Observations

On the Effects of Cucu, or Coca, the Leaves of Erythroxylon Coca.

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The brief notice taken in my introductory address to this Society in November last, of the restorative and preservative virtues of the Peruvian coca or cocoa-leaf against bodily fatigue from severe exercise, has led to numberless references to me by friends and strangers in all parts of the kingdom for information as to its effects, its safety, its applicability to the treatment of some states of disease, and the quarters in which it may be obtained. As I am not aware of any trials of it having been made in this country, either earlier than mine or so extensive, and as I shall probably best answer the many inquiries sent me by publishing an account of these experiments, I have been induced to present the following narrative to the Botanical Society. The inquiry, of which my recent trials form a part, is very far from being complete, because my supply was quite inadequate till the other day, when I received a sufficiency through the kind services of my colleague Professor Wylle Thomson, of the Challenger expedition. But the facts already obtained will probably interest not a few at the present time, were it for no more than that they set at rest all doubts that the more important effects of coca, experienced in its own country by the natives of Peru and the neighbouring states, may be equally produced in Europeans at home; and that, contrary to what seems universally believed in Peru, the virtues of the leaf may be preserved, with due care, for many years.

Since my observations must bear reference to what is the doctrine and practice of the Peruvians as to the use of this vegetable, I must introduce the subject with a summary of what has been written about it by the historians of Peru and by travellers in that country. The accounts which have thus appeared from time to time are apparently very contradictory; but I think they may be reconciled, and a consistent result obtained.

In the first place, however, let me remark that I have ventured to restore to the commercial article its original name, coca. This was its Indian name, which the Spaniards corrupted into coca. But there is no reason why other nations should adopt a Spanish corruption; and there is a very good argument against transferring it to our own tongue, inasmuch as we have already two totally different vegetable products, cocoa and cacao, which, as indiscriminately pronounced in ordinary speech, cocoa and cacao, are indistinguishable from the corrupted name of this new invention. I hope, therefore, that others will second me in attaching a characteristic name to an article which seems very likely to come ere long into general use among our countrymen at home.

The early historians of Peru have taken special notice of the culture, properties, and uses of coca. Among these, none is more full, clear, and fair, than the famous chronicler of the reign of the Yncas and of the Spanish conquest, Garcilasso de la Vega. His narrative bears internal evidence of great historical care. Other reasons, to be adduced to present, also add to the confidence which the statements themselves cast on the reader; and hence it is scarcely necessary to refer to any other early authority. Garcilasso's information was derived partly from what he personally knew, partly from a Spanish priest, Bias Valera, who was long in Peru, and whose manuscripts came into the historian's possession.

G. de la Vega informs us that the use of coca in Peru dates from an early period of the dominion of the Yncas; that at first it was scarce, and was monopolised by the monarchs themselves; that it was em}
to become mere slaves to it, surrender every other occupation for it, and, quitting society, pass their time in the wild forests between hunting for their sustenance and living under a tree covering the beloved weed, calling up delightful visions and building castles in the air, and so insensible to outward occurrences as to remain thus all night indifferent to cold, torrents of rain, and even the howl of the wolf. The boot and tunic of their neighbourhood gives way; the countenance becomes haggard, and the limbs emaciated; they can no longer take sufficient food, and even lose all relish for it, which has been so ruinously destroyed by the constipation so often occasioned in them by the abstraction of the leaves enabling them to climb heights, and pursue swift-footed game, with no greater difficulty than in similar rapid exercise on the coast; and that he experienced a sense of satiety which did not leave him till the time of the next meal after that which he might otherwise have taken. He mentions the following instance, which he carefully watched, of the power of the Indians to bear long fatigue with very small sustenance. A miner, sixty years old, was left for him at distant diggings five days at a time without food, or more than two hours of sleep nightly, his only support being half an ounce of coca leaves every three hours. The man then accompanied him on foot during a ride of sixty miles in two days, and, at parting, expressed himself ready to engage to undertake as much as he had performed. Nevertheless, von Tschudi was assured by the priest of the district that he had never known the man to die.

