow, the latter white. Other predominating reactions of this matter I could not ascertain. In addition to these most

important constituent parts of the *urari* poison, I found sugar, gum, resin, extractive matter, tannic acid, gallic acid, and traces of salt-like connections of organic acid, probably of tartaric acid and of malic acid. This is all I am able to communicate as to the results of my investigations."

The following is the report from the scientific commission appointed as before-mentioned, which sets aside many of the mistaken ideas concerning the effects of the *urari* :—

"Lately Von Osterlein has expressed it as his opinion that the South American arrow poisons—*urari*, curary, and woorarii—contain strychnine, and are said to produce paralysis more quickly, yet less convulsions and tetanus. Nevertheless, the poison is represented by Osterlein as pure tatanic spinantia, wherein is contained nux vomica, strychnine, brutin, cocculus indicus, faba, St. Ignatii. From the analysis of Professor Heintz, it is shown that at least in the *urari* no strychnine is contained, though it appears that the physiological operation, as shown by Osterlein, agrees with the observations made by Waterton. As Schomburgk has given us such a good opportunity for the direct examination of the *urari*, we make use of it to communicate our direct experiences concerning the operation of the *urari*, and the appearances shown on the dead bodies after having been poisoned. The poison which was, according to Mr. Schomburgk's statements, five years old, and which would, according to the opinion of the Macusi Indians, only operate for two years, is so effective that we all took care to protect ourselves against all likelihood of being poisoned. From the very firm extract of dark brown colour and of shellac fracture, we prepared a solution of about 0·67 grains to 1 drachm of distilled water. In a vessel we put a few drops of this concentrated solution, to which we added several ounces of distilled water, and in this solution we dipped the hind foot of a frog for twenty minutes. During this time the frog was sprinkled with a few drops of the concentrated solution, so that by this means, if any absorption were possible, it would surely take place; yet the frog remained without any visible change, so that we thought that either the poison was without effect if applied in this way, or, as Schomburgk represented, the operation of the poison, through lapse of time, was lost, or, at least its power lessened, and the operation would therefore be slower. Yet after the lapse of a quarter of an hour the frog hopped as well as ever. We then let fall a few drops of the concentrated solution in an open wound on the right shoulder-blade. After the lapse of six minutes the frog fell on its fore legs, which were lying flat on the table; afterwards the hind part of the body fell on the outspread hind legs, and the frog was dead. Mechanical irritation was applied without success. Shaking the table on which the frog was lying did not cause any reflex movement. A solution of strychnine was dropped in the wound of the frog, but had not the least effect. Of the same solution, we

introduced ten drops in a fresh wound made on the neck of a rabbit. At the end of the third minute the animal sunk down and bent his head to the ground; the fore legs were fixed firmly to the ground; this was followed by a weak contraction of the flexors of the extremities, as also by peculiar movements of the under lip, though these appearances of movement soon relaxed. The action of the heart ceased in the first instance; after awhile it began to be regular again, then it diminished, and before the end of the seventh minute it ceased entirely. The thorax was opened, and the auricles contracted but weakly. We then tried bronchotomy, obtained by conducting air into the cavity, respiration through the trachea, and the contraction of the heart appeared most vehemently, more, however, in the auricles than in the ventricles. After keeping up the respiration artificially for six or seven minutes, we stopped the experiment, yet we could observe the contraction of the auricles of the heart twenty minutes after the experiment had been discontinued. The next day we opened the heart, and found in it, as usual, congealed blood. The animal was quite stiff. Another rabbit we wounded in the middle of the back—the wound was about an inch long—and dropped into it twenty drops of the concentrated solution. Shortly after the operation the animal was feeding, but after twelve minutes it involuntarily dropped its head and the hind part of its body; it then spread out its fore legs, and seemed to fix them firmly to the ground. Fifteen minutes afterwards no movement could be observed in the animal. When we lifted the rabbit by the ears its extremities were hanging limp and flexible; the heart was still beating, in the beginning at long intervals, with a short double stroke, then it began to grow regular—ninety-six to the minute—but after the lapse of twenty minutes the beating ceased. The animal, which we opened immediately after, did not show any accumulation of blood in the smaller or larger veins. The blood taken out of the heart was fluid, yet without any alteration in the color, and congealed in a few minutes, just like the blood of slaughtered animals. The blood globules were unchanged. The movements of the intestines continued for a short time. While the muscular fibre was inclined to contract in places directly irritated, the irritation of the nerves did not show any sign of motion. The before-mentioned solution was also applied to poison a cat. We made a wound in the skin of the right shoulder-blade about one and a half inches long, put ten drops of the solution in the wound, and after the operation we allowed the cat to run about. While running about in the room very actively she escaped, to our great regret, into the open flue of an unlighted stove. But before the lapse of twenty minutes we were able to extract her from her hiding-place, when she was found lying in a contracted position. The head remained in the position in which it had come by lying down on the floor, but the flexors of the extremities contracted often and slowly; the heart made eighty-eight strokes in the minute, and ceased by degrees, yet later than the contraction before mentioned.

