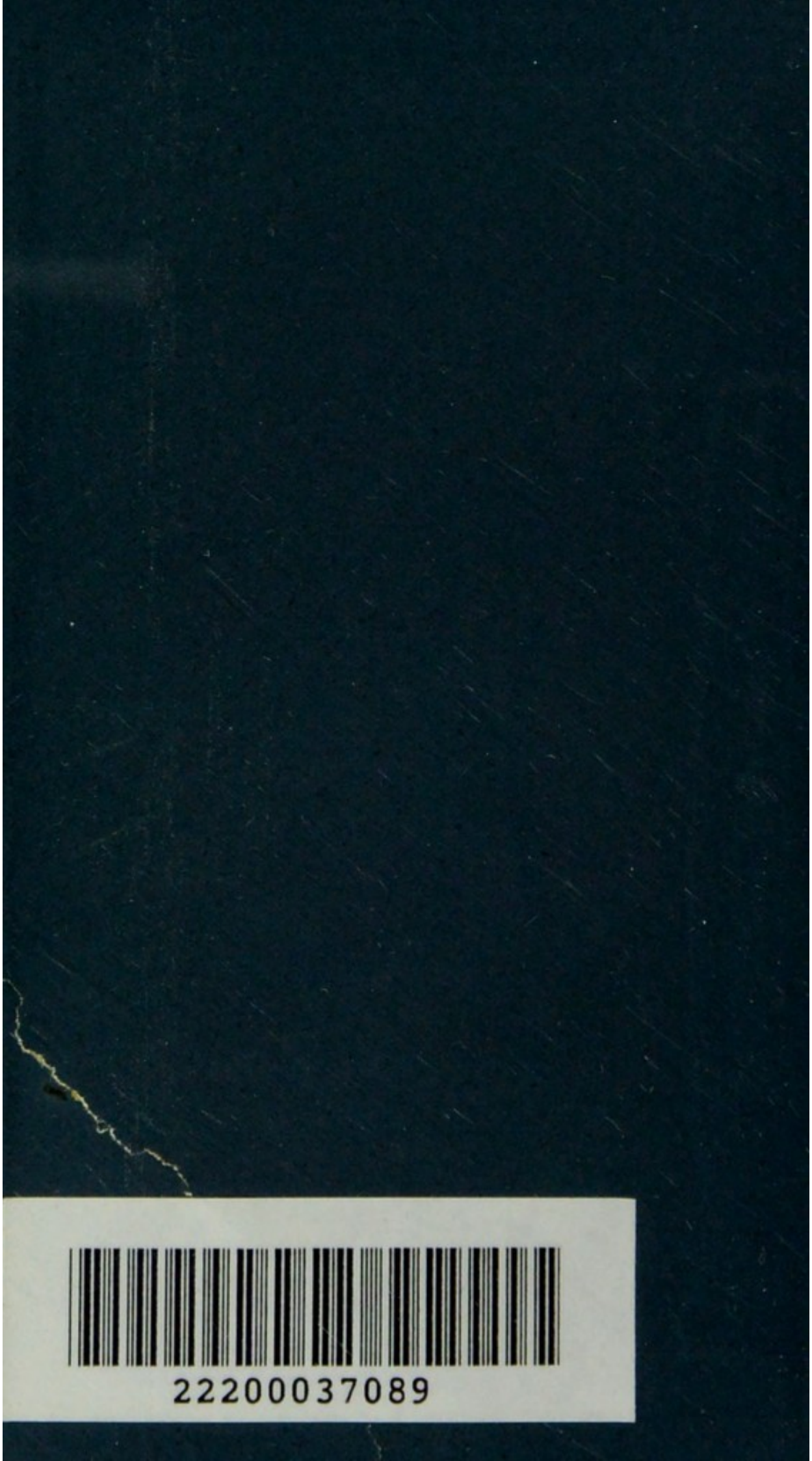
Coca, cocaine and its salts : their history, medical and economic uses, and medicinal preparations.

COCA,
COCAINE AND ITS SALTS

MARTINDALE



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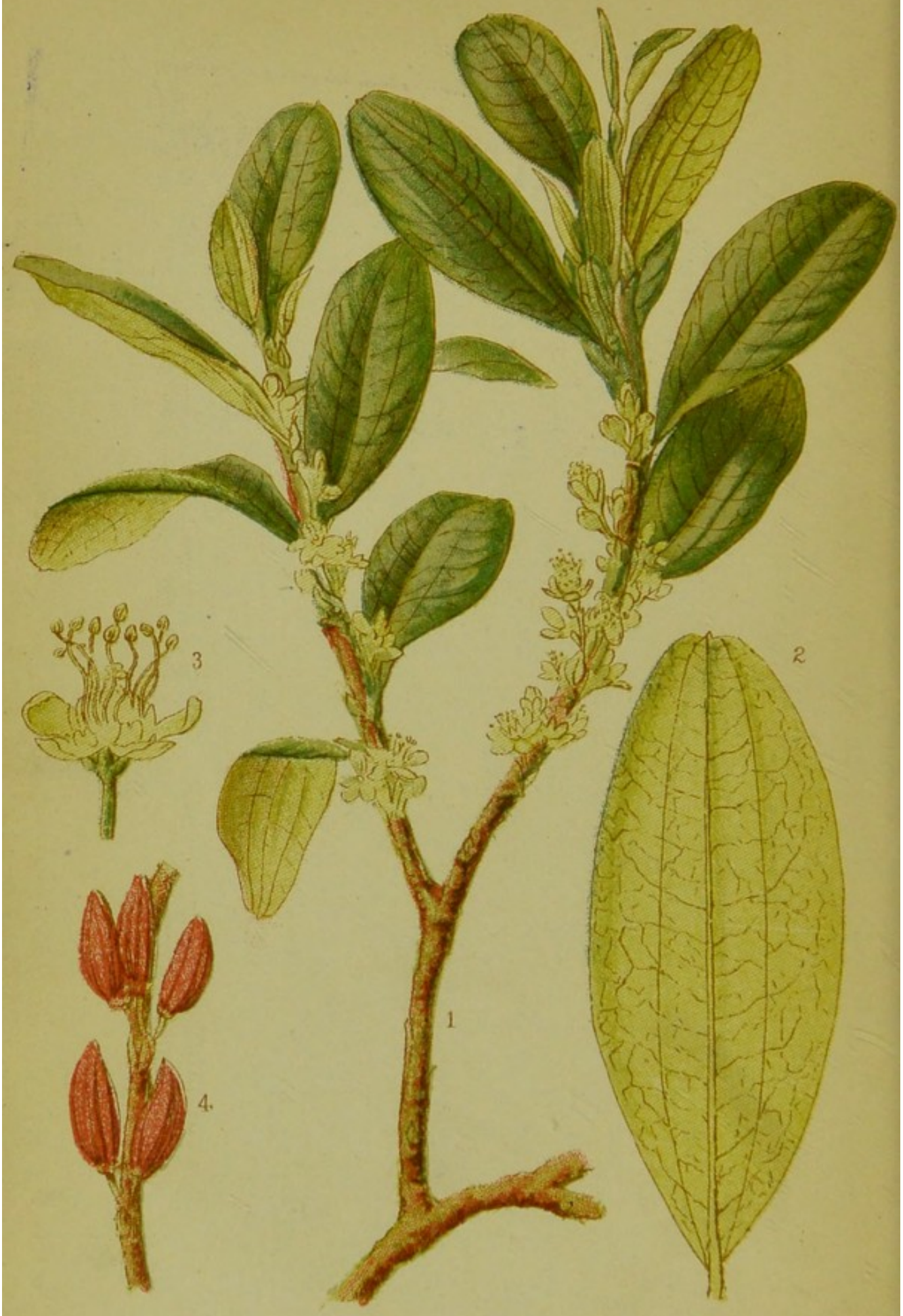

1._ERYTHROXYLON COCA 2._BACK OF LEAF (*full size.*)
3._FLOWER (*enlarged.*) 4._FRUIT.

COCA,

COCAINE AND ITS SALTS:

THEIR HISTORY,

MEDICAL AND ECONOMIC USES,

AND

MEDICINAL PREPARATIONS.

BY

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"EXTRA PHARMACOPŒIA."

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PREFACE.

I HAVE been induced to compile this brochure, as supplementary to the short description of Coca given in the "Extra Pharmacopœia," on account of the attention this plant, and its alkaloid Cocaine, have excited during the past eighteen months.

Although made known to us soon after the conquest of Peru by Pizarro,—more than three centuries ago,—the accounts travellers have given of Coca have only received about the same credence, and been treated with about the same reverence, as we pay to a myth. We have considered the writers as having been over credulous, as in some cases they undoubtedly were. It was thought the use of the leaves by the Indians of Peru was only that of a masticatory, which simply increased the flow of saliva. We looked upon its so-called nutritive properties, or rather its hunger and thirst-appeasing effects, as well as its power to ward off fatigue and relieve oppressive respiration during mountain ascents, as superstitions unworthy of more attention than the betel-nut mastication practised in India. The surgical uses of Cocaine as a local anæsthetic have, however, to some extent dispelled these illusions, and we have been more ready to receive the accounts of early as well as recent travellers, thinking "there may be something in them." I have endeavoured to reproduce what many have written, as much as possible in their own words, or translations of them.

The old habit of Coca chewing has clung to the Peruvian Indians after their "power, civilization, language, alphabets, writings, and even old religions have disappeared" * says Johnston; "the common-life customs and the bodily features of the people have alone survived." By him Coca is classed among the "Narcotics we indulge in," along with Tobacco, Hop, Poppy and Lettuce, Indian Hemp, Areca or Betel-nut, Ava or Kava, Red Thorn Apple fruit *Datura sanguinea*, also n use among the Indians of the Andes, Siberian Fungus or Fly Agaric *Amanita muscaria*, and

* "Chemistry of Common Life," Vol. ii., p. 398.

Sweet Gale *Myrica Gale*, formerly used to give bitterness and strength to the fermented liquors of the ancient Britons. But physiologists have more recently classed it with Tea, Coffee, Maté, Kola Nut, and Cocoa,—the Theine (Methyl-Theobromine) and Theobromine yielding plants,—although Cocaine has no chemical alliance with these principles. As a beverage to substitute for tea or coffee, a decoction or infusion of Coca is worthy of attention at th present time. The Indian use of it in moderation seems to prolong life, without much need of sleep or food, or even the desire for these, although in excess it has no doubt a degrading effect. A taste for infusion or decoction of Coca or its pharmaceutical preparations is easily acquired; if a good sample of leaves be used it is not even at first disagreeable.

As the plant admits of easy acclimatisation, and yields annually several crops of leaves, should it come into more extended use it is probable that its cultivation in suitable localities in mountainous parts of India, Ceylon, and Jamaica will prove a profitable enterprise to planters now commencing the growth of it.

Cocaine has done such great things for the eye, that, in having this printed, I have tried to avoid straining this organ by using plain black and white, as it has been stated that such violent contrasts between the colour of the ink and the paper are injurious. Works printed in blue ink on green paper are said to be admirable for the sight. Hence their selection in this instance.

The following abbreviations are used:—

B.M.J. for *British Medical Journal.*

L. for *The Lancet.*

M.R. for *The London Medical Record.*

M.T.G. for *The Medical Times and Gazette.*

Off. for *Official*—in the *British Pharmacopœia.*

P.J. for *Pharmaceutical Journal.*

Pr. for *The Practitioner.*

My thanks are due to my colleague, Dr. Wynn Westcott, for valuable assistance and aid in abstracting some of the references.

WM. MARTINDALE.

NEW CAVENDISH ST., W.

March, 1886.

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COCA AND COCAINE.

INTRODUCTION.

The medical interest which has centered in Cocaine as a local anæsthetic during the last eighteen months, has gradually become diffused as "public opinion," the more so, of late, as it has been recommended as a remedy for sea-sickness, from which Britons all more or less suffer on leaving our sea-girt home; otherwise, internally, Cocaine has been but little used compared with its future probably extended use when its effects are better known. This now important alkaloid is obtained from the leaves of *Erythroxylon Coca*, Lamarck, a shrub cultivated on the slopes and plateaux of the Andes, chiefly in Bolivia and Peru, but also in the Argentine Republic, Ecuador, United States of Colombia, and Central America, as far north as San Salvador.

CHAPTER I.

EARLY HISTORY.

The earliest extant accounts of Coca are contained in the writings of the historians who treat of the Spanish conquests in South America in the sixteenth century, and of Spanish travellers and Jesuit missionaries who followed in their wake.

Pedro de Cieza de Leon thus writes,* (A.D. 1532 to 1550):—

"I have observed in all parts of the *West Indies*, where I have been, that the natives delight in holding herbs, roots, or twigs of trees in their mouths. Thus, in the territory of *Antiocha*, they use a small Herb, called *Coca*, and other sorts in the province of *Arma*. In those of *Quimbaya* and *Anzerma*, they cut twigs off a sort of tender middling trees, which are always green, wherewith they are incessantly rubbing their teeth. In most parts about *Cali* and *Popayan*, they hold in their mouths the aforesaid small *Coca*, with a composition they keep in little calabashes, or else a sort of earth, like lime. Throughout all *Peru*, from the time they rise in the morning till they go to bed at night, they are never without this *Coca* in their mouths. The reason some *Indians*, to whom I put the question, gave me for so doing, was, that it made them insensible of hunger, and added to their strength and vigour. Something there may be in it, yet I am rather of opinion it is only an ill habit, and fit for such people as they are.

"This *Coca* is planted on the Mountains *Andes*, from *Guamanga*, to the town of *La Plata*, where it grows up to little trees, which they cherish and nurse up carefully, that they may bear those leaves, resembling our Myrtle.

* "The Seventeen Years' Travels of Pedro de Cieza de Leon through the Mighty Kingdom of Peru," chap. lxxxiii. p. 211 (English Translation, London, 1709).

They dry them in the sun, and then lay them in long narrow baskets, each of them holding about a quarter of a hundredweight. So highly was this Coca valued in Peru, in the years 1548, '49, '50, and '51, that I believe no plant in the world, except Spice, could equal it; for at that time most of the plantations about *Cuzco*, *La Paz*, and *La Plata* yielded some 80, some 60, some 40,000 pieces-of-eight a year, more or less, and all in *Coca*; and whoever had lands assigned him first reckoned how many baskets of *Coca* they yielded. In fine, it was more esteemed than the best wheat. They carried it to sell at the mines of *Potosi*; and so many fell to planting, that it is now much fallen in the price, but will always be valued. Several *Spaniards* got estates by buying and selling of *Coca*, or bartering for it in the Indian markets."

Nicholas Monardes,* a Spanish physician of the sixteenth century, also quotes Pedro de Cieza de Leon more fully from his Commentaries "on Peruvian Things" under the heading of Betre (Betel), "History of Aromatics," book i., with annotations:—

"This plant Coca has been celebrated for many years among the Indians, and they sow and cultivate it with much care and industry, because they all apply it daily to their use and pleasure.

"It is indeed of the height of two outstretched arms; its leaves somewhat like those of Myrtle, but larger and more succulent, and green (and they have, as it were, drawn in the middle of them another leaf of similar shape); its fruit collected together in a cluster, which like Myrtle fruit becomes red when ripening, and of the same size, and when quite ripe it is black in colour. When the time of the harvest of the leaves arrives, they are collected in baskets with other things to make them dry, that they may be better preserved, and may be carried to other places. For from their native

* "Simplicium Medicamentorum ex novo orbe delectorum quorum in Medicina usus est Historia," liber iii. Antwerp. 1582 (translated from the Latin edition of Carolus Clusius). I have been unable to refer to the original "History of Aromatics" by Cieza, and corroborate the statements here made in regard to mastiche, tobacco, and oyster shells.

mountains they are carried to other mountainous parts for the sake of trade, and are exchanged for other goods, such as clothes and flocks, salt and other articles, which stand to these people in the position of money. The seed is enclosed in mastiche, and removed from thence is sown elsewhere in well-cultivated earth in drills or rows, just as we sow the pea or the bean.