In general, this traveller declares he is "clearly of opinion that the moderate use of coca not only is innocuous, but may even be conducive to health"; and, again he observes, "after long and attentive observation, I am convinced that its use in moderation is nowise detrimental, and that the Indians, as well as the poorly fed Peruvian Indian would be incapable of going through his usual labour. The coca plant must be considered a great blessing to Peru".

Weddell, in less glowing terms, says, that careful inquiry where coca is most in use satisfied him that it might be injurious to Europeans not gradually accustomed to it; but that it has the power of sustaining the strength for a time without food, yet without interfering with the appetite soon afterwards; that, in his own trials, he experienced a slight excitement and a little subsequent sleeplessness, but nothing else; and that, in the countries he visited, he never saw things go the length described by Poppig, who must have been misled by exceptional cases.

The testimony of Clements Markham is very explicit. He says the properties of coca are to enable a greater amount of fatigue to be borne with less nourishment and to prevent difficult breathing in the ascent of steep mountain-sides; that, although when used to excess it is prejudicial to the health, yet of all the narcotics used by man, it is the least injurious and most soothing and invigorating; that, he himself, felt it frequently, and, besides an agreeable soothing feeling, found he could endure long abstinence from food with less inconvenience than he could otherwise have felt; and that it enabled him to ascend precipitous mountain-sides with a feeling of lightness and elasticity, and without losing breath. "It enabled him to ascend the most difficult parts of the Andes with ease and comfort."

It is difficult to reconcile with these favourable opinions the very opposite conclusions of Poppig, founded apparently on personal observation. Probably, he was too prosessed with the abhorrence with which the practice of chewing coca was regarded by the white inhabitants of the towns; hence he might have mistook for the effects of the habit what perhaps was no more than the physical expression of the natural indulgence of the Indian race when indulged in to excess; or, in other cases, the result of over-indulgence in ardent spirits, which, he says, the curers sometimes adds to his coca.

Mr. Bates met with this habit among the natives on the banks of the river Amazons, where he says it is regarded with abhorrence by respectable people, and therefore only practised secretly. He represents there called yapa, as stimulating and refreshing when used in moderation, but producing weakness and nervous exhaustion.
when indulged in to excess. His observations, however, are too brief and general to throw much light on the subject.

The native cucurbitaceous plant which thrives best in the clearings in the elevated forests of the Andes, in a climate distinguished by frequent rain-showers, and exemption equally from frost and from extreme heats. In other localities, which are considered as similar (facies) of delicately fragrant flowers, which give it the appearance of a black sumac in spring; and the flowers are succeeded by red berries. The place bears striking of their leaves three times in the course of the year. Great care is usually taken to nip them off before burning the axillary buds. They are dried at once quickly and thoroughly, and so as not to curl; at least, all good specimens I have seen present the leaves flattened and many of them entire, almost as if intended as a herbarm. Great care is taken to keep them afterwards dry, when transported from place to place. When newly dried, they have a strong odour, which is said to be apt to cause headache in those who frequent the dry Rooms for the first time; but this odour passes off by the time the leaves are packed. The packages when opened have a powerful tea-like odour; which they retain on reaching Europe, if duly protected from damp. In Peru it is alleged that their properties soon deteriorate, that in a few months they lose much of their virtue, and that when taken to the coast they are worthless in twelve months. This statement, however, must be received with some limitation. It is evident, from the pains taken by the colonists to preserve them from damp and exposure, that the leaves are easily damaged without due precaution; so that neglect will account for the inferiority of many old specimens. Besides, it is contrary to all analogy, that leaves destitute of volatile oil, at least not owing their virtue to volatile oil, should lose their useful properties from the ordinary causes of decay, and several medicinal leaves of European growth, formerly thought to become inert by keeping, are now known to retain the properties very long, since we have been aware of the precautions for preserving them. Moreover, several specimens brought to Europe have been found to yield a crystalline principle, which physiologically possesses no mean activity as a narcotic, which is probably the active ingredient, and which apparently bears transport and long keeping well. Lastly, well preserved cuca will produce in Europe in no small degree, after being kept several years, the remarkable effects on man which are every day experienced in Peru.