We then inflated the lungs and kept up respiration artificially for twenty-eight minutes ; in consequence the heart began to beat again, and made 264 strokes in one minute. There was no appearance of the function in the sensorium or any active signs of motion, but on applying very strong mechanical irritation the animal muscular fibre was contracted.

The following experiments were also made by my late brother, Dr. Otto Schomburgk, and me, with a similar solution :—A Newfoundland dog was wounded in the ear ; the wound was about one inch long, and fourteen drops of the solution were applied to the wound. For the first five minutes the dog walked about. In the sixth minute he stood still and began to smell the ground, closed his eyes and opened his mouth several times ; at the tenth minute he sat down on his hind legs, and dropped his head lower and lower until it touched the ground. He then dropped down, stretching out his fore legs, and expired after the fifteenth minute. His heart still beat ninety-six times per minute after he had lain for three minutes quite motionless. We opened the animal directly, but he did not show, like the rabbit, an accumulation of blood in the smaller or larger veins. The blood taken from the heart was also fluid, and without any alteration in color, and congealed in a few minutes. From the same solution twenty-five drops were applied to a horse which had been wounded in the neck—the wound about an inch and a half long. Five minutes after wounding, it was feeding eagerly on hay, but suddenly it stopped and began to smell the hay ; after the tenth minute it became restless and tried to walk ; it had advanced scarcely six steps when it began to stagger and fell on its fore legs with its head on the ground ; at the twelfth minute its hind legs became slightly convulsed and it fell on its side, the eyes became fixed, and it tried several times to raise its head from the ground, but without success. Its breathing was heavy, and after the twenty-second minute there was no sign of life, only the heart continued beating four minutes longer at the rate of eighty-eight strokes per minute. The opening of the animal showed the same appearances as with the former animals. A pig was then wounded with the same solution in the fat part, and twenty-five drops applied in the wound, but the poison had not the slightest effect upon the animal. After twenty-five minutes a fresh wound was made in the fleshy part of the leg, and sixteen drops of the *urari* applied. The animal died with the same symptoms as the other animals in the sixteenth minute.

From these experiments made by Professors Virchow and Münter they conclude—1. That the *urari* kept dry will, even after the lapse of five years, and given in small doses, retain its intense and rapid efficiency. 2. That the *urari*, in accordance with the chemical experiments made, has no effect similar to that of strychnine. 3. That *urari* therefore, is not a tetanic poison, but, like opium, it operates by stupifying ; and though we may observe convulsive

appearances, like those with the cat, there is certainly no appearance of tetanus or trismus. 4. That *urari* causes palsy, producing a discontinuance of the voluntary movements of the muscles with continued functions of the voluntary muscles of the heart, intestines, &c. 5. That *urari*, by external application, is not fatal, but only when it is absorbed by the living animal substance through an incision made in the same. 6. That the effects of the poisoning with *urari* are stiffness or inflexibility, and coagulation of the fibres, exactly the same as with an animal killed in a mechanical way. 7. Our opinion is that death is not the direct result of the poisoning, but of the discontinuance of the mechanical action of respiration." Professors Münter and Virchow's interesting physiological experiments show that the *urari* poison does not appear to destroy by absorption from without, but chiefly when it is absorbed by animal substance after solution of continuity; that *urari* does not belong to tetanic poisons, and that it especially produces paralysis and cessation of action in the voluntary muscles, whilst those of the heart and intestines continue unimpaired.

TREATMENT OF TETANUS BY URARI POISON.

Before concluding my paper, I cannot forbear to mention that for some years back great interest has been excited amongst medical men by the experimental employment of *urari* in tetanus. The *urari* poison prepared from the bark of *Strychnos* species has been found, when used by injection, to be a direct sedative of the molar nerves, producing a relaxation of the muscular system, and having the power of allaying spasm in tetanus.

Dr. J. Green, of New York, I believe, was the first, having been engaged with some distinguished physiologists in experimenting by the endermic method. A favorable opinion was formed of the important results achieved from the sedative effects of the poison in cases of tetanus or rubies.

Experiments have been made by English, German, French, and Italian medical men, which have clearly shown the antagonism between *Strychnos* and *urari*, in many cases successfully; having also, in many cases, failed.

I have already observed that the different tribes in South America do not prepare their poison from plants of the same nature. Several do not use at all

the bark of the *Strychnos* species, especially the tribes inhabiting the Rivers Amazon and Rio Negro, and their poison acts much more slowly—often two to three hours—than that prepared by the Macuis, which acts in so many minutes, their principal ingredient being the bark of the *Strychnos toxifera*.

The South American arrow poisons are known under the names of *urari*, *woorari*, *wourali*, and *curare*, and are prepared from different ingredients. May it not have been that—in cases of tetanus in which *urari* has been used and has failed—an *urari* has been employed obtained from tribes which use no *Strychnos* bark in the preparation of their poison?

News has lately reached us from America that the *urari* has been successfully employed in cases of hydrophobia.