"Its use for many purposes is common among the Indians, for it is a necessary to them when on a journey, and they also use it when in their homes for their enjoyment, and in this manner—they burn the shells of oysters and other shells, and thus make the lime into a powder, then they grind up the Coca leaves with their teeth, this they mix with the powder of the burnt shells, and thus mingle both at once, but the quantity of lime, however, must be less than the amount of leaf; from this mass they prepare small balls or lozenges, and expose them to dry.

"When they require to use these, thay take one little ball into the mouth, and suck it, turning it now this way now that way as long as they can retain it: one being consumed, they take another, and then a third, proceeding thus the whole time they have need during their long journeys, especially if they are in neighbourhoods where neither bread nor water are plentiful, because they assert that by this suction of these little balls their thirst is removed, and their strength preserved.

"If, on the other hand, they desire to use the Coca for the sake of enjoyment, they use it alone, turning it over and over in the mouth, until all its properties are exhausted, then they take more. But, if their purpose is to be inebriated, or to be taken to some extent out of themselves as if by mental alienation, they mix the leaves of Coca with those of Tobacco, and chew and suck them simultaneously; by this means they find themselves with their reason lost to them, and are like drunken men, and they experience thence very great pleasure. Wonder at this matter is not wanting, when these Indians are observed to be in this state of delight and deprivation of mind and sense, for they do indeed use Tobacco and Coca together for this purpose, or even Tobacco alone, as we describe in the second volume of this history."

Augostin de Zarate* says:—

"In certain valleys, among the mountains, the heat is marvellous, and there groweth a certain herb called Coca, which the Indians do esteem more than gold or silver; the leaves thereof are like unto Zumake (sumach), the virtue of this herb found by experience is that any man having these leaves in his mouth hath never hunger nor thirst."

Joseph Acosta,† the Jesuit, describes the use of Coca by the natives of Peru, and says:—

"For my part, and to say the truth, I am persuaded that it is not pure imagination; but, on the contrary, I hold that it gives strength and courage to the Indians; for one sees the effects of it, which cannot be attributed to imagination, as in travelling without food during many days with a handful of Coca and other similar agents."

CHAPTER II.

SUPERSTITIONS IN REGARD TO COCA.

THE employment of Coca as a masticatory goes back to the time of the first Incas, being used in their religious rites as an offering to the sun; the sacrificing priest never consulted the oracles without holding some Coca leaves in his mouth, and throwing some into the fire which consumed the victims. It was reserved for this use and that of the monarch, and those who for services rendered had become worthy of the honour of partaking of it with their sovereign.

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* "Strange and delectable history of the Discovery of Peru" (translated by T. Nichols, 1581, from the Spanish of 1555, book i. chap. viii.).

† "Natural History of the Indies," (translated into Latin by R. R. Cauxois, 1600) from the Spanish of 1590, book v. chap. xxii.

Von Tschudi* says :—"By the Peruvian Indians the Coca plant is regarded as something sacred and mysterious, and it sustained an important part in the religion of the Incas. In all ceremonies, whether religious or warlike, it was introduced for producing smoke at the great offerings, or as the sacrifice itself.

"During divine worship the priests chewed Coca leaves, and unless they were supplied with them, it was believed that the favour of the gods could not be propitiated. It was also deemed necessary that the supplicator for divine grace should approach the priests with an *acullico* (or quid) in his mouth. It was believed that any business undertaken without the benediction of Coca leaves could not prosper, and to the shrub itself worship was rendered. During an interval of more than three hundred years Christianity has not been able to subdue this deep-rooted idolatry, for everywhere we find traces of belief in the mysterious powers of this plant. The excavators in the mines of Cerro de Pasco throw chewed Coca on hard veins of metal, in the belief that it softens the ore and renders it more easy to work. The origin of this custom is easily explained, when it is recollected that in the time of the Incas it was believed that the *Coyas* —the deities of metals—rendered the mountains impenetrable if they were not propitiated by the odour of Coca. The Indians, even at the present time, put Coca leaves into the mouths of dead persons, to secure to them a favourable reception on their entrance into another world; and when a Peruvian Indian on a journey falls in with a mummy, he, with timid reverence, presents to it some Coca leaves as his pious offering."

The reliance, Pöppig says, on its extraordinary virtues among the Peruvian Indians is so strong that, in the Huanuco Province, they believe that if a dying man can taste a leaf placed on the tongue, it is a sure sign of his future happiness.†

After the Spanish conquest the cultivation of Coca

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* Travels in Peru, 1838 to 1842, pp. 454. London: 1847.
† Quoted in Markham's Travels in Peru and India. London. 1862.

much increased for a time, as described by Pedro de Cieza and Garcilasso de la Vega, the Inca historian (who spells its name as Cuca); the latter and Acosta exalted its virtues, yet some fanatics proposed to proscribe its use, and root up the plants, because they had been used in the ancient superstitions, and their cultivation took the Indians away from their other work. The reverence rendered by the natives to it induced the Spaniards to believe that it possessed some demoniacal influence. "The second Council of Lima, consisting of bishops from all parts of South America," therefore "condemned the use of Coca in 1567. Coca was described 'as a worthless object, fitted for the misuse and superstition of the Indians;' and a royal decree of October 18, 1569, expressly declares that the notions entertained by the natives is an illusion of the devil." In addition, numerous complaints were made to the home government, who espoused the cause of the Indians, who had been driven from the high Andes and employed by forced labour in its cultivation in the Cocals, situated on moist, warm slopes. This was a change of climate which to them proved fatal to their health. The Peruvian mine owners were the first to discover the importance of the *chacchar* (Coca-chewing), in assisting the Indians to go through their excessive labour, and they, together with the plantation owners, became the most earnest defenders of Coca. The consequence was that in defiance of royal and ecclesiastical ordinances (like tobacco after King James's "Counterblast") its use rather increased than diminished. One of the warmest advocates of the plant was the Jesuit Don Antonio Julian, who in a work entitled "Perla de America," laments that Coca is not introduced into Europe instead of tea and coffee. "It is," he observes, "melancholy to reflect that the poor of Europe cannot obtain this preservative against hunger

and thirst; that our working people are not supported by this strengthening plant in their long-continued labours."

Under Don Francisco de Toledo, Viceroy of Peru, the cultivation continued, on the condition of only voluntary and well-paid labourers being employed in cultivating it. At this period of its prosperity, which is much exceeded at the present day in the mines of Cerro de Potosi alone, Dr. Weddell, the quinologist, says it was consumed to the extent of one million kilogrammes (2,204,860 lb. Eng.) annually. But after this the culture of Coca greatly decreased, as, owing to the hardships endured by the Indians tending its growth and other occupations, their race suffered a great depopulation.

CHAPTER III.

COCA IN LITERATURE.

Coca has not been official in any but the last Codex, and last United States and British Pharmacopœias, and although mentioned by Guibourt and tried upon himself by Sir Robert Christison (see p. 51), it is not mentioned by such pharmacologists as Quincy, Pereira, or Hanbury. As a theme for the poet, Milton, who drew many of his similes from tropical plants and scenery, appears not to have known of it, as he does not mention it. Abraham Cowley, later, in his Book V. of Plants, makes Bacchus fill Omelichilus* "a bowl with juice from grape," but

* "An American Godling;" the names of others follow.

"He unaccustom'd to the acid Juice
Storm'd and with blows had answer'd the Abuse,
But fear'd t'engage the *European* Guest,
Whose Strength and Courage had subdu'd the *East*.
He therefore chooses a less dang'rous Fray,
And summons all his Country's Plants away:
Forthwith in decent Order they appear,
And various Fruits on various Branches wear.
Like *Amazons* they stand in painted Arms,
Coca alone appear'd with little Charms,
Yet led the Van, our scoffing Venus scorn'd
The shrub-like tree, and with no Fruit adorn'd,
The *Indian* Plants, said she, are like to speed
In this dispute of the most fertile Breed,
Who choose a *Dwarf* and Eunuch for their head;
Our Gods laugh'd out aloud at what she said.
Pachamama defends her darling Tree,
And said the wanton Goddess was too free;
You only know the fruitfulness of Lust,
And therefore here your judgment is unjust,
Your skill in other off-springs we may trust,
With those Chast tribes that no distinction know
Of Sex, your Province nothing has to do.
Of all the Plants that any Soil does bear,
This Tree in Fruits the richest does appear,
It bears the best, and bears 'em all the year.
Ev'n now with Fruits 'tis stor'd—why laugh you yet?
Behold how thick with Leaves it is beset,
Each Leaf is Fruit, and such substantial fare,
No Fruit beside to rival it will dare.
Mov'd with his Country's coming Fate (whose Soil
Must for her Treasures be exposed to spoil)
Our *Varicocha* first this *Coca* sent,
Endow'd with Leaves of wond rous Nourishment,
Whose Juice Succ'd in, and to the Stomach tak'n
Long Hunger and long Labour can sustain;
From which our faint and weary Bodies find
More succour, more they cheer the drooping Mind,
Than can your *Bacchus* and your *Ceres* join'd.
Three Leaves supply for six days march afford.
The *Quitoita* with this Provision stor'd
Can pass the vast and cloudy Andes o'er,
The dreadful *Andes* plac'd 'twixt Winter's store
Of Winds, Rains, Snow, and that more humble Earth,
That gave the small but valiant *Coca* Birth;
This Champion that makes war-like *Venus* Mirth.
Nor *Coca* only useful art at home,
A famous Merchandize thou art become;
A thousand *Paci* and *Vicugni* groan,
Yearly beneath thy Loads, and for thy Sake alone
The spacious World's to us by Commerce known.
Thus spake the Goddess, (on her painted Skin
Were figures wrought) and next calls *Hovia** in,

* I have not been able to identify this plant; if intended to be anything more than a creature of the poet's imagination, it probably yielded a sedative drug known two centuries ago, which is now lost to us.

That for its stony Fruit may be despis'd,
But for its Virtue next to *Coca* priz'd
Her shade by wondrous Influence can compose,
And lock the Senses in such sweet Repose,
That oft the Natives of a distant Soil
Long Journeys take of voluntary Toil,
Only to sleep beneath her Branches' shade:
Where in transporting Dreams entranc'd they lye,
And quite forget the *Spaniards'* Tyranny."

CHAPTER IV.

ACCOUNTS OF MODERN TRAVELLERS.

All the mountain Indians,* Von Tschudi states, are addicted more or less to the practice of masticating Coca. Each man consumes, on an average, between an ounce and an ounce and a half per day, and on festival days about double that quantity. The owners of mines and plantations allow their labourers to suspend their work three times a day for the *chacchar* or masticating operation, which usually occupies upwards of a quarter of an hour; and after that they smoke a paper cigar, which they allege crowns the zest of the Coca mastication. The Coca leaves, he says, are taken deliberately one by one, stillness and repose being indispensable to their full enjoyment. No urging of the traveller will interrupt the Indian in this meal,—the servant would leave his master if prohibited the use of Coca—he would rather miss food. In a state of silent abstraction the leaves are first masticated into a small ball or *acullico*, a thin slip of damp wood is then thrust into the *ishcupuru* or gourd, and when drawn out, some portion of the powdered lime adheres. The *acullico*, or ball of masticated Coca leaves, is whilst still lying in the mouth, punctured with this slip of wood, until the lime mixing with it (setting free its alkaloid), gives it a proper

* Travels in Peru, by J. J. Von Tschudi. London: 1847, p. 450.

relish, and the abundant flow of saliva thus excited is partly expectorated (? see Weddell, p. 19) and partly swallowed. When the ball ceases to emit juice, it is thrown away, and a new one is formed by the mastication of a fresh mouthful of Coca leaves. In Cerro de Pasco, and in places still farther south, the Indians use instead of unslaked lime a preparation of the pungent ashes of the Quinoa (*Chenopodium Quinoa*, L.) This preparation is called Llucta or Llipta. In using it a piece is broken off and masticated along with the *acullico*. In some regions the Llipta is made from the Musa root.

The Indians maintain that Coca is the best preventive of that difficulty of respiration felt in the rapid ascents of the Cordilleras and the Puna. "Of this fact," says Von Tschudi,* "I was fully convinced by my own experience. I speak here, not of the mastication of the leaves, but of their decoction taken as a beverage."

"When I was in the Puna, at the height of fourteen thousand feet above the level of the sea, I drank always before going out to hunt, a strong infusion of Coca leaves. I could then, during the whole day, climb the heights and follow the swift-footed wild animals, without experiencing any greater difficulty of breathing than I should have felt in similar rapid movements on the coast. Moreover I did not suffer from the symptoms of cerebral excitement or uneasiness which other travellers have experienced. The reason perhaps is, that I only drank the decoction on the cold Puna, where the nervous system is far less susceptible than in the climate of the forests beneath. However I always felt a sense of great satiety after taking the Coca infusion, and I did not feel a desire for my next meal until after the time at which I usually took it."

He also says:—

"A cholo of Huari, named Hatan Huamang, was employed by me in very laborious digging. During the five days and nights he was in my service he never tasted any food, and took only two hours' sleep each

* Op. cit. p. 454.

night. But at intervals of two and a half or three hours he regularly chewed about half an ounce of Coca leaves, and he kept an *acullico* continually in his mouth. I was constantly beside him, and therefore I had the opportunity of closely observing him. The work for which I engaged him being finished, he accompanied me on a two days' journey of twenty-three leagues across the level heights. Though on foot, he kept up with the pace of my mule, and halted only for the *chacchar*. On leaving me, he declared he would willingly engage himself again for the same amount of work, and that he would go through it without food, if I would but allow him a sufficient supply of coca. The village priest assured me that this man was sixty-two years of age, and that he had never known him to be ill in his life."

In this account we cannot but conclude that the traveller's credulity was imposed upon. He further adds:—

"Setting aside all extravagant and visionary notions on the subject, I am clearly of opinion that the moderate use of Coca is not merely innoxious but that it may even be very conducive to health." He instances cases "by no means singular," of longevity among the Indians of individuals who had attained the great age of 130 years, under its use.

Pöppig* says the average yield of a Cocal or Coca plantation is about 800 lb. of dry leaves per English acre. When nearly dry, he says, they emit an odour similar to mellilot, or the new-mown hay odour of *Anthoxanthum odoratum* (probably due to Coumarin). which causes headache to strangers. If not perfectly dry when packed they heat and ferment, they become inert and useless (especially to the manufacturer of Cocaine. W.M.).

Both Pöppig and Von Tschudi give a doleful account of the intemperate use of Coca by the inveterate *coquero*, as he is called,—his bad breath, pale lips and gums;

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*Companion to *Bot. Mag.*, 1835, i. 161, translated from "Reise in Chile, Peru und auf dem Amazon Ström, 1827 to 1832."

greenish and stumpy teeth, and an ugly black mark at the angles of his mouth, his unsteady gait, yellow skin, dim and sunken eyes encircled by a purple ring, his quivering lips, and his general apathy,—all bear evidence of the baneful effects of the Coca juice when taken in excess. He prefers solitude, and, when a slave to his cravings, he will often take himself for days together to the silence of the woods to indulge unrestrained the use of the leaf. The habit must be very seducing, as, though long stigmatised and very generally considered as a degrading purely Indian vice, many white Peruvians at Lima and elsewhere retire daily at stated times to chew Coca. Even Europeans, Von Tschudi says, have fallen into the habit. Both he and Pöppig mention instances of *white coqueros* of good Peruvian families who were addicted to the vice. One is described by Pöppig who became averse to any exertion; city life and its restraints were hateful to him; he lived in a miserable hut. Once a month, at least, when irresistibly seized with the passion he would disappear into the forest, be lost for many days, after which he would emerge sick, powerless, and altered.