Coca is not yet a regular commercial article in this country. In the prospect of its soon becoming so, the characters of a good sample should be well understood. I have had two fine specimens of it, and have seen several evidently much inferior. The fine qualities consist of leaves in a great measure unbroken, often folded, but many of them too spread out, never curled, but always flattened, never brown, always deep green on their upper and gray-green on their under source, and uniform in that respect, seldom mottled in colour. They are thin and crisp, beautifully reticulated, and traversed longitudinally by a single fine vein on each side of the strong midrib. In mass they have a strong odour resembling that of tea, and when chewed they have a peculiar well-marked herbaceous taste, not disagreeable, followed, after a continuous chewing for some minutes by a gentle, pleasant sense of warmth in the mouth. Inferior specimens, besides differing in appearance from those, have a fainter odour, and do not occasion warmth in the mouth when chewed.

Coca has been subjected to chemical analysis, and found to contain a crystalline principle, which to naturally has been given the name of cocaine, but it is not my intention to enter here into the chemistry of the subject.

Nor is the Botanical Society the fit place for discussing fully the experimental investigations which have been made into the physiological actions of cocaine, or of coca itself, further than as they bear on what has been said above upon that point, or on what is to follow as the account of my own observations. In that respect, the most important inquiry is that of Dr. Mantegazza of Milan, published in a prize essay, which has been noticed in the Österreichische Zeitschrift für Praktische Heilkunde for November 1859. He found, by personal trials, that in small doses it produced in him a sensation of warmth, which raised the animal heat, and accelerated respiration; that in a dose somewhat larger, there is added a facility of motion and desire for it, succeeded by a soothing effect; and that in a large dose, such as three drachms or upwards, it doubles the rate of the pulse, causes flashes of light, headache, strong tendency to muscular action, and great vigour of mind, succeeded by a state of pleasing, imaginative calm, described by the analyses and their colors, which resemble the poetical ravings of Dr. Quinsey, in representing the visionary musings of the opium-eater.


* A specimen of the plant is now in flower in the Edinburgh Botanic Garden (Anigozanthon), as represented in an uncoloured engraving in Hooker's Companion to the Botanical Magazine, ii, 1836.

* Were these effects the general rule, there would be more justice in the unfavourable representations of Popigian than of Roberts aden actions. It must be allowed as some confirmation of Mantegazza's statement, that Weddell thought he occasionally observed hallucinations in the coqueros of Peru, when under the influence of their dose; and that Von Tschudi was so much impressed by their association with stramonium, an unequivocal narcotic poison. I scarcely think the recently ascertained deadly effects of the principle cocaine upon animals can be fairly added to the evidence in the same direction. It is true that experimental inquiries, and, among these, the most recent by Dr. Alexander Bennett, published in his thesis, and also as part of an experimental research carried on by a committee of the British Medical Association, prove that in small doses cocaine has an effect on the brain. They retained an adequate dose paralysis of sensation, tetanic convulsions, and death. But he found the same effects to be caused by theeine, caffeine, theobromine, and guaranine, the nearly identical crystalline principles of tea, coffee, chocolate, and the Brazilian guaraná; yet no one will imagine on that account, that the habitual use of these restoratives has any injurious influence on the health. At all events, however, the following experiments, which does not act so extraordinarily in the case of Dr. Mantegazza, show results materially different from his, and prove that the leaves may be easily used by most, if not all, persons, so as to produce no unpleasant, assumed, by the body; and, when used in small doses, for the prevention of fatigue, and for the treatment of cases of anxiety and shock. Nevertheless, counteraction of the whole facts recorded by good observers, and the opinions formed by competent judges, that if coca is to be used to the restorative of Europe—what it ought to be used to be used with first at caution, and under close observation of its relative effect in several varieties of condition, such as age, sex, and constitution, rest and exercise, bodily and mental, dose and form, etc.

I then determined to make some careful personal trials with the scantsy remains of my best specimen. For this purpose I thought it

* Edinburgh Medical and Surgical Journal, 1874, Part ii, p. 373.
best to adopt the Peruvian method of chewing, but I discarded their lime and ashes. For not only was I unable to discover, in the nature, composition, and effects of the leaf, anything which could be made the basis of such an addition; but likewise I found that the Llpta, as the addition is called, which was presented to me with one of my specimens from Peru, has no alkaline or calcareous taste, and therefore cannot affect the decomposition of the lime, while it is masticated. The result confirms the view I had thus taken.

I had first to ascertain what amount of exercise was required to cause very thorough and permanent fatigue. At the same time, I made such observations on certain of the functions as seemed desirable and easily practicable. In the beginning of May, under a day temperature of 58 deg., I walked fifteen miles in four stages, with intervals of half-an-hour, at four-mile pace, without food or drink, after breakfast at half past eight, and ending with a stage of six miles at half past five in the afternoon. I had great difficulty in maintaining my pace through weariness towards the close, and was as effectually tired out as I remember ever to have been in my life, even after thirty miles at a stretch forty or fifty years before.* Perspiration was profuse during every stage, particularly the last of all. I took the urinesolids every two hours, and found a decided increase of the hourly solids during the forenoon's exercise, and a decrease during the evening's rest after dinner. The pulse, naturally 62 at rest, was 110 on my arrival at home; and two hours later it was still 90. I was unfit for mental work in the evening, the sleep, though soundly all night, and awaking me, was somewhat wearied and disinclined for active exercise, although otherwise very well. Two days afterwards, I repeated this experiment, and obtained nearly the same results, except that the urinesolids were not so abundant during exercise as before, although my food had been precisely the same.

Four days later, with precisely the same dietary, I walked sixteen miles in three stages of four, six, and six miles, with one interval of half-an-hour, and a second of an hour and a-half. During the last forty-five minutes of the second rest I chewed thoroughly eighty grains of my best specimen of cuca, reserving forty grains more for use during the last stage. To make assurance doubly sure, I swallowed the exhausted fibre, which was my only difficulty. On completing the previous ten miles, I was lagged enough to look forward to the remaining six miles with considerable reluctance. I did not observe any sensible effect from the cuca till I got out of doors, and put on my usual pace; when at once I was surprised to find that all sense of weariness had entirely fled, and that I could proceed not only with ease, but even with facility. I got over the six miles in an hour and a-half without difficulty, found it easy when done to get up a four-and-a-half mile pace, and to ascend quickly two steps at a time to my dressing-room, two floors upstairs; in short, had no sense of fatigue or other uneasiness whatsoever.

During the last stage, I perspired as profusely as during the two previous walks. On arrival at home, the pulse was 90, and in two hours had fallen to 72; the excitement of the circulation being thus much less, and its subsidence more rapid, than after the same amount of exercise without cuca. The urinesolids hourly were much the same while the exercise lasted as during exercise on the day of fifteen miles' walking without cuca, although the breakfast diet was precisely the same, the exercise of the evening's rest in the early morning during the exercise being the same as during the preceding period of exercise—a fact which is capable of more interpretations than one.† On arriving at home before dinner, I was famished and hungry, but thirstless; I drank a glass of drink and of every kind for nine hours; but on dinner appearing in half an hour, ample justice was done to it. Throughout the evening I was alert, and free from all drowsiness. Two hours of restlessness on going to bed I ascribed to the dose of two drachms being rather large; and after that I slept soundly, and awoke in the morning quite refreshed, and free from all sense of fatigue, and from all other uneasiness. Another effect, not unworthy of notice, was that a tenderness of the eyes, which for some years has rendered continuous reading a somewhat painful effort, was very much mitigated during all the evening.