"He was of use to me," he says, "as a good and eager sportsman, and by liberally supplying him with such fine gunpowder as he could not obtain by purchase, I soon gained his perfect confidence and goodwill. His disposition was generally kind, but any remonstrance against his vice would throw him into an ungovernable rage. He has frequently assured me in confidential moments that he would rather, as he has done for months together, live alone in the midst of some Coca shrubs in the most solitary spot in the wilderness, depending for support on his fishing line and gun than return home to his family at Huanuco. His descriptions of the lovely visions that appeared to him in the forest at night, and of his delicious sensation at such moments, had in it something truly awful. When it rained he used to cover his half-naked body with the soddened leaves that had fallen from the trees, and he assured me that when this wretched substitute for raiment was brought to steam by

the warmth of his person, that he could lie thus enveloped for hours without experiencing inconvenience or cold."

Such isolated cases, in some respects at least parallel as inveterate drunkards, are occasionally met with in this country. *Coqueros* become afflicted with a peculiar disease. Pöppig says:—"The natives of the cold and dry districts of the Andes are more addicted to the consumption of Coca than those of the close forests, where, undoubtedly, other stimulants do but take its place. Weakness in the digestive organs," . . . "increasing continually in a greater or less degree, first attacks the unfortunate *coquero*. This complaint, which is called *opilacion*, may be trifling in the beginning, but soon attains an alarming height. Then come bilious obstructions, attended with all those thousand painful symptoms which are so much aggravated by tropical climate. Jaundice and derangement of the nervous system follow, along with pains in the head, and such prostration of strength that the patient speedily loses all appetite; the hue of the whites assumes a leaden colour, and a total inability to sleep ensues, which aggravates the mental depression of the unhappy individual, who, spite of all his ills, cannot relinquish the use of the herb to which he owes his sufferings, but craves brandy in addition. The appetite becomes quite irregular, sometimes failing altogether, and sometimes assuming a wolfish voracity, especially for animal food. Thus do years of misery drag on, succeeded at length by a painful death."

Later, Dr. Weddell, however, who travelled where Coca was most in use, saw no results from its use at all bearing comparison with these just narrated. He gives the following interesting detailed account of the growth, cultivation, and use of Coca from personal observation.

CHAPTER V.

DR. WEDDELL'S ACCOUNT.*

"The cultivation of *Erythroxylon Coca*, as carried on in Bolivia in the present day, does not appear to differ from that which prevailed previous to the conquest; and the province of Yungas de la Paz is that which, since the Spanish occupation, seems to have supported the most considerable plantations. All the slopes of the mountains, below an elevation of 2,200 mètres [7,217 feet], are literally covered with them, and the traveller has continually in view the factories or *haciendas* where the leaf is prepared for the purposes of trade.

"The *Coca* shrub is propagated from seed. For this purpose the seeds, immediately after gathering, are scattered on the surface of the light and frequently watered soil of a little nursery (*almaciga*), where they come up generally at the end of ten or fifteen days. The waterings are continued, and, should the sun strike the young plants too violently, they are sheltered with mats.

"The following year the shrubs, whose height is already from 40 to 50 centimètres [16 to 20 inches] are transplanted into a plot of ground specially prepared for them and called a *cocal*. The arrangement of these plantations is much more complicated than that of an ordinary plantation, and varies according to the inclination of the surface. When the *cocal* occupies the slope of a mountain, which is the usual case, the cultivator forms a series of narrow steps, each intended for a single row of shrubs, and the more elevated (consequently, the less numerous) as the surface is more steep. They are generally supported by little stone walls, which serve not merely to contain the earth and prevent its drying, but also to protect the stem and roots of the

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* *Pharm. Journ.* 1854, pp. 162–4, 213–5, translated from Dr. Weddell's "Voyage dans le nord de la Bolivie." Paris: 1853, 8vo. ch. xx x.

young shrubs from the too direct influence of the solar rays, by means of the projection which they form above the level of the soil.

"Where the ground is level, they make, instead of steps or terraces, simple furrows (*uachos*) in a straight line, and separated from one another by little walls of well-moulded earth, called *umachas*, at the foot of each of which is planted a row of the shrubs, more or less far apart from each other.

"At the end of a year and a half the plant affords its first crop, and from this period to the age of forty years or more it continues to yield a supply. Instances are cited of *Coca* plantations which have existed for nearly a century, and which still produce. Nevertheless, the greatest abundance of leaves is obtained from plants of from three to six years of age. When the trees run up too much, the produce is less than when they spread; they are therefore pruned in some cases to favour an increase in breadth, which, however, is never considerable, as the form of the shrub is irregular. The average height of the wild plant appears to be about 2 mètres, but in cultivation it is generally allowed to attain but 1 mètre [39 inches].

"The first gathering which takes place in a Coca plantation is at the expense of only the lower leaves of the shrubs, and it is therefore called *quita calzon*.* The leaves of which this gathering consists are larger and more coriaceous than those of subsequent collections, and also have less flavour. They are mostly consumed on the spot. All the other gatherings go by the name of *mitas*, and take place three times, or exceptionally, four times, per annum. The most abundant harvest is that occurring in March, that is, immediately after the rains; this is the *mita de marzo*. The most scanty is that which takes place at the end of June or beginning of July, and which is called *mita de San Juan*. The third, named *mita de Santos*, is made in October or November.

"The watering of the Coca plantations greatly increases their productiveness. Forty days are then sufficient, I have been told, for naked shrubs to become covered with new leaves; but these leaves are not equal in their pro-

* From *quitar*, to take away, and *calzon*, pantaloon.

perties to those produced without irrigation; their colour also is less deep, and they frequently blacken in drying. Artificial watering is needful, moreover, only during the dry season, and the cultivators who have the means of employing it realise nearly always four, and sometimes even five, crops in the year. This is particularly the case in the districts of Irupana, where there are facilities for obtaining water that do not exist elsewhere.

"I have examined the soil in which *Coca* is cultivated, and almost everywhere have found it composed of sandy, argillaceous earth, softish to the touch; it originates in the decay of the schists which form the chief geological feature of these mountains. The soil of the Coca plantation is, in one word, formed of what we call primitive or normal earth, but it is naturally mixed with an abundance of angular fragments of unaltered schist which, if not removed, would interfere with the growth of the roots. This is therefore done by the cultivator while preparing the furrows for the reception of the shrubs, the stones being employed for the little walls before spoken of; indeed these little walls, or *umachas*, are often formed entirely of the stones thus met with. I need hardly say that it is to the greater or less perfection to which this preliminary operation is carried, and to the labours incurred subsequently in stirring up the soil from time to time, and in keeping it free from weeds, that the *haciendero* owes the abundance of his crops. The last operation I have mentioned, is especially needful while the shrubs are young. The weeding, which is regularly performed after each crop has been collected, is called *mazi*.

"The collection of the leaves of the *Erythroxylon* is performed much in the same way as that of tea. It is, in general, women and children that are employed upon this operation, which is all the easier from the presence of the little walls separating the furrows of the plantation. The gatherer squats down, and, holding with one hand the branch she wishes to pluck, removes with the other all the leaves, often one by one. The leaves are deposited in a cloth, which each Indian carries with her, and afterwards collected in sacks or some other recipients to be carried from the plantation.

"Nothing is now easier than the preparation of the *Coca*. The leaves are carried from the plantation to the house, or *casa de hacienda*, where they are spread out in the sun, in little courts constructed especially for the purpose, and the floors of which are formed of slabs of black schist (*pizara*); if the weather is fine, they are left there until completely dry, which takes place without their shape becoming altered. They are then packed with strong pressure into bags made of the sheath of the banana leaf, strengthened with an outer covering of coarse woollen canvas. The bales thus formed contain, on an average, twenty-four pounds of leaves and go by the name of *cestos*. The *tambor* is a a bale of double the size of the *cesto*, whose price at La Paz varies from 4½ to 6 piastres" (18s. to 24s.)*

"The Peruvian ordinarily keeps his Coca in a little bag called *chuspa*, which he carries suspended at his side, and which he places in front whenever he intends to renew his *chique*, which he does at regular intervals, even when travelling. The Indian who prepares himself to *acullicar*, *i.e.* to chew, in the first place sets himself as perfectly at ease as circumstances permit. If he has a burden, he lays it down; he seats himself; then, putting his *chuspa* on his knees, he draws from it one by one the leaves which are to constitute his fresh 'quid.' The attention which he gives to this operation is worthy of remark. The complaisance with which the Indian buries his hand in the leaves of a well-filled *chuspa*, the regret he seems to experience when the bag is nearly empty, deserve observation; for these little points prove, as I shall have occasion to repeat further on, that to the Indian the use of Coca is a real source of enjoyment and not the simple consequence of want.

"As the Indian deposits the leaves in his mouth he wets them by turning them over with the tongue, forming them into a sort of little ball, which he places against the

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* As it is easily damaged by damp in transit, the only absolute security is to have it soldered in tin or zinc, enclosed in wood, such packages generally contain two tambores, or about a Spanish quintal of 100 pounds. Although shipped from many ports along the whole coast, the principal port in Peru seems to be Salaverry, the port of entry to Truxillo, and the principal port for Bolivia is Arica, Mollindo being now closed by the civil war in Peru.—Squibb's 'Ephemeris," ii.792.

cheek as a sailor does his tobacco. This done, he takes from his *chuspa* a little box which generally accompanies the Coca, and removes from it a very small quantity of an alkaline paste, called *llipta*, which is the ordinary condiment to the leaf. The *llipta* which the Peruvians, and especially the Bolivians, are in the habit of using, is made of the ashes of the *Quinoa* (*Chenopodium Quinoa*) or of those of the common *Cereus*. The ashes of several other plants, however, are used for the same purpose, they are often sold in the markets in the form of little flat cakes. In some parts of America lime is substituted for them.

"From the constancy with which the Indians employ an alkali with the Coca, one might presume that it favours the solution of the active matter of the leaf; but on this head we know nothing positive. Others have said that the *llipta* was intended to neutralise the acid of the leaf; but it is easy to convince oneself that the Coca contains no principle of this nature in appreciable quantity.

"The leaves of the *Erythroxylon* approach in shape and size those of tea, but they have never the dentated margin; on the under side, a prominent and curved line on each side of the mid-rib serves to distinguish them from most other leaves known. When dried well, they are of a very pale green, deeper on the upper than on the under side; their odour is then agreeable, and even analogous to that of tea. When, on the contrary, the Coca has been dried less perfectly, this agreeable aroma is hardly perceptible, or rather is overpowered by a pungent odour, *sui generis*, recalling the abominable smell exhaled by the breath of the masticators of Coca, which is, in fact, this odour in a concentrated state. This *bouquet*, if I may so term it, is very perceptible on tasting the Coca, and serves, according to its abundance, in indicating its quality. On the other hand, in a concentrated infusion, and still more so in a decoction, it is a bitterness mixed with something styptic that more particularly strikes the palate.

"As to the immediate physiological effects of this infusion, frequently-repeated trials enable me to assert that they are in general limited to a slight excitement, succeeded in most cases by some degree of sleeplessness.

"The questions relative to the effects resulting from

the use of Coca are less easily determined; we may begin, nevertheless, by stating that an immense majority of authors, both ancient and modern, who have written on the subject, have agreed in attributing to the Coca-leaf thus employed, virtues whose well-ascertained existence would warrant it being placed among the more beneficial products of the vegetable kingdom; and such would doubtless remain the admitted opinion, had not a modern traveller (Pöppig) completely shaken it by supporting an opposite view, that is to say, in attributing to Coca very pernicious effects, comparable, in fact, to those brought about by the excessive use of opium.

"Such assertions, in the presence of reports so opposite as those I have cited, may well cause some astonishment. Individuals are, however, not wanting, who give us to understand that, if this traveller had not trusted too implicitly to the accounts of ill-informed persons, he had erred, at least, in too much generalising exceptional facts. For my part, I may say, that the researches that I have been able to make on the subject, in localities where the Coca is most in use, have shown me that the mastication of the leaf does sometimes produce evil consequences among Europeans who have not accustomed themselves to it from youth; and, in two or three cases, I have thought I could attribute to the abuse of this practice a peculiar aberration of the intellectual faculties indicated by hallucinations. But, in the countries which I have visited, on no occasion have I seen the results to reach the point instanced by M. Pöppig.

"Let us now examine what are the beneficial properties attributable to Coca. Of these the most remarkable is undeniably its reputed power of sustaining the strength in the absence of any other nutriment. The facts on which this opinion rests have been asserted by so many credible persons, that scepticism must be carried very far to throw over it a doubt; it appears to me, however, that opinions may vary according to the interpretation of the same facts.

"One of two things is certain, either the Coca contains some nutritive principle which directly sustains the strength, or it does not contain it, and therefore simply *deceives* hunger, while acting on the system as an excitement.

"As to the existence of a nutritive principle in Coca, I

am far from wishing to deny it; analysis, indeed, shows the existence in the leaf, and especially in its active principle, of a notable quantity of nitrogen together with assimilable carbonised products; but the proportion of these substances is so small compared with the total mass of the leaf, and especially with the quantity of it that the Indian consumes in a given time, that they can hardly be taken into consideration. Moreover, I can affirm very positively that Coca, as it is taken habitually, does *not* satiate hunger. This is a fact of which I have convinced myself by daily experience. The Indians who accompanied me on my journey chewed Coca during the whole day; but, evening arrived, they filled their stomachs like fasting men, and I am certain I have seen one devour as much food at a single meal as I should have consumed during two days. The Indian of the Cordillera is like the vulture of his mountains; when provisions abound, he gorges himself greedily; when they are scarce, his robust nature enables him to content himself with very little. The use of Coca assists, it may be, to support the abstinence; but we must have cases far more conclusive than those which I have witnessed to convince me that it plays a part more important than that which I attribute to it. I will, however, add to what I have before said of the *llipta*, that this alkaline substance may also contribute, by its direct influence on the secretions of the stomach, to allay the requirements of that organ.

"The action of Coca is then, in my opinion, confined to an excitement, but an excitement of a peculiar kind, which I consider as very different from that resulting from the use of most of the ordinary excitants, and especially of alcohol. Brandy gives strength, as all know; but who does not know also that the 'gift' is but a *loan* made out at the expense of strength reserved for the future? The action of this agent, though powerful, is transient. The stimulus produced by mastication of the leaf of the *Erythroxylon* is, on the contrary, slow and sustained, characters which it owes, doubtless, in great part to the manner of its employment, since an infusion of Coca acts very differently from the leaf taken in the ordinary way. It will be said that tea and coffee, whose effects appear to have more analogy with those of Coca, would perhaps produce analogous results if taken in the same manner. I do not believe such would be the case.

Tea and coffee (coffee in particular) act specially on the brain, on which they produce an antisoporific effect, but too well known to those who are not in their habitual use. But Coca, while producing a little of this effect, when taken in large doses, as I have often experienced in my own person, does not act perceptibly upon the brain in small doses. To account for the ordinary effects of the leaf, one must then suppose that its action, instead of being localised, as in the case of tea and coffee, is diffused, and bears upon the nervous system generally, producing upon it a sustained stimulus, well suited to impart to those who are under its influence that support which has been erroneously attributed to peculiar nutritive properties.

"Finally, I think that in the fidelity of the Indian to the use of Coca, as with some smokers and their pipes, much is due to habit; and it is, I think, essential not to lose sight of the fact, that the force of habit must have an influence all the more powerful, since the habit in question is almost the only one he retains of past times, and that now, as then, he attaches to the use of the Coca-leaf superstitious ideas, which, to his imagination, must at least treble the greatness of the benefits he derives from it. Lastly, that in the mastication of Coca he finds the sole distraction that breaks the incomparable monotony of his existence."

Dr. Weddell supposes that the word *Coca* comes from the Aymara (Indian) *Khoka*, signifying *the tree* or *plant*, just as the shrub producing Paraguay Tea (*Ilex Paraguariensis*) is called *la Yerba*, i.e., *the plant*. Botanical specimens were first sent by Joseph de Jussieu to his brother in 1750; these Antoine Laurent de Jussieu referred to the genus *Erythroxylon*, and finally they served as types for Lamarck to give the plant his designation, *Erythroxylon Coca*, in the *Encyclopédie Méthodique*.

CHAPTER VI.

SCHERZER, FUENTES, AND OTHERS, ON COCA.

Carl Scherzer, who brought the supplies to Europe from which Niemann and Lossen under Wöhler first isolated Cocaine, narrates the following:*—

"A Scotchman named Campbell, who was settled as a merchant at Tacna in Bolivia, and with whom I travelled to Europe from Lima, informed me that a few years before, being engaged upon matters of urgent business, he had performed in one day a distance of 90 English miles on mule-back, and throughout that long distance had been accompanied by an Aymara Indian, who kept up easily with the mule, without other refreshment than a few grains of roasted maize and Coca leaves, which, mingled with undissolved chalk (? slaked lime), he chewed incessantly. On reaching the station where he had to pass the night, Mr. Campbell, though mounted on an excellent animal, found himself greatly fatigued; the guide, on the other hand, after he had stood on his head for a few minutes,† and had drunk a glass of brandy, set off without further delay on his homeward journey!"

"In April, 1859, Mr. Campbell despatched a native from La Paz to Tacna, a distance of 249 English miles, which the Indian accomplished in four days. He rested one day at Tacna, and set off the following morning on his return journey, in the course of which he had to cross a path 13,000 feet in height. It would seem that, throughout the whole of this immense journey on foot, he followed the Indian custom of taking no other sustenance than a little roasted maize and Coca leaves, which he carried in a little pouch at his side, and chewed from time to time.

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* "The Voyage of the Novara," by Carl Scherzer, vol. iii. p. 402, London, 1863.

† A custom, Scherzer says, of these Indians after long and fatiguing marches, which seems to be the result of an instinct, and teaches them how best to mitigate the pressure of the blood.

"The mail goes four times a month from La Paz to Tacna, and usually weighs 25 lb., which the courier carries on his back, and delivers within some five or six days, without other nourishment than that already specified."

According to Senor Fuentes,* "the incontestable facts which experience affords as to the virtues of Coca may be divided into two classes, those relating to healthy persons, and those concerning ailing or sickly individuals. It has been admitted that the Indians of the mountains, who among the natives of Peru are most given to the use of Coca, are those who endure the hardest labour, such as:—

"1. Mining operations. The mines are almost all situated in the coldest parts of the Cordilleras. There the Indians work night and day, the pickaxe or the shovel in their hand, to detach the minerals, which they carry on their shoulders through long and deep subterraneau passages, or they stamp with their feet masses of mineral from which they have to extract the metal. All the rest they get during this incessant toil is to lie down, turn by turn, on a skin covered with a poncho to snatch a few moments of repose, and to chew their portion of Coca leaf.

"2. The postal service. Bearing a case of letters on their shoulders, they may be seen undertaking with celerity journeys of hundreds of miles, traversing, to shorten their route, deserts and rugged Cordilleras. These unfortunate Indians suffer from all the injuries of the rarified air, which exercises a most severe effect on a half naked-man, obliged to traverse the rocks and deserts of the sierras or mountainous regions. His only shelter and chance of repose, when snow-storms surprise him or fatigue overcomes him, is to take refuge in some cavern or under some projection of rock, where, reclining on the frozen ground, he snatches a few hours of sleep.

"3. The occupation of shepherd. The Indian generally pastures his wool-bearing animals of the alpaca tribe on the bleak pampas, which produce scarcely anything but

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* *Chemist and Druggist*, 1876, p. 155. Notes on Coca Leaf, by P. L. Simmonds, abstracted from "Mémoire sur le Coca de Pérou." Par Manuel A. Fuentes (de Lima).

a coarse kind of grass, called locally 'hichu.' The rigour of the climate renders these mountain shepherds as black as Ethiopians.

"4. Irrigation. When the Indians are obliged to water their fields during the night, in the middle of the rigours of winter, and on the most elevated plateaux, they are often many hours knee-deep in water, and exposed like their comrades to the cutting blast of a cold and penetrating wind.

"For resisting all these fatigues and the inclemencies of the seasons, the Indians have no other food than a handful of maize, a few potatoes, and their pouch of Coca leaves. They never eat flesh unless it is given them, which is rarely, as they respect the lives of their flocks as their own.

"Dr. Ignacio Flores having seen an Indian of the tribe of the Canaris, who was employed in the postal service between Chuquisaca and La Paz in Bolivia, that is a distance of over 100 leagues, with no other provision with him than a few grains of roasted maize, a few cakes of chuno, or frost-dried potatoes, not weighing together two pounds, and his bag of Coca leaves, declared that there was not a monk or hermit in the world so austere or abstinent. This frugality, and this hardihood to fatigue, the very recital of which makes one shudder, have been attributed by many not to the use of Coca, but to the training and education, as it were, of the Indians. This assertion, however, may be easily rejected by having regard to the following facts:—

"1. The Indian has naturally a voracious appetite whenever he is brought into contact with any one generous enough to feed him.

"2. A great many Spaniards, who could not support the labour of the mines and the inclemency of the Cordillera, having taken to the regular use of Coca, have forthwith acquired the Herculean force of the Indians.

"3. When the natives give up the use of Coca, and change their ordinary food system, they lose that ancient vigour and power which enabled them to resist fatigue and the inclemency of the weather.

"4. Notwithstanding the rigorous prevention of the use of Coca in Tucuman, the habit of chewing the leaf is clandestinely practised, because it is alone found to give to the muleteers the power of resisting the rigours

of the icy plateaux of Lipes, and of prolonged night watches to prevent the mules they are transporting to Peru from straying.

"5. During the prolonged siege which the rebel Indians carried on in 1781 against the town of La Paz in Bolivia, the inhabitants had no other food left than leather, unclean animals, &c., and having to watch at night in the trenches during a rigorous winter to repulse the attacks of the Indians, a great many took to the use of Coca, as the only means of averting this horrible famine.

"Passing now to the beneficial effects of Coca on the sick and invalid, facts which, Senor Fuentes asserts, experience has confirmed. It is said to strengthen the gums and preserve the teeth. Taken in the form of an infusion, like tea, it excites perspiration and soothes those who suffer from asthma. Taken either in infusion or chewed, it assists the functions of the stomach, removes obstructions, and cures gripes or colic. Applied externally in friction or plasters, it allays rheumatic pains caused by the cold.

"Our author further asserts that it cures intermittent fevers in the dose of a teaspoonful of sulphate of cocaine (?), and is a protection against syphilis. This last allegation is probable, seeing that an Indian is rarely met with afflicted with venereal diseases, so common among whites and negroes."

In Western Brazil a preparation of the Coca leaf in powder is known as Ypadú or Ipadú. Martius says * "the powder of the dried leaves is notable from its wonderful effect on the nervous system, especially on the brain, as has been lately observed, and it should be received into the treasures of materia medica."

By R. Spruce,† Ipadú is described as he saw it used on the banks of the Rio Negro, an affluent of the Amazon; the powdered roasted (?) Coca leaves are mixed with a little tapioca and the ashes of Imbaúba (*Cecropia*

* "Systema Materia Medica Vegetabilis Braziliensis," by C. F. P. de Martius. Leipsic: 1843.

† "Journal of a Voyage on the Amazon and Rio Negro. Hooker's "Journal of Botany," Vol. v., 1853, p. 212.

peltata, &c.). He says:—"With a chew of Ipadú in his cheek an Indian will go two or three days" without food, and without "having any feeling or desire to sleep."

The "quid of Coca" is frequently mentioned by Squier,* a recent American traveller in Peru, but he gives no details of its cultivation or use.

Fitzroy Cole † also describes the use of Coca in terms similar to Weddell, but he confounds it with *Theobroma*, which yields Cocoa. He says:—"The incredible fatigue endured by the Peruvian infantry on very spare diet, but with the regular use of Coca, the laborious toil of the Indian miner under similar circumstances throughout a long series of years, certainly afford sufficient ground for attributing to these Coca leaves the quality, not only of a temporary stimulant, but also of a strong nutritive principle."

CHAPTER VII.

THE CULTIVATION OF COCA.‡

THE most recent account of the cultivation of Coca is given by Henry H. Rusby, M.D., who, for more than two months, has been engaged in the study of the Coca plant and its products in the districts of Bolivia which produce the best quality of leaves. He says:—

"For the details concerning cultivation here presented I am chiefly indebted to Mr. Oscar Lohse, one of the most intelligent cultivators in this country, and pro-

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* "Peru, Incidents of Travel and Exploration in the Land of the Incas." London: 1877.

† "The Peruvians at Home," by Geo. R. Fitzroy Cole. London: 1884.

‡ From the *Therapeutic Gazette* (Detroit), January, 1886, p. 14, and *Pharm. Jour.*, 1886, p. 705.

prietor of the Finca of San Antonio, two leagues from the town of Caroica, Yungas.

"The district of Caroica may be considered as fitly representing the remainder of Yungas, and Yungas as representing the principal Coca districts of this republic. The conditions of soil and climate may be briefly stated. Proceeding eastward from La Paz, itself somewhat more than ten thousand feet* above the sea, for a distance of four or five leagues, we reach the summit of the pass over the easternmost cordillera of the Andes, this cordillera having an average elevation in this immediate district of perhaps sixteen thousand feet. This ridge, always more or less snow-covered, cuts off a large portion of the westward-bound clouds, which are either precipitated in the form of rain before reaching the summit, or, arriving there, are deposited in the form of snow, and then returned by means of rivulets to the valleys, chiefly of the eastern slope. It should be noted that in Northern Peru and Ecuador this cordillera is higher than here, so that the eastern slope in those regions is more profusely and regularly watered than here. From this pass, had we a direct road, we could travel in half a day, so steep is the descent, to the banks of the Caroica River, having an altitude of only two thousand four hundred feet. When we have descended to six thousand four hundred feet we should meet with our first Coca plantations, and after passing the two thousand foot level we should have left them principally or entirely behind. Within this four or five thousand feet, then, lie the cocales of Bolivia. No description can convey a perfect idea of the steepness of this luxuriant slope. Travel, entirely by riding-animals, is extremely difficult. There are only occasional places where we can readily leave the road, and here plantations are established. The hedge of coffee-plants at the roadside proves on examination to be the uppermost row of a plantation; and as we peer down among the shrubs we marvel that anyone can preserve his footing while cultivating or collecting the coffee. The scenery is of course magnificent, and of a different type, I should think, from that of any other part

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* "I have given altitudes and measurements approximately in English feet. By the Spanish measurements the altitudes are much greater."

of the world. The mountains are too young to have lost to a great extent their ragged outline, yet softness is imparted by the richness of the vegetation. We stand among the coca-plants and distinctly see another cocal nearly four thousand feet below us.

"The cultivated plants of the coca district are coffee, rice, cacao, sugar cane, tobacco, maize, cotton (the arborescent species), sweet potatoes, yuccas, and the ordinary garden vegetables. The principal fruits are oranges, bauanas, cocoanuts, lemons (sweet and sour), citrons, grapes, chirimoyas, alligator pears, tumbas, pomegranates, grenadillas, figs, papayas, lukmas, melons, and pineapples, the last just introduced.

"The soil in such a broken country is of course very diversified, ranging from a very light decomposed shale or sandstone to a heavy blue or chiefly yellow clay.

"The rainy season begins in October, and continues until May or June. During this time the rains are copious and almost constant. During the succeeding two months there is scarcely a drop of rain, and during the next two there are only occasional showers.

"Such are the conditions under which the Coca grows in this section.

"When we come now to consider the methods of cultivation here adopted, we must be cautious about accepting them as the best, merely because they are generally followed here. It is to be remembered that the Bolivian system of agriculture has not received the attention that it should have had, and that it is very probable that reforms might be introduced in present methods.

"Nor is it proper to proceed concerning Coca-culture without a few words concerning what is meant by the 'best quality' of Coca-leaves. To a manufacturing chemist the best quality would mean the quality that would yield the largest percentage of crystallizable cocaine, obtainable in the easiest manner, while the same Coca might be considered for domestic consumption as representing one of the lower grades. It is highly probable that the amount of cocaine forms no element in the Indian's estimate of the quality of Coca, no more than the percentage of nicotine establishes the quality of a particular grade of tobacco. Coca-leaves are classed in general by the Indians as "hajas dulces" (sweet leaves) and "hajas amargas" (bitter leaves). The

former are made sweet by the abundance of alkaloids other than cocaine. While it is true that a greater abundance of those alkaloids is usually accompanied by a larger percentage of cocaine also, yet the variation in the amount of the latter is not so great as in the former; so that while in the sweet leaves the bitter taste of the cocaine is masked by the presence of the other alkaloids, in the bitter leaves its flavour is the predominant one. The presence, then, of these *sweet alkaloids*, as we may call them, translating the simple and expressive term of the Indians, determines the domestic value of the Coca, and all that is known of the best methods of cultivation is based on the production of the highest percentage of these alkaloids.* Experience may determine that for manufacturing purposes a very different line of principles of culture should be followed.

"I have made a large number of assays tending towards elevations, soils, exposures, seasons, ages of plants, and of leaves, different varieties, wild and domestic, different parts of the plant, and various modes of drying and packing. The results will be embodied in a future monograph, mere passing references being made to them for the present. I have about concluded that the percentage of the sweet alkaloids varies inversely as the amount and continuousness of moisture that the plant receives. Thus, the Peruvian, Ecuadorian, and Brazilian Coca, which, as I have stated, is much more copiously and regularly watered than the Bolivian, is markedly inferior, so that Bolivia regularly exports about one-eighth of her crop to those countries. I am inclined to think that the greater breadth and thinness of the northern leaf may be partly due to the greater water-supply and the consequent greater degree of evaporation. Again, the Indian always seeks the Coca grown at the higher elevations, where the humidity is much less and more irregular than in the districts along the rivers. We are thus obliged, for reasons to be elaborated in the future, to regard these alkaloids as preserving a sort of a balance of moisture, by which the plant stores up during the wet weather a concentrated supply of water, which may be very slowly yielded up during a time of need.

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* "It is desirable that there should be a more precise definition of the peculiarities here referred to.—Ed. Ph. J."

"Having thus chosen a high altitude, the next thing is to select a soil. A rivalry exists between a yellow clay and a hill-side soil rich in vegetable matter. My assays have yielded the best results (as to total alkaloids) from soils of the latter class, and I am inclined to think that those who prefer the former soil do so because it yields a somewhat larger crop.

"The ground for the nursery-bed is prepared during the latter part of the dry season by breaking it up very thoroughly to the depth of a foot or more. The fruits mature during the early part of the rainy season, December and January. They are red, and consist of a fleshy outer portion and a shell-like inner portion, which encloses the single seed. These people suppose that the germ cannot escape from the shell if planted in its natural condition, and they have continued for hundreds of years to deposit the seeds as soon as gathered in a shaded place, in layers an inch or more deep and covered with a thin layer of decaying leaves or similar substance. The heat generated by the decomposition of the fleshy pericarp serves to induce germination, and the embryo bursts from its bony covering. This growth unites them in from eight to fourteen days into a solid mass, which is broken up into small pieces and planted in furrows in the nursery. In this process very many of the sprouts are broken off and the plants destroyed. Mr. Lohse has adopted the plan of sowing the seeds broadcast as soon as gathered, and covering with a little earth, or, better, a layer of banana leaves or decaying vegetable matter. Germination requires from eight to twelve days longer, but all the plants are saved. In either case, a covering of brush or straw must be placed over the nursery, at first only three or four inches above the surface, and elevated to six or seven inches, as the plants grow. Usually this elevation is repeated once more.