I reserved what remained of my good specimen of cuca for further trials in after-dinner hours, and to keep as an occasional stimulant in my absence. On September 3rd, while residing at St Fillans on Loch Earn, I ascended Ben Vecht. The mountain is 3,224 feet above the sea, and 2,900 feet above the highest point of the loch—its summit being 250 feet above the level of the sea. The ascent was made by a rugged path, and then through short heather and short deep grass; but the final dome of 700 feet is very steep, and half of it was ascended by drudging; but eventually I was so much exhausted as to be unable to proceed the whole ascent. The summit at the base of the side was 62 deg.; on the summit, 52 deg. In consequence of midisolation, I had to descend an intervening slope on the way, so that the whole ascent was 3,000 feet along a full half a mile, and it was so fatigued near the close, that it required considerable determination to persevere during the last 300 feet. I was richly rewarded, however, by an extremely clear atmosphere, and a magnificent mountainous panorama, of which the grandest object was Ben Nevis, forty miles off, shown quite apart from other mountains, and presenting the whole of its great precipice eddies towards the eye. My companions, who, as well as I, were provided with an excellent luncheon, soon disposed of it satisfactorily; but I contented myself with chewing two-thirls of one drachm of cuca-leaves. We spent three-quarters of an hour at the top, during which I looked forward to the descent with little disgust.

On rising to commence it, however, although I had not previously experienced any sensible change, I at once felt that all fatigue was gone, and I went down the long descent with an ease like that which I used to enjoy in my mountainous rambles in my youth. At the bottom, I was neither weary, nor hungry, nor thirsty, and felt as if I could easily walk home four miles; but that was unnecessary. On arriving home at five o'clock, I still felt no fatigue, hunger, or thirst. At six, however, I made a very good dinner. During the subsequent evening, I was disposed to be busy, and not drowsy; and sound sleep during the night left me in the morning refreshed and ready for another day's exercise. I neither food nor drink of any kind after breakfasting at half past eight in the morning; but I continued to chew my cuca till I finished the sixty grains when half-way down the mountain. I had not with me in the country any apparatus for the determination of the temperature.

Eight days afterwards, I repeated the experiment, but used ninety grains of cuca. Being better acquainted with the way, no ground was lost by any intervening descent, so that the perpendicular height to be reached from the highway was 2,000 feet, and I took two hours and a quarter to ascend, and on reaching the summit was extremely fatigued. The weather had changed, so that the temperature, 51 deg. at the loch-side, was 47 deg. at the top. A moderate breeze consequently caused so much chilliness that my party were glad to descend in half an hour, by which time I had consumed two-thirds of the cuca, taking, as formerly, neither food nor drink. The effects were precisely the same, perhaps even more complete, for I easily made the descent without a halt in an hour and a quarter, covering at least four miles of rugged ground; and I walked homewards two miles of a smooth level road to meet my carriage. I then felt tired, because nearly three hours had elapsed since I consumed the cuca, and in that time the Peruvians find it necessary to renew their restorative. There was no more cuca left, and I was tempted to substitute a draught of excellent ale. I suppose this indulgence led on to the unusual allowance of four glasses of wine during dinner, instead of one or none; and the two errors together, with possibly some discordance between cuca and alcohol, were the probable cause of the severe and pestilential illness which overtook me the next day. I was feverish with a dry skin, and my head ached with a burning heat; but quiet sleep succeeded, and I awoke quite refreshed and active next morning.

One of my sons, who accompanied me on both occasions, used cuca to the same effect, and on the whole was quite contented with its restorative action. He was not in a good condition for such work, he made it out without fatigue; and on the second occasion, when there was no more cuca to give him, he felt decidedly the want of it when he reached the highway at the foot of the mountains.

These trials have been described particularly, because I feel that, without details, the general results, which may be now summarised, would scarcely convey conviction with them. These are the following. The chewing of cuca removes extreme fatigue, and prevents it. Hunger and thirst are suspended; but eventually appetite and digestion are unaffected. No injury whatever is sustained at the time, or subsequently in the result. I can say nothing of what may or may not happen if it be used habitually. From sixty to ninety grains are sufficient for one trial; but some persons either require more, or are more in the habit of its restorative action. It has no effect on the mental faculties, so far as my own trials and other observations go, except liberating them from the dulness and drowsiness which follow great bodily fatigue. I do not yet know its effect on mental fatigue purely. As to the several functions, it reduces the effect of severe protracted exercise in accelerating the pulse. It increases the salivation, which, however, may be no more than the effect of fasting. It does not produce either the pleasant or the painful sensations which can be judged. It probably lessens the hourly secretion of urinesolids. On

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* The degree of fatigue thus occasioned by so great amount of exercise was being partly to the experimentalist having been quite out of the habit of much exercise for five months, and partly to his having to carry the weight of seventy-eight years.

† See Journal of the Royal Geographical Society, p. 53.

‡ Perhaps it should be mentioned that at all times I have been exempt from thirst under a long day's continuous exercise.
I think I see how further experiment may clear them up. At present, I may only observe that great attention has been paid to the condition of the urine in which the treatment of the kidneys is taken only in the aggregate for four-and-twenty hours; and that the sudden decrease of urine solids noted that raises a suspicion that, under a sense of much fatigue, such an interval of exercise, the action of the kidneys may languish like other functions.

**CLINICAL LECTURE**

on

**A CASE OF PENETRATING WOUND OF THE THORAX.**

Delivered in University College Hospital, London.

By CHRISTOPHER HEATI, F.R.C.S.,

Holme Professor of Clinical Surgery in University College, and Surgeon to the Hospital.

GENTLEMEN,—I regret to have to bring you into the post mortem room instead of the clinical theatre to-day, because I would rather speak of a living than a deceased patient; but the case of injury to the chest which you have watched in Ward 1 for the last three weeks has unfortunately ended fatally; and, whilst Mr. Barker is making the necessary preliminary steps of the post mortem examination, I will recall a few points of the patient's history which were left unfinished.

The patient was a healthy man aged 24, a carpenter by trade, who was playing with a fellow-workman on October 29th, when the latter tried to hit him with the flat of an inch-and-a-half chisel, and unfortunately the blow flew from the handle and struck him in the back. When admitted half an hour afterwards, the man was suffering from some degree of collapse; there was some difficulty of breathing, but no hemoptysis. He was bleeding, but not profusely, from a clean cut wound one inch and a half long, placed between the ninth and tenth ribs of the right side, and parallel to them, about an inch and a half from the spine. Mr. Collins, the house-surgeon, applied a compress over the wound, and gave the patient ice to suck and turpentine to inhale; and, when I came to make the visit about an hour afterwards, you had the opportunity of seeing the case with me. We then ascertained that air passed in and out of the chest during respiration, and this current was strong enough during an effort of the patient to blow out a lighted candle. There was no emphysis about the wound; there was normal resonance over the right side of the chest, and the breath-sounds were healthy. There could be no doubt, then, that the cavity of the chest had been opened and the lung, in all probability, wounded; for, although air might be sucked into and driven out of the pleural cavity by the action of the diaphragm, which would rise to near the level of the wound, the current would not be strong enough to blow out a candle, nor could we explain the flow of blood save by a wound of the lung itself. And yet there had been no hemoptysis, none of that violent coughing up of furred frothy blood which you may have been led to expect as the inevitable accompaniment of a wounded lung, but which does not occur unless some large pulmonary vessel is divided. Again, the admission of air into the pleura did not produce much effect upon the lung, which certainly did not collapse, and, therefore, we had no pneumothorax in the ordinary acceptation of the term.

And next as regards treatment: with a clean cut wound done by a sharp instrument, there could be no question of foreign body in the chest, and no object, therefore, if there ever be, in probing the wound or inserting the finger. To restore the pleural cavity to its normal condition, and to secure rest for the lung, were the objects to be attained; and I, therefore, had the wound carefully drawn together with plaster, applied colloidion over it, and put a broad bandage round the lower part of the man's chest. Then, with the view of preventing the inevitable pleurisy from running too acute a course, I ordered small doses of antimony and opium in combination every four hours, and put him on milk-diet, with ice to suck.

You will find that there have been differences of opinion on the question of the opening in cases of penetrating wound of the chest: but the best authorities are agreed that, in clean cut wounds, union should be encouraged, although it may be necessary later on to reopen the wound for the purpose of clearing out accumulated effusions.

It is but just to attempt to explain all the deviations here indicated from what might have been anticipated by received doctrines.

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