"All this taking place during the rainy season, the plants have reached a good size before the advent of the dry weather, and so do not call for any artificial water-supply. Advantage is taken of the ensuing dry season to clear the land and prepare the ground for the new cocal. On the manner in which this is done depends much of the future well-being of the plants. The ground should be thoroughly powdered to the depth of two, and, if possible, three feet, all roots and large stones being

removed. On these steep slopes it is necessary to terrace, the terraces being supported by stone walls, the stones laid dry. The width of the terraces, according to the slope, varies from several feet, with a number of rows of plants, to much less than the height of the wall, only a single row of plants being admissible. It is here generally believed that shade tends to the production of the best quality of leaves; so the cocales are planted thickly with a small broad-topped leguminous tree related to the St. John's bread, but whose name I cannot at this moment recall. There is no doubt that this is a mistake. I have made repeated comparative assays of shade-grown and sun-grown leaves from adjoining plants, and invariably found the latter much richer in total alkaloids. I judge the custom to have arisen from two considerations. There is, as I have stated, a period of two or three months when the plants receive no rain, and then these trees afford a protection from the fierce heat. Secondly, shade conduces to the production of a large, smooth, beautiful leaf, of elegant colour, and thus adds to the *appearance* of the product. The terraces being thus prepared, on the advent of the permanent rainy season, the plants, now from 8 to 12 inches high, are transplanted, being set from one-half to six inches apart, according to the ideas of the haciendero. From this time until the first leaves are picked, the greatest care must be taken to keep the soil thoroughly stirred and free from weeds. The plants having been transferred in October or November of one year, the first picking is made in March or April of the second following year, one year and a half from the time of transplanting, or two and one-half from the seeds. In case an insufficient space has been prepared, the remaining plants are often left until the following year, and then transplanted, the operation being much more dangerous to the life of the plants.

"The chief danger of picking the leaves earlier than the period indicated above is not the strain upon the vitality of the young plant, as many of the leaves drop off themselves, but because it is almost impossible to avoid breaking off the very tender tips of the twigs, the result being fatal to many plants. Immediately after this first picking, fresh leaves develop with great rapidity, and in July or August of the same year the plant flowers for the first time. The lovely white flowers, if undis-

turbed, remain from three to six days; but from the very first they are dislodged by the slightest jar, the corolla falling entire, although it is morphologically polypetalous. The fruit ripens in December and January.

"During the first few years the percentage of alkaloid increases rapidly, reaching its maximum at or before the age of ten years. At the age of twenty it begins to diminish, but with extreme slowness, so that the plants are practically in their prime up to the age of thirty-five or forty. It is probable that the decline is then due rather to the exhaustion of the soil than of the vitality of the plant. Fertilisation of the soil has never been resorted to. It is probable, as suggested by Mr. Lohse, that as much can be done for the Coca in this way as has been done for other plants.

"A Coca harvest is called a *mita*, an Indian word meaning a division or drawing of lots, and there are from three to five in a year, according to the season. The time of picking is determined solely by the condition of the leaves. When they have become mature they turn yellow if in the dry season, and brown if in the rainy, and within eight days at the outside will fall to the ground and be lost. As soon as the mita is over, the ground is cleared from weeds, and, under an ignorant notion that further cleaning is injurious, is left undisturbed until after the next mita. But Mr. Lohse has tried the plan of keeping the ground clean, with the result, thus far, of receiving the next crop in little more than one-half the time required by his neighbours. No irrigation is resorted to during the dry season. Although it is possible that good might result, at least to the welfare of the plant and the size of the crop, I suspect that after a long time an abundant and steady supply of water would result in a decrease in the amount of alkaloids. Mr. Lohse has tried the experiment of mulching at the end of the wet season with a few inches of banana-leaves or other refuse, with excellent effect upon the plants during the succeeding dry season.

"This plant is subject to only two diseases of any importance. The first is taja, which I suppose to be the result of a fungus which attacks the undeveloped leaves and tender twigs. It is said by some to be caused by careless picking, in which the twigs are broken. By others it is said to result from the planting of seeds taken

from young plants. The only remedy is to remove and burn the diseased portions. The second disease, if such it can be called, is the ravages of a caterpillar called "ulo," which makes its appearance in December, and destroys the crop so quickly that it admits of no remedy.

"The method of picking and drying the Coca has been so often and so well described of late that it is not necessary to dwell upon it. Coca-picking is a profession to which the children are trained from a tender age. The leaves are picked singly, both hands being employed with a rapid alternating motion, which strips a twig in an instant. Great care is taken to avoid breaking the twigs, and the young leaves are not picked. Little sacks are tied about the waist or the women's aprons are pinned or sewn into the required form. They are then transferred to larger sacks, which must be filled and emptied with great promptness, or the leaves will become heated and turn black.

"The price here paid for picking is a Bolivian dollar, equal to about seventy-one cents United States currency, or three shillings English, for each thirty pounds, which, when dry, will weigh about twelve pounds.

"The leaves are exposed to a hot sun upon a pavement of nicely-fitted flat stones, and stirred occasionally until dry. Under the most favourable conditions the drying is accomplished in about three hours. About the Coca place are built the storage and packing sheds. These are furnished with very broad doors, and men are in constant attendance to sweep the Coca with brush-brooms through these broad portals at the slighest indication of rain. A very few drops of rain are sufficient to decolorise and ruin the sale of the Coca, though it is my impression that such decolori-ation, if produced by but little rain, is no indication of loss of cocaine. During the first few days that the dry Coca lies within the storage-sheds it undergoes a slight sweating process.

"When I come now to speak of the best methods of packing the Coca for export, it is fair to say that nothing definite is known. Such Coca as has reached Europe or the United States in good condition has done so purely by accident; for perhaps the very next lot, dried, packed, and shipped as nearly as possible in the same manner, has arrived entirely ruined. I have tried many methods,

and as often as I had thought that the secret was dis covered, my hopes have resulted in disappointment.

"As regards the exportation of the culture of Coca, the experiment has been tried, I believe, but once. Several years since, Mr. F. L. Steinart, of La Paz, shipped a small quantity of seeds *viâ* London to Ceylon, and during the past season the first products were shipped to London and sold at a high price. Seeds for export should be exposed for several days to a hot sun, so as to rapidly dry the fleshy exterior, which thus forms a protection to the germ within.

"It is my opinion that the Coca-plant is adapted for culture in many countries where it is now unknown. Among the countries where it would be well to experiment with it are Guatemala, Mexico, the East and West Indies, India, Southern China, portions of Africa, and possibly of Italy. It is doubtful if it would grow in any portion of the United States. Requiring an average temperature of at least 70°, the only districts at all suited would be Florida and Southern Texas; and it is highly probable that proximity to the sea-coast at so low an altitude would prove fatal. Nor would irrigation prove adequate in those countries possessing a long dry season. The plants must not only have an abundant supply of water at the roots; they must be bathed in a humid atmosphere for the greater portion of the year. But from what I have read of some of the countries above named, I am confident that the plant would there find a congenial home. Jamaica offers especially hopeful conditions."

CHAPTER VIII.

DR. MANTEGAZZA'S EXPERIMENTS WITH COCA.

Dr. Paolo Mantegazza,* also of Milan, who practised for many years in South America, thus writes of Coca:—

"The Erythroxylon Coca, a plant which grows in moist and woody regions on the eastern slopes of the Andes, is highly valued by the inhabitants of Peru, Chili, and Bolivia, not only as a medicine, but also as an article of food; and serves with them as a substitute for the tea, coffee, betel, tobacco, haschisch, and opium used by other nations. Its culture, upon which, since the time of Pizarro's conquest, much care has been bestowed, has recently increased to such a degree, that in the year 1856 the revenue of the Republic of Bolivia, from the sale of this herb, amounted to thirteen millions of francs—a very large sum if compared with the small number of consumers (800,000). According to the account of M. Pöppig and of other well-known travellers, the natives use the dried leaves of the Coca-plant either by themselves or in combination with a highly-alkaline substance called *Ilipta*, which is prepared from roasted potatoes and the ashes of different other plants; they masticate them like the Malays and the inhabitants of the Indian Archipelago do the calcined leaves of the *Chavica Betle*. The use of this masticatory, which is considered a great delicacy, is not, however, confined to the rich; on the contrary, it is particularly among the hard-working Indians that the Coca enjoys a high reputation as a nutriment and restorative, and its use is considered absolutely essential for the endurance of fatigue and exertion, so that a labourer, in making his contract, has a view not only to wages,

* *Pharm. Journ.*, 1860, p. 616 ex *Oesterreichische Zeitschrift für Praktische Heilkunde*, Nov. 4, 1859.

but to the amount of Coca to be furnished. The Inca, who lives at a height of seven to fifteen thousand feet above the level of the sea, and whose meagre fare consists principally of maize, some dried meat, and potatoes of bad quality, believes that he can sustain his strength solely by the use of Coca; the porter, who carries the mail, and accompanies the traveller over the roughest roads at the quick pace of the mule, invigorates and strengthens himself by chewing Coca; the Indian, who works half naked in the silver and quicksilver mines, looks upon this plant as an ambrosia capable of imparting new life, and of stimulating to new exertions. It is not surprising, under such circumstances, that this article should be very much abused, and that the evil of intemperance in the use of Coca, known as coquear, should be quite as prevailing among the natives of those districts as intemperance in the use of tobacco, alcoholic liquors, and opium is among other nations. They intoxicate themselves for several weeks, hide in the deepest forests in order not to be disturbed in their enjoyment, and not rarely return home to their family suffering from delirium or decided idiocy. The child and the feeble old man seize with equal eagerness the leaves of the wonderful herb, and find in it indemnification for all suffering and misery."

Dr. Mantegazza observed that "the chewing of a drachm of the leaves of the Coca increased salivation, giving at first a somewhat bitter, and afterwards an aromatic, taste in the mouth, and a feeling of comfort in the stomach, as after a frugal meal eaten with good appetite. After a second and third dose, a slight burning sensation in the mouth and pharynx, and an increase of thirst were noticed; digestion seemed to be more rapidly performed, and the fæces lost their stercoraceous smell, the peculiar odour of the juice of the Coca becoming perceptible in them. On using the Coca for several days, the author observed on himself as well as on other individuals a circumscribed erythema, an eruption around the eyelids resembling pityriasis; from time to time a not unpleasant pricking and itching of the skin was felt. An infusion of the leaves, taken internally, was found to increase the frequency of the pulse in a considerable degree. In making observations on the frequency of the pulse, the author was very careful to consider all the conditions

which might influence it; he found that, the temperature of the air being the same and the liquids being heated to an equal degree, an infusion of Coca will increase the action of the heart four times its normal standard, while cocoa, tea, coffee, and warm water only double it. By taking an infusion prepared from three drachms of the leaves a feverish condition was produced, with increased heat of the skin, palpitation of the heart, seeing of flashes, headache, and vertigo; the pulse rose from seventy to one hundred and thirty-four. A peculiar roaring noise in the ear, a desire to run about at large, and an apparent enlargement of the intellectual horizon indicated that the specific influence upon the brain had commenced. A peculiar, hardly describable feeling of increased strength, agility, and impulse to exertion follows; it is the first symptom of the intoxication, which is, however, quite different from the exaltation produced by alcoholics. While the latter manifests itself by increased but irregular action of the muscles, the individual intoxicated by Coca feels but a gradually-augmented vigour, and a desire to spend this newly-acquired strength in active labour. After some time the intellectual sphere participates in this general exaltation, while the sensibility seems to be hardly influenced; the effect is thus quite different from that produced by coffee, and resembles in some degree that of opium. Dr. Mantegazza could, in this excited condition, write with ease and regularity. After he had taken four drachms he was seized with the peculiar feeling of being isolated from the external world, and with an irresistible inclination to gymnastic exercise, so that he, who in his normal condition carefully avoided the latter, jumped with ease upon the writing-table without breaking the lamp or other objects upon it. After this a state of torpidity came on, accompanied by a feeling of intense comfort, consciousness being all the time perfectly clear, and by an instinctive wish not to move a limb during the whole day, not even a finger. During this sensation sleep sets in, attended by odd and rapidly-changing dreams; it may last a whole day without leaving a feeling of debility or indisposition of any kind. The author increased the dose to eighteen drachms in one day; his pulse rose in consequence of it to one hundred and thirty-four, and, in the moment when delirium was

most intense, he described his feelings to several of his colleagues, who observed him, in the following written words: '*Iddio è ingiusto perche ho fatto l'uomo incapace di poter vivere sempre cocheando*' (this is the expression for intoxication by Coca). '*Io preferiscto una vita di* 10 *anni con Coca che un di* 1,000,000 *secoli senza Coca.*' After three hours of sleep Dr. Mantegazza recovered completely from this intoxication, and could immediately follow his daily occupation without the least indisposition —on the contrary, even with unusual facility. He had abstained for forty hours from food of any kind, and the meals then taken were very well digested. From this fact, the author finds it explainable that the Indians employed as carriers of the mail are able to do without food for three to four days, provided they are sufficiently supplied with Coca.

"From these experiments, made repeatedly on himself and on other individuals, Dr. Mantegazza draws the following conclusions:—

"1. The leaves of the Coca, chewed or taken in a weak infusion, have a stimulating effect upon the nerves of the stomach, and thereby facilitate digestion very much. 2. In a large dose Coca increases the animal heat and augments the frequency of the pulse, and consequently of respiration. 3. In a medium dose (three to four drachms), it excites the nervous system in such a manner that the movements of the muscles are made with greater ease; then it produces a calming effect. 4. Used in a large dose, it causes delirium, hallucinations, and finally congestion of the brain.

"The most prominent property of Coca, which is hardly to be found in any other remedy, consists in the exalting effect it produces, calling out the power of the organism without leaving afterwards any sign of debility. The Coca is in this respect one of the most powerful nervines and analeptics. These experiments, as well as the circumstance that the natives have used the Coca from the earliest period as a remedy in dyspepsia, flatulency, and colic, have induced Dr. Mantegazza, and several of his colleagues, in South America and Europe, to employ the leaves of the Coca in a variety of cases, partly as masticatory, partly in powder, as infusion, as alcoholico-aqueous extract in the dose of ten to fifteen grains in pills, and as clyster. Dr. Mantegazza has used

Coca with most excellent results in dyspepsia, gastralgia, and enteralgia; he employed it not less frequently in cases of great debility following typhus fever, scurvy, anæmic conditions, &c., and in hysteria and hypochondriasis, even if the latter had increased to weariness of life. The Coca might also be employed with great benefit in mental diseases where some physicians prescribe opium. Of its sedative effect in spinal irritation, idiopathic convulsions, nervous erethism, the author has fully convinced himself. He proposes its use in the highest dose in cases of hydrophobia and tetanus. It is a popular opinion that the Coca is a reliable aphrodisiac; the author has, however, observed only two cases in which a decided influence upon the sexual system was perceived.

"Dr. Mantegazza, finally, recommends this remarkable plant, which could be easily introduced into trade, to the profession for further physiological and therapeutical experiments, and adds the full history of eighteen cases by which the medicinal virtues of the remedy are proved to satisfaction."

CHAPTER IX.

BOTANICAL SOURCE AND DESCRIPTION.

Erythroxylon Coca, Lam. Syn. *Khoka*, Aymara, *Cuca*, Peruvian; *Coca*, Spanish; *Ypadú or Ipadú* Tupiu (Brazilian).

By recent botanical authorities, the genus Erythroxylon is classed in the natural order *Linaceæ*, tribe *Erythroxyleæ*. The genus contains a number of tropical plants growing principally in South America, West India Islands, Madagascar, Mauritius, and some in India and Ceylon. The vernation of the leaf which causes the peculiar marked line on each side of the midrib is characteristic

of many of the species. One has large leaves eight or nine inches long. Lindley thus describes the Coca plant and genus :—

ERYTHROXYLON.

"Calyx 5-parted, 5-angled at the base. Styles 3, distinct from the very base, not consolidated. Cultivated on the Andes of Peru from 2000 to 9000 feet above the sea."

Erythroxylon du Pérou, *Erythroxylon Coca. Erythroxylon foliis ovatis acutis subtrilineatis, ramulis crebre tuberculosis.* "Encyclopèdie Méthodique Botanique," tome ii. Lamarck. Paris : 1786, 393.

"Leaves alternate, 1½ to 2 inches long, membranous, flat, opaque, acute at both ends, the apex almost mucronate; quite entire, dark green above, pale beneath, 3-nerved in the middle, with fine connecting veins. Petiole 2–4 lines long, with a pair of intra-petiolary ovate-lanceolate brown acute stipules, upon the back of the outside of which, indeed, the petiole is articulated, and from which the leaf readily falls away, leaving the branches scaly with the persistent stipules. Flowers numerous, in fascicles from the branches where the leaves have fallen away (or axillary, W. M.), bracteated. Peduncles about as long as the flower, sharply angled. Calyx 5-cleft; segments acute. Petals alternate with the calycine segments, oblong, concave, wavy, with a lacerated and much plaited membrane arising from within and above the base. Stamens 10; filaments longer than the pistil, combined below into a rather short cylindrical tube. Ovary oval. Styles 3, about as long as the ovary. Stigmas thickened. Fruit a 1-seeded, oblong drupe, in a dry state obscurely furrowed. Nut of the same shape and furrowed. A powerful stimulant of the nervous system, affecting it in a manner analogous to opium. Less violent in its effects than that drug, but more permanent in its action."

The chromo-lithograph Frontispiece is from a water-colour, by Mr. J. Allen, of the plant in flower at Kew.

1. Sprig of Erythroxylon Coca.
2. Back of Leaf (full size).
3. Flower (enlarged).
4. Fruit.

The leaves vary much in shape on the same plant even, the upper and lower are different, and, probably owing to much cultivation and numerous varieties, the dried leaves in commerce are very variable in size and appearance, shape and colour, as well as state of preservation. They are usually one to two inches long, but large varieties are often four or five inches long. They are oval oblong, but some are ovate, while others are obovate, entire on the margin, sometimes acuminate, but usually blunt and emarginate, and often with an apiculus in the notch at the apex; rather thin, smooth, with a prominent midrib, and on each side a curved line running from the base to the apex. The fresh leaves are paler in colour beneath, and a bloom on the surface gives them a dichroic appearance; in one direction the upper surface appears yellowish green, whilst if looked at direct it is dark green. The dried leaves have a slight odour of tea, and a somewhat grass-like, bitter, aromatic taste; in colour they vary from a pale bright green, changing to a yellowish green (Peruvian variety, according to Gibbs)—this is smaller, thinner, and much broken—to a dull brownish olive (Bolivian variety) this is larger, broader, and a thicker leaf, not broken, paler in colour beneath, the inner curved lines from base to apex are very marked on this, but only faintly on the Peruvian variety, in some leaves hardly discernible. These two varieties shade off into each other, and both countries claim theirs as being the best. In selecting them, care should be taken that they have not fermented or become fusty—they may appear of a good green colour, yet have a mouldy taste. The leaves are also collected from wild plants which have strayed from cultivation. The original habitat of the Coca plant is not known; it has been acclimatised in Ceylon and some parts of India.

The uses of the Coca leaf in Bolivia and Peru have been described by many travellers, who have seen it chewed, as has been before mentioned. From two to eight or twelve

drachms or more is used daily, in conjunction with the ashes of a plant or with lime, as a remedy for, or preventive against, the effects of extraordinary physical exertion, to relieve the difficulty of respiration in ascending mountains, and to appease hunger, thirst, and fatigue. The leaves contain the crystalline alkaloid, Cocaine (See page 52). They are said to be most active when freshly dried, and are much used by the native Indians, miners, travellers, and others. The benumbing effect on the tongue—dulling its sensibility—I find is much greater on chewing a fresh living leaf than that produced by a number of dried leaves. "The average duration," * says Markham, "of Coca in a sound state on the coast is about five months, after which time it is said to lose flavour, and is rejected by the Indians as worthless." It cannot be kept in stock for any length of time without suffering deterioration, unless it be either stored in air-tight cases in a cool and perfectly dry place, or kept in its original compressed packages; like hops, it is said to lose its aroma if detached from the "pocket." "The Peruvians," † says Pöppig, "are of opinion that too much heat deprives even the best Coca of the active principle, that a warm climate will spoil the 'Coca del Dia' (that dried in one day) in ten months, whilst it continues good for a year and a half in the cold and dry districts of the Andes."

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* "Travels in Peru and India." London: 1862, p. 237.

† *Op. cit.*," p. 168.

CHAPTER X.

COCA IN COMMERCE.

The Hon. Richard Gibbs, U.S. minister to Bolivia, for some years resident at La Paz, gives a similar account to Weddell of the cultivation of Coca at the present day.* He says the consumers of Coca, both in Peru and in Bolivia, are the native races; the whites seldom use it, except as an infusion, and then the first water is thrown away as being too strong. The habitual consumers of it, he says, know nothing of toothache, and have their teeth in good condition to a great age. The Peruvian Government is said to record and tax a production of over 15,000,000 lb., and the Bolivian Government about 7,000,000 lb. annually; of the latter about 55 per cent. is consumed in Bolivia; the Argentine Republic and Chili about 15 per cent. each; Peru, 10 per cent.; while about 5 per cent. is exported to Europe and the United States.

As "Coca is very easily damaged by the combined effects of heat and moisture, it is, therefore, always stored in dry, cool warehouses, and rarely handled or transported in damp weather or during the rainy season. The rainy season is from January to April, and, therefore, that stored on the west side of the coast range is alone available for export during the rainy season. When exported it is said that it usually starts in very good condition, and will reach its destination in the same condition if carried in a cool, dry place. Such transportation

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* Squibb's "Ephemeris," vol. ii. p. 790.

is always stipulated for on bills of lading, but the proper precautions are generally neglected, and hence the worthless condition in which it is often seen."

Of late the importations of Coca into London, Liverpool, Havre, and Hamburg have overstocked the European market. Some of it comes in tin-lined cases containing two tambores, but most of the large leaves (Bolivian variety) still arrive in rough canvas bales, generally lined with waterproof tarpaulin, and weighing from 120 to 150 lb. each, two of which it is said form a load for a mule for transportation through mountain passes or across the Andes for exportation. The bales usually contain three, or sometimes only two, tightly packed tambores, each weighing about 40 to 45 lb. These latter have a canvas covering over a banana leaf lining. Other bales contain from six to nine smaller packages of about 16 to 20 lb. each, wrapped round with a coarse woollen fabric and large dock-like leaves. The small leaves (Peruvian variety) are usually either in closely-packed bales, containing 2 to 3 hundredweights, covered with canvas, then with tarpaulin, and again with canvas, or else in loosely packed canvas "beds" about 6 feet square by about 1½ to 2 feet thick, containing brick-shaped packages, wrapped in pieces of banana leaf, weighing from 1 to 3 lb. each, and measuring about 5 inches by 5 inches, and from 12 to 18 inches in length. The larger leaves at times arrive in bales containing similar packages

Cowley (quoted p. 9) seems to have been gifted with second sight, and referred to the commerce of the present day; until recently it was quite unknown in the London drug market; even yet no reliable statistics of our imports are obtainable.

CHAPTER XI.

USE OF COCA AS A RESTORATIVE AND BEVERAGE.

NOTWITHSTANDING the scepticism expressed in Weddell's last sentence quoted (p. 22), and his attributing much of the effects said to be produced by Coca on the Indians to the force of habit, Markham (*Op. cit.*) regards it as the least injurious and the most soothing and invigorating of all the narcotics used by man, and Dr. Archibald Smith ("Peru as It is," London: 1839) states, that Coca, when fresh and good, and used in moderate quantity, increases nervous energy, removes drowsiness, enlivens the spirits, and enables the Indian to bear cold, wet, great bodily exertion, and even want of food, to a surprising degree, with apparent ease and impunity, though it is said, if taken to excess, to occasion tremor in the limbs, and even a gloomy sort of mania. Such dire effects, he considers, must be of rare occurrence, since, after living for years in constant intercourse with persons accustomed to frequent Coca plantations, and with Indian *yanacones* or labourers, all of whom, whether old or young, masticated the favourite leaf, he never witnessed a single instance in which the chewer was affected with mania or tremor.

Whether, in Europe, it will ever share the field of favour with tea, coffee, and cocoa, and become a common beverage, is doubtful. It certainly is worthy of the attention of students who have a tendency to become drowsy. An infusion, 1 in 50 of distilled water, has a bitterish grass-like taste—much the same flavour as the selected tea supplied at the Chinese kiosk during the Fisheries Exhibition, 1884. It may be taken after meals

as a refresher; it is not unpalatable; if sweetened, with milk or a slice of lemon added or infused with tea it may be taken as an ordinary cup of tea. The writer finds that the dose, taken hot, produces a slight diaphoretic action, quickened circulation, slight fulness in the head, buoyancy of spirits, and wakefulness; on one occasion, taken late, this was succeeded by rather restless sleep. It produces more cerebral action than tea or coffee. Johnson, in his "Chemistry of Common Life," says we may dismiss those fears of the Coca leaf which old Spanish prejudices awakened, and which representations like those of Pöppig have tended to perpetuate in Europe. There is no good reason why it should not be tried among ourselves. That Coca dilated the pupils of the eye was noticed by Von Tschudi. He says, "After partaking of a strong infusion of Coca, or the mastication of a great quantity of it, the eye seems unable to bear light, and there is a marked distension of the pupil, and, when taken to the utmost excess, it never, like opium, causes a total alienation of the mental powers, or induces sleep; but, like opium, it excites the sensibility of the brain, and the repeated excitement occasioned by its intemperate use after a series of years wears out mental vigour and activity."

Weddell and others, from the sleeplessness induced by an infusion of Coca, thought that it might contain Theine, but neither he nor Professor Frémy were able to isolate it, although he held that an active bitter principle, which it had not been possible for them to obtain in crystals, was contained in the leaves. The isolation, since, of Cocaine, an alkaloid possessing such curious properties, and the accounts of the use of Coca just narrated, show that the affects attributed to it are more than imagination and the "force of habit." Whether it does more than deceive or lull hunger, thirst, and fatigue, and how they act in these respects, are subjects still to be investigated. The effect travellers

describe it has on respiration at high elevations cannot be imaginary. Under the influence of Coca, it has been said, it appears that a new force gradually introduces itself into our organism, as water into a sponge. Gubler thinks that as with tea, caffeine, theobromine, Coca brings to the nervous system the strength with which it is charged in the manner of a *fulminate*, with this difference, that it only yields it slowly, not all at once.

CHAPTER XII.

PHARMACEUTICAL PREPARATIONS.

Elixir Cocæ.—1 in 6 of Simple Elixir.

Dose.—1 to 4 drachms in water is a palatable preparation.

Extractum Cocæ Liquidum (*Off.*).

Syn.—Extractum Erythroxyli Fluidum, U.S.

Dose.—½ to 2 drachms.

Coca leaves are exhausted by percolation with proof spirit, the second part of percolate concentrated and dissolved in the first portion, and the strength adjusted so that 1 ounce = 1 of leaves; this is about six times the strength of the French nostrum mentioned below.

By distilling off the spirit and concentrating by evaporation, a solid semi-alcoholic preparation is obtained about four times the strength of the above, known as:—

Extractum Cocæ.

Dose.—2 to 15 grains or more, in pills or pastils.

The Indians always chew Coca with lime or plant ashes, which isolates the alkaloids; it may be that

galenical preparations of dried leaf do not exhaust it of alkaloids, the aid of an acid or an alkali being necessary; long-continued heat applied during the preparation seems to be detrimental to the product.

An **Extractum Cocæ** is sometimes imported from South America, prepared from the *fresh* green leaves.

Dose.—5 to 15 grains, in pills.

As Coca leaves lose much of their virtue by keeping, this is a good pharmaceutical preparation, but of late there have been no arrivals.

Infusum Cocæ.—1 in 50 of boiling water.

Taken hot like tea with milk and sugar, or with a slice of lemon, it forms a refreshing beverage. In tonsillitis it may be used warm as a gargle.

Pastillus Cocæ Extracti.—2½ grains of the extract in each.

Dose.—One every two or three hours.

Coca pastils are good; cocaine cured case of asthma of 15 years' standing; recommended for hay-fever, spasmodic asthma, and post-nasal catarrh.—M.P.C. ii./85,320.

Vinum Cocæ.—1 in 30 of Sherry.

Dose.—½ ounce to a wineglassful.

French nostrums, much advertised, are a **Wine of Coca**, containing about 1 in 30—*dose*, a wineglassful—and a **Liquid Extract**, and an **Elixir**, about 1 in 6—*dose*, 1 to 4 drachms.

CHAPTER XIII.

MEDICAL USES AND REFERENCES.

Coca has been praised as a nervine and muscular tonic, preventing waste of tissue, appeasing hunger and thirst, relieving fatigue, aiding free respiration, and as being useful in various diseases of the digestive and respiratory

organs. It is said to be specially useful in many forms of asthma, chronic bronchitis, obstinate cough, phthisis, and general debility; in gastric derangements, owing to its slight astringency, it seems to give more tone to the stomach than the mere anæsthetic action of the Cocaine it contains would produce locally; it is recommended for indigestion, gastralgia, gastrodynia, nausea, sickness, distaste for food, is given to relieve pain, nausea, vomiting or discomfort caused by excess in either eating or drinking or by pregnancy, and as a cure for morphine and alcohol craving. In using it for this in America it is said in some cases to have produced "Coca Craving."

Coca is also said to cause mental exhilaration, to overcome diffidence or bashfulness in company, and to be an excitant of the vital functions. It has been used in melancholia, in cases of inordinate hunger or thirst, such as occur in some forms of diabetes, and in cases of generative debility. Locally, a solution of the extract in water has been used as a pigment in irritated, inflamed, and granular conditions of the larynx and pharynx.

The pastils have been used similarly for loss of voice due to weakness or relaxation of the vocal cords. Topically these preparations act as astringent sedatives without deranging the stomach. Externally, it may be made into poultices, or a plaster made with the extract combined with resin or soap plaster may be applied for rheumatism, lumbago, &c. The leaves are sometimes smoked to relieve asthma.

The leaves are chewed to appease hunger and support strength, in the absence of food, and used generally for the stimulant and narcotic effects of tobacco and alcohol. —Pr. xvi.467.

Coca-leaves as an inhalation, or smoked in a pipe, have a decided effect on bronchial spasm.—L. i./76,520.

Is of use to steady the nerves of excitable persons—to a sportsman in shooting, for example; to give endurance, is used by travellers in Bolivia and Peru, and to counteract the effect of rarefied air on mountains.—L. ii.76,449.

Historical and botanical account of the plant and its uses; the result of a series of experiments on its use was most unsatisfactory, although the drug was given in every variety of ways, under all circumstances, and at all hours of the day.—L. i./76,631,664.

Two ascents of Ben Voirlich, under the influence of,

respectively, 60 and 90 grains, done with ease by Sir Robert Christison. By the use of Coca hunger and thirst are suspended, but eventually appetite and digestion are unaffected; the mental faculties are not affected after great bodily fatigue, except by freeing them from dulness and drowsiness.—B.M.J. i./76,527; P.J. 1876,883.

Twelve athletes, during a game, chewed, without lime or ashes, from 60 to 90 grains; at first in some, dryness was felt, and relieved by washing the mouth; then followed a feeling of invigoration, so that fatigue was wholly or in great part resisted; the pulse increased in frequency, and perspiration augmented. Save exhilaration of spirits, no mental effects were noticed or disagreeable effects realized.—P.J. 1877,221.

A party climbing Mont Blanc, each chewing 80 grains of Coca during ten hours, were much relieved from thirst by its use. They drank no water, tea, or coffee, and but a limited amount of wine, yet Coca enabled them to make the trip with comparative comfort.—M.T.G. ii./82,165.

It enables a greater amount of fatigue to be borne with less nourishment, and lessens the difficulty of respiration in ascending mountain sides. Tea made from it has much the taste of green tea, and is much more effectual in keeping people awake.—Markham's Peruvian Bark, p. 152.

In France, Bouchardat states it has rendered most valuable therapeutic service, almost equal to cinchona bark. It is a stimulant to the nervous and muscular systems, and ranks with tea and coffee; it prevents the rapid waste of tissue, and enables the consumer to go a long time without food.—B.M.J. i./76,486.

Use in walking feats.—B.M.J. i./76,335,361,387,518, 519,750,752.

The leaves are neither nutritive nor tonic; it is in their anæsthetic properties, developed by chewing the leaves with lime or plant ash, the Indian finds the numbing effect on the mucous membrane of the stomach that he seeks.—P.J. 1885.266.

Wine of Coca checks vomiting of irritable stomach.—L. ii./85,1078.

Fluid extract of Coca relieved hæmorrhage from bowel when given internally.—Pr. xxxv.401.

CHAPTER XIV.

COCAINE AND ITS SALTS.

Cocaina, Cocaine.

Dose —$\frac{1}{16}$ to 1 grain, in a pill or tablet.

This now important alkaloid was first isolated by Niemann in 1860. From analysis he gave it the formula of $C_{32}\ H_{20}\ NO_8$ (old notation), but Lossen in 1862 assigned it the now accepted formula of $C_{17}\ H_{21}\ NO_4$ (new notation). It has a bitterish taste, and crystallizes in shining monoclinic prisms. It requires 700 or more (upwards of 1,300, Dr. Paul) parts of water to dissolve it, it is more soluble in alcohol (about 1 in 20), freely so in chloroform, ether (about 1 in 3), oil of cloves, and many other volatile oils, and 1 in 10 respectively of melted vaseline and castor oil, and other fixed oils. The following are also ready solvents, each taking up about 1 of it in 3 parts: benzol, toluol, and amylic alcohol; of petroleum spirit about 25 parts are required. The latter solutions have proved serviceable in eye cases. Manufacturers inform us that good Coca leaves yield 0·5 per cent. or more of Cocaine, but the average is less, if fermented—often *nil*. Cocaine seems to be very sensitive to chemical and physical action, and readily yields derivatives. The dried leaves are also said to contain Hygrin, a volatile principle, with Ecgonine, Coca-tannin, and Coca-wax. Ecgonine (together with benzoic acid and methyl-alcohol) may also be obtained as a derivative from Cocaine when the latter is heated with hydrochloric acid, thus:—

$$\underset{\text{Cocaine.}}{C_{17}H_{21}NO_4} + \underset{\text{Water.}}{2H_2O} = \underset{\text{Ecgonine.}}{C_9H_{15}NO_3} + \underset{\text{Benzoic Acid.}}{C_7H_6O_2} + \underset{\text{Methyl Alcohol.}}{CH_4O}$$

By concentrating by evaporation an aqueous solution of pure Cocaine, Dr. Paul obtained a gummy residue which eventually crystallized, and which he supposed to be Ecgonine. It was much more soluble in water than Cocaine. W. Merck also, by operation with hydrochloric acid on a by-product, benzoyl ecgonine, obtained in the

manufacture of, and probably a derivative from, Cocaine, converted this into benzoic acid and ecgonine, thus:—

$$C_{16}\,H_{21}\,NO_4 = C_9\,H_{15}\,NO_3 + C_7\,H_6\,O_2$$

Benzoyl Ecgonine. Ecgonine. Benzoic Acid.

With this substance also, he, as well as Skraup, have made Cocaine synthetically by heating in a tube to 100° C., a mixture of benzoyl-ecgonine, iodide of methyl, and methyl alcohol; the excess of the two latter is driven off by heat and the Cocaine extracted as a syrupy hydriodate; from the salt is produced pure Cocaine, melting at 98° C. and answering all other tests. (Ber. D. Chem. Ges. 1885, 2264.) Merck has also made the synthesis from Anhydrous Ecgonine by combining it with benzoic acid and iodide of methyl.—*Ib.* 2952.

The preparation of Cocaine can be expeditiously effected by the process given by Prof. A. Bignon, of Lima, which I have experimentally used, it is as follows:—The Coca leaves are soaked in a solution of Carbonate of Sodium of 20° Baumé (this contains about 40 per cent. of the salt) for three or four days. The mixture is then dried (reduced to powder) and exhausted by percolation with light petroleum spirit. The whole of the Cocaine which the alkaline carbonate set free is dissolved in this menstruum, which is preferred to the better solvent of Cocaine, benzol, as it takes up less colouring matter. The petroleum solution obtained (was concentrated by me) is now shaken up with water acidulated with one-tenth of the hydrochloric acid. The aqueous solution containing the Hydrochlorate of Cocaine is separated and allowed to deposit. The clear liquid is decanted, and from it the alkaloid is precipitated by the addition of carbonate of sodium; about 98 per cent. of this precipitate, when slightly washed and dried, is pure Cocaine, but, as it still contains some uncrystallizable matter, it is better to take up the precipitate formed on adding the alkaline carbonate by agitation with repeated portions of ether; the decanted ethereal liquors, when mixed, on evaporation will yield crystals of almost pure white Cocaine, or, if agitated with hydrochloric acid *q.s.* Hydrochlorate of Cocaine separates as a granular white powder.

No coloration is produced by dissolving pure Cocaine or its hydrochlorate in cold concentrated sulphuric acid;

with the salt, effervescence occurs, owing to hydrochloric acid gas being set free. Some samples of them give a faint evanescent yellow coloration, and others give it a magenta tinge which gradually passes to a brownish yellow, and eventually the solution becomes almost colourless.

As pure Cocaine (the alkaloid) is soluble in fats and oils, and its salts are not, it should always be used when it has to be combined with fatty or oily substances, for use externally, *e.g.*:—

Bougies of Cocaine. $\frac{1}{2}$ grain in each or more, with cacao-butter.

Are useful in painful affections of the urethra.

Ceratum Cocainæ. 1 in 30 of petroleum cerate.

Is useful in burns, scalds, urticaria, pruritus, &c.

Collodium Cocainæ. 2 per cent. in flexible collodion.

Allays the itching, and is a cure for inflamed chilblains.

Emplastrum Cocainæ.—1 dissolved in 50 of lead plaster heated in a water bath.

Useful for intercostal neuralgia, sciatica, tender corns, bruises, &c.

Oleatum Cocainæ.

A saturated solution of the alkaloid in oleic acid; heated, one part will dissolve in two parts of oleic acid; it may be further diluted with oleic acid or oil. Has not proved so satisfactory a preparation as

Oleum cum Cocainâ.

A 2 per cent. solution, more or less, if ordered, in almond oil, is mostly used. This is useful for earache. For the eye a 2 per cent. solution in castor oil is used; for catheters, a solution in equal parts castor and almond oils does well, it is viscid, and does not crystallize in winter.

Suppositories and Pessaries of Cocaine have $\frac{1}{2}$ grain (or more, if ordered) in each with cacao-butter.

Tabellæ Cocainæ, Cocaine Tablets. $\frac{1}{20}$ grain in each, with chocolate.

Dose.—1 every quarter-, half-hour or hour, quickly

eaten and swallowed. Useful for sea-sickness, chloroform or alcohol sickness, sickness of pregnancy, &c.

Unguentum Cocainæ. 1 in 30 of lard or lanoline (more or less, if ordered).

Useful where absorption is required, as in facial neuralgia, shingles, eczema, erysipelas, urticaria, and pruritus.

Vaselinum Cocainæ. 4 per cent. (more or less, if ordered).

Suitable for the eye; is very bland; also for smearing catheters, burns, scalds, &c.

Cocainæ Benzoas, Benzoate of Cocaine.

This compound may readily be formed in solution by rubbing together benzoic acid 1 part with pure cocaine 3 parts (or slightly more to exactly neutralise) and adding distilled water *q.s.*; as concentrated a solution as 20 per cent. or stronger may thus be made.

Benzoate of Cocaine has of late been particularly recommended by M. Bignon, who considers benzoic acid the co-working acid of Cocaine; is harmlessly antiseptic (the solution is said not to be liable to become fungoid), and further, as the application of a solution of the hydrochlorate of cocaine to the eye always produces at first a sensation of smarting preceding for some seconds the anæsthetic effect, the application of a solution of the benzoate is quite painless; the anæsthesia from it also in a case of epithelioma of the tongue was much more persistent than that produced by the hydrochlorate, which only lasted one hour, whereas from the benzoate it lasted four hours. It would seem to fulfil the conditions of a desirable compound of Cocaine.—*Les Nouveaux Remèdes*, Feb. 15, 1886, p. 74; L. i./86, 370.

Cocainæ Citras, Citrate of Cocaine.

Dose.—$\frac{1}{20}$ to 1 grain or more.

Is in deliquescent small white crystals; used by dentists.

Cocainæ Hydrobromas, Hydrobromate of Cocaine.

Dose.—$\frac{1}{20}$ to 1 grain, in a pill or solution. Is a stable salt, in odourless, small, white, hard, acicular crystals, free from odour.

Cocainæ Hydrochloras (*Off.*).

Off. Dose.—"$\frac{1}{5}$ to 1 grain," but less and more may be given, in aqueous solution, pill, or pastil.

This salt has been most used: it appears to be a dry white granular powder, which in reality consists of crystals of slender white needles, usually having a slight aromatic ethereal odour. It may be obtained in silky white acicular crystals, with slight odour, by dissolving the alkaloid in amylic alcohol and adding dilute hydrochloric acid *q.s.* to neutralise. The large crystals of commerce lose 10 per cent. of water of crystallization on drying in a water bath, and they do not even keep so well in aqueous solution as the anhydrous official preparation. Its action on the tongue and mucous surfaces is more intense than that of the pure alkaloid. It is soluble in half its weight of water, and freely soluble in spirit and glycerine; insoluble in ether, fats, and oils, and therefore incompatible with them. It dissolves with effervescence but without colour in cold sulphuric acid (*see* Cocaine p. 53), but chars if heated. Ignited in the air, it burns without residue. Its aqueous solution gives a white precipitate with carbonate of ammonium, soluble in excess. It is an antiseptic, a five per cent. aqueous solution delays the putrefactive changes in an extract of meat; yet fungi occasionally grow in its aqueous solutions.

As with an aqueous solution of sulphate of atropine, so with an aqueous solution of hydrochlorate of cocaine, some samples seem prone to grow fungi, while others will not. Evil results having followed the application of Cocaine as a local anæsthetic in several eye operations, the bad effects have been attributed to these fungoid growths. Still, three London surgeons who have used it very largely inform me they have never seen any untoward results from its use in simple aqueous solution. Various modes of keeping the solution free from fungi have been suggested; carbolic, salicylic,

boric, and benzoic acids, perchloride of mercury, thymol, camphor, and chloroform have been adped to check their growth; a half to one per cent. of boric acid has been particularly recommended, but it is of little use, as an aqueous solution of boric acid itself sometimes grows a fungus; chloroform is probably the least objectionable. But all these additions do but contaminate, and are unwarranted in dispensing unless specially ordered. By a careful selection, and the testing of each supply purchased, the writer has come to the conclusion that, if the solution in distilled water be sterilized by boiling, and afterwards kept free from dust, such additions are unnecessary.

Buginaria Cocainæ Hydrochloratis, NASAL BOUGIES OF HYDROCHLORATE OF COCAINE.

One-sixth of a grain in each with gelato-glycerine basis. Useful in hay fever.

Injectio Cocainæ Hydrochloratis Hypodermica. 1 in 20.

Dose.—2 to 10 minims. For sciatica and many local affections acts better than morphia.

Lamellæ Cocainæ, Discs of Cocaine (*Off.*).

Discs of gelatine, each containing $\frac{1}{200}$ grain of hydrochlorate of cocaine. These should be prepared in an atmosphere carefully freed from dust and germs of fungi and disease.

Liquor Cocainæ Hydrochloratis. 4 and 20 per cent.

For ophthalmic use, &c.—See above.

Pastillus Cocainæ Hydrochloratis. $\frac{1}{20}$ grain in each (or $\frac{1}{10}$ grain or more if ordered).

Useful in allaying irritation of the throat and hoarseness. They invigorate the vocal organs of singers and public speakers.

Pilula Cocainæ Hydrochloratis. $\frac{1}{3}$ grain in each (or more, if ordered), with sugar of milk and syrup *q.s.* to make a grain pill.

Tabloids of Hydrochlorate of Cocaine. $\frac{1}{10}$ and $\frac{1}{3}$ grain each.

Are prepared for hypodermic injection.

Trochisci Cocainæ Hydrochloratis. $\frac{1}{12}$ grain in each.

Used for similar purposes as the pastils.

Cocainæ Salicylas.

Dose.—$\frac{1}{5}$ to 1 grain or more.

Is in minute snow-white crystals, slightly deliquescent, and is recommended for the use of oculists, as it forms a solution which keeps well.

Dentifricium Cocainæ.

Phosphate of Calcium (dry),	2 ounces.
Orris, in powder,	1 ounce
Myrrh, in powder,	30 grains.

Mix, and add in solution :—

Cocaine,	1½ ,,
Oil of Eucalyptus,	12 minims.

Triturate well together and add ammoniacal solution of carmine, 15 minims. Mix well and sift.

Said to be useful for toothache and spongy gums.

Cocaine and its salts, although selling at one time as high as 3s. 6d. per grain, are now reduced to a very moderate price.

CHAPTER XV.

USES OF COCAINE.

The curious property cocaine possesses of producing local anæsthesia was even noted by the discoverer of the alkaloid—Niemann, who, so far back as 1860, wrote: "It produces temporary insensibility on the part of the tongue with which it comes in contact" (Watts's Dict., i. 1059, *ex* "Ann. Ch. Pharm." cxiv. 215). This interesting fact seems to have lain dormant for 24 years, until about a year ago, when Herr Koller, a medical student in Vienna, was led to test the local anæsthetic action of the hydrochlorate of the alkaloid, on account of the effect he had witnessed when cocaine

in solution was pencilled upon the pharynx to render it less susceptible in laryngoscopic examination. A vial of the solution was given by Herr Koller to Dr. Brettauer, of Trieste, who, on Sept. 15th, 1884, demonstrated its properties at the meeting of the Ophthalmological Congress in Heidelberg. Several experiments were made with the two per cent. solution, which showed that when two drops of the liquid were placed upon the surface of the normal cornea, and the application repeated after an interval of ten minutes, at the end of ten minutes more, the sensibility of the cornea was so far diminished that it could be pressed with a probe; the cornea and the surface of the eyeball and eyelids adjoining could be rubbed; a speculum could be inserted and the lids widely separated, and the conjunctiva could even be seized with fixation forceps, and the eye moved in various directions without causing the patient notable discomfort.

Besides rendering the superficial structures of the eye anæsthetic, it is a mydriatic, and paralyses the accommodation, which passes off sooner than the dilatation of the pupil; this does not at longest last more than twelve hours. The sensitiveness of the iris is less affected than that of the surface of the eye. The great excellence of cocaine consists in the limitation of its action to the tissues to which it is applied. No doubt, other symptoms at a distance do result from the external application of the anæsthetic, but they are, for the most part, insignificant and by no means dangerous. In some measure cocaine may be compared with curare. The one agent paralyses the termination of the sensory nerves, whilst the other paralyses the termination of the motor nerves. Aconite would seem to act in a manner the very reverse of cocaine. When applied to a mucous membrane, it has probably a constricting action on the vessels, produces a blanching of the part, and simultaneously a deadening of the nervous excitability which passes into a complete state of anæsthesia; its effect, however, does not sink deeply into the adjacent tissues, nor does it last long. This surface application is sufficient to render painless the use of a caustic, the passage of catheters and lithotrites, or the performance of operations which do not involve the more deeply-seated tissues. Such operations as the opening of abscesses

and buboes, the removal of small tumours, require the surface anæsthesia to be supplemented by two or more hypodermic injections, of a quarter of a grain in each, of the hydrochlorate in close contiguity to the part to be operated on. Injected hypodermically, the aqueous solutions of its salts deaden sensibility around the puncture, so that the deep prick of a pin is not felt—the surrounding part is reddened, but after thirty minutes it resumes its normal condition; injected locally, is more useful than morphia in relieving sciatica. Although solutions of it are little absorbed by the skin,—even a chloroform solution is scarcely at all absorbed,—yet the application of an ointment of the pure alkaloid, made with lard or an oily solution, to a surface will remove the pain of inflammation, as in eczema or erysipelas, or the pain of facial neuralgia or shingles, and the irritation of urticaria or pruritus. Burns and scalds should first be brushed over with a 4 per cent. aqueous solution of the hydrochlorate, and the pure alkaloid, combined with carron oil (Linimentum Calcis), petroleum cerate, or boric acid ointment, afterwards applied on cotton wool or lint. Combined with boric acid ointment, also, it may be used for fissured nipples, or for these and stings and bites of insects an aqueous solution may be applied. The irritability of inflamed mucous surfaces, as in hay-fever, influenza, coryza, bronchitis, spasmodic asthma, laryngitis, and pharyngitis, is much relieved by the spray of a watery solution of a cocaine salt. In obstetrics, its local application relieves the pain of the dilating os uteri, and diminishes the sensibility of the perinæum whilst being dilated in first labours; rents of the perinæum may be stitched up almost painlessly under its action, and under its influence many minor gynæcological operations are much facilitated by the ability to insert needles and make small incisions without pain. The spasmodic and painful affections of the vagina, causing dyspareunia and vaginismus, may be minimised, by vaginal injections of a quarter of a grain of cocaine in 1 per cent. oily solutions. In dentistry, it is useful in toothache; it deadens the sensibility of exposed pulp. The pure alkaloid is preferable to the salts for this purpose, because, being less soluble in water, it is less liable to be washed away by the saliva. If a little be inserted in the cavity of a carious tooth and covered with a plug of mastic solution,

all pain is obtunded for a considerable time. A strong solution in oil of cloves is also useful. In preparing the cavity, previous to filling, the sensitiveness of the dentine is more effectively treated by using a salt of cocaine—either the hydrochlorate or citrate; the latter has been recommended, as it can be formed into a pellet with the fingers and pressed into the cavity, but it is not so rich in true alkaloid as the hydrochlorate; yet, either of these is absorbed more quickly than the alkaloid itself, which, as before said, is more suitable for plugging a cavity for some length of time. Before using arsenical paste to destroy the nerve when exposed, if about a quarter of a grain of a cocaine salt be inserted into the cavity, after partially clearing, it will anæsthetize the pulp in about five minutes, and enable the operator thoroughly to open the cavity and expose the pulp directly to the action of the arsenical paste without pain to the patient. In extraction, if a dose be hypodermically injected into the gum on each side at the base of the tooth, after waiting about five minutes this may be done almost painlessly, and, if a 50 per cent. aqueous solution of the hydrochlorate be painted on the surrounding gum, the first pain of inserting the forceps is annulled. The eye, ear, throat, mouth, tongue, pharynx, nose, larynx, trachea, urethra, vagina, os uteri, anus, rectum, and, in fact, the whole mucous membrane, as well as cut surfaces and open sores, are affected by it, and the true skin less so.

Solutions of hydrochlorate of cocaine have been employed topically in excision of the tonsils, cauterizing the turbinated tissue of the nose, painting chancres previous to the application of nitric acid or other caustics, opening abscesses, removing polypi, and many cases of iridectomy and operation for cataract, squint, and removal of foreign bodies from the eye. For the eye an aqueous solution of the hydrochlorate of cocaine of 2 to 4 per cent. is generally used, and a 4 to 20 or even 50 per cent. for other purposes; of the weaker solutions it is necessary to repeat the application three to five times, at intervals of three to five minutes. At a discussion on Anæsthetics at the Medical Society (L. ii./84,957), a speaker advocated the use of the strongest solution. No injurious effects, either local or constitutional, seem to follow its use. Its action commences in three minutes, increases from

ten to twenty minutes, and mostly disappears within half an hour.

Equal parts of an 8 per cent. solution and liquor atropinæ sulphatis form an effective remedy for all painful and inflamed conditions of the eye; and half a grain of pilocarpine nitrate, added to 1 drachm of a 4 per cent. solution, produces anæsthesia without in the least disturbing the accommodation.—Whitla.

As regards the toxic properties of cocaine, its effects appear to be mild and not cumulative. It causes cessation of respiration,—small doses have an exhilarating effect on the nerve-centres and other parts of the nervous system. In a case of attempted suicide by an apothecary, a dose of 1·5 grammes (23 grains) seemed to have no seriously injurious effect.—Varge's "Zeitschr." v.f. 11, 5, p. 222, 1863.

A writer in the *British and Colonial Druggist*, Feb., 1885, p. 36, thus describes the effect of a full dose:—

"Inasmuch as the writer—whose nervous system is of an almost unfortunate degree of sensitiveness—has taken doses of the hydrochlorate, equivalent, in the aggregate, to no less than 32 grains of cocaine itself within the space of three hours, without (as the present lines sufficiently prove) a fatal result following, this remarkable body cannot fairly be classed among the poisonous alkaloids. Among the chief symptoms induced were increased cerebral activity mounting at intervals into the region of delirium, the latter tendency always subservient to a powerful effort of the will. This continued for five hours, the heart action and breathing being meanwhile slightly increased, but not to any painful extent. At first the muscular powers appeared to be enhanced, heavier weights being lifted without undue stress than is ordinarily the case, while the reflective faculties—as instanced by ability to read and form conclusions upon novel scientific matter—seemed stimulated. An hour after the entire quantity named had been taken, the sensibility of the limbs to external influences—which had gradually diminished from the first—became materially lowered, and neither pinches, pricks, nor slight burns with a heated wire, could be felt upon the fleshy portions of the arms or legs. The trunk, however, never lost its sensibility to pain in any marked degree."

"Slight convulsive movements and a sensation of bodily torpor succeeded, giving way about the eighth hour to considerable somnolency. No special desire, or distaste, for food was noticeable, but sleep overcame all other symptoms between ten and eleven hours from the commencement, and continued for thirteen hours afterwards; a slight feeling of dizziness was experienced on waking, but this gradually wore off, and had entirely disappeared twenty-four hours later."

By physiologists, it had been supposed that cocaine would have properties allied to, if not identical with, caffeine, theine, or theobromine, in the manner that these themselves are allied. But, chemically, cocaine is quite distinct; it is much less soluble in water than caffeine; it is a strong base, which caffeine is not, and its chemical constitution and derivatives are quite distinct from those of caffeine. As a medicine, coca has been more used in France and America than in England.

Opinions are at present divided as to whether the anæsthesia produced by Cocaine is the result of the vaso-motor disturbance the small vessels are caused to contract by its application, and the nervous filaments are doubtless anæmic, or whether Cocaine acts directly as a paralyser on the nervous endings, whether of sensibility, or touch, or of special sense, since it removes the power of taste and smell, as well as the perception of touch and pain. When Cocaine is administered in such a dose and manner as to affect the whole system, the brain seems to become excited, the heart stimulated, and blood pressure increased. Poisonous doses kill by asphyxia, the breathing becoming arrested and the heart failing in diastole; but this has not yet been observed in man, the dose necessary to produce this effect being very large; 20 grains have been taken without very serious result. It diminishes all the secretions, and, although the intestinal movements are slightly stimulated at first, larger doses or continued use cause sluggish action, dyspepsia, and constipation. Tissue change is lessened, and the amount of urea is similarly diminished; the temperature seems to be somewhat higher than normal; albuminuria has been found to follow its use, and sugar has also been found in the urine. The kidneys are probably the special means of its elimination. With regard to its action on muscular fibre nothing is known,

observers being completely at variance in their opinions.—Buxton, in Ringer's "Therapeutics," 11th edition.

"Brown-Sequard regards the effect as a new sample of inhibitory action, his experiments convincing him that Cocaine acts through the medium of the peripheral nerves on the nervous centres, which react in bringing about inhibition of sensibility. The phenomena which result from the injection of Cocaine at the level of the larynx, he finds to be the same as those which are consecutive to the application of a jet of carbonic acid on the mucous membrane of that organ. Two minutes after the injection there is a generalised anæsthesia and an analgesia of the different wounds made on the body of the animal. The cutaneous anæsthesia lasts only a few minutes, but the analgesia of the wounds persists even till the following day. If fresh wounds are made, these, far from being analgetic, become, on the contrary, hyperalgetic. That which proved that Cocaine acts on the nervous centres, and particularly on the cerebellum, is that injections of this substance produced sometimes a rolling motion to the side opposite to the injection, and at others a turning motion. Evidence of the inhibitory action is offered by another of Brown-Sequard's experiments: when the dose of Cocaine injected was large enough to produce convulsions, it was sufficient to pull or forcibly flex the toes to immediately stop the convulsions. In animals which died under these conditions the temperature of the body after death was as high as 44°·4 C., or 111°·6 F."—Brown-Sequard in Prosser James' "Guide to New B.P."

In Vienna, cocaine has been recommended for use internally in cases of great exhaustion, such as loss of blood, sunstroke, or diarrhœa, also by mouth or hypodermically as a cure for morphine and alcohol craving. Morphine and cocaine appear to be mutually antagonistic. Cocaine has been used in some cases of melancholia and insomnia; it also possesses aphrodisiac properties. It was likewise found to lessen the desire for sleep and feeling of hunger, and to be a stimulant which quickly increases and sustains, in a harmless manner, the physical powers of the body, such as are required in long marches, mountain ascents, &c., in dose of ¾ to 1½ grains.

Cocaine is a stomachic, useful after excess either in eating or drinking, in distaste for food, in sea-sickness

and vomiting of pregnancy or from other causes; it also improves the condition of the stomach in atonic indigestion and nervous affections of this organ, as well as in phthisis and cachectic cases, especially those arising from the use of mercury.

CHAPTER XVI.

MEDICAL NOTES AND REFERENCES.

COCAINE is a mydriatic; slightly raises the temperature, quickens respiration, and pulse is more frequent; by long use, sleep is longer and more profound. Improves nutrition, useful in insomnia and simple melancholia.—M.R. 1883,86.

Eleven successful cases, including three of operation for cataract, one double iridectomy, one removal of tumour from lid, and three for convergent strabismus. In cases of intolerance of light it acts like magic.—L. ii./84,911.

In papillomata of larynx, interior painted with 20 per cent. solution of hydrochlorate of Cocaine once, in five minutes was able to introduce the forceps four times and remove large portions of tumours without patient experiencing any pain or subsequent shock.—L. ii./84,912.

Physiological effects on the eye.—L. ii./84,911.

Seven eye cases under its influence.—Med. Rec. (N.Y.) 1884,510.

Use in the nasal cavity, cotton wool soaked in 2 per cent. solution applied at the end of a probe in over forty cases, including hypertrophy of the nasal mucous membrane (twenty-seven cases cauterized), acute coryza, nasal polypus and hay-fever, all having marked swelling of the nasal mucous membrane, both from chronic and acute causes; in every case there was complete subsidence of the turgescence of the membrane and the sinuses were emptied of their blood.—Med. Rec. (N.Y.) 1884,533.

Cocaine solution applied to a blistered surface anæsthetizes the part.—B.M.J. i./85,300.

Solution painted on or injected into piles relieves the pain of operating on them.—B.M.J. i./85,227.

References to its surgical use as a local anæsthetic:—L. ii./84,608 (ophthalmic), 683 (ophthalmic), 936 (laryngeal), 975 (ophthalmic), 975 (nasal), 992 (ophthalmic), 1022 (physiological action), 1023 (ophthalmic and aural), 1068 (ophthalmic), 1097 (ophthalmic), 1123 (ophthalmic and dental), 1167 (circumcision and catheter passing); L. i./85,86 (uterine, vaginal, and oral), 123 (in tenesmus), 130 (on mucous membranes), 168 (dental), 220 (rectal), 226,315 (minor surgery), 965 (ophthalmic), 1033 (fistulas, canals), 1067 (ophthalmic), 1097 (nasal), 1112 (ophthalmic); B.M.J. ii./84, 761 (ophthalmic), 1074 (laryngeal), 1132,1142,1143,1249,1256 (ophthalmic), 1133 (dysphagia), 1188 (throat and nose), 1255 laryngoscopic), 1256 (midwifery and tinnitus); B.M.J. i./85,45,77,134,145,863 (effects on the eye); B.M.J. i./85,24,36,77,235,286,456,792,1266 (ophthalmic surgery); B.M.J. i./85,36,47,209,456,479 (nose and larynx); B.M.J. i./85,377 (cancer); B.M.J. i./85,227, 653,994 (rectal operations); B.M.J. i./85,17,36,47, 361,994 (vagina and urethra); B.M.J. i./85,17,24, 36,69,736,926 (in dentistry); B.M.J. i./85,402 (for scalds); B.M.J. ii./85,396 (tumour of lip removed).

Translation of Carl Koller's report of the earliest observations on the use of cocaine and its salts as local anæsthetics.—L. ii./84,990.

Hydrochlorate of cocaine, 20 per cent. solution allowed nitric acid to be applied without pain.—L. ii./84,1023.

In skin diseases, relieves the inflammation in eczema and acne and the irritation of urticaria.—L. i./85,76.

Fungoid growths in aqueous solutions of salts of cocaine and other alkaloids.—L. i./85,224,315,504, 597,647.

Physiological action.—L. i./85,439.

Summary of its pharmacy.—L. i./85,488.

Checks hæmorrhage from lips and gums in purpura.—L. i./85,581; Pr. xxxiv.450.

Hay fever relieved by solution applied locally to nose and eyes.—L. i./85,925; L. ii./85,50,99,123,232; B.M.J. i./85,1084,1291.

For moles, warts, &c., about 6 grains of cocaine to a drachm of nitric acid applied once or twice a day with the point of the rod of an acid bottle is painless; a ring of melted wax should be put round the mole first.—L. i./85,1052.

Résumé of action and uses. — B.M.J. ii./84,1081, 1132; B.M.J. i./85,36; Pr. xxxiv.56.

Physiological experiments on animals.—B.M.J. ii./84, 1313; B.M.J. i./85,17,97,863.

In senile gangrene, the intense pain of, relieved by a 4 per cent. solution on contiguous parts. — B.M.J. i./85,653.

In coryza, 4 per cent. solution useful applied on cotton wool.—B.M.J. i./85,430,1084.

The mydriatic effects on the iris, and on the tension of the eyeball, caused by its local application.—B.M.J. i./85,1303.

The painless removal of urethral caruncles.—B.M.J. ii./85,153.

In obstetrics, several valuable applications.—Pr. xxxiv.65.

The oleate is useless, except for sores on penis and anus.—Pr. xxxiv.451.

Hypodermic injections apt to be followed by faintness. —Pr. xxxiv.450.

Gonorrhœa, acute, 2 per cent. solution injected relieves the pain.—Pr. xxxiv.222.

Rectal and prostatic pains relieved by ½ grain suppositories.—Pr. xxxiv.128.

Summary of its effects on the eye, viz., dilatation of pupils, constriction of small peripheral vessels, paralysis of accommodation, and enlargement of the palpebral fissure; the effect is local only, by paralysing the endings of the sensory nerves, and irritating the sympathetic nerves.—Pr. xxxiv.1.

Dysmenorrhœa, the pain of, removed by painting the cervix with 4 per cent. solution.—B.M.J. ii./85,399.

After lithotrity, ½ an ounce of 4 per cent. solution injected for painless removal of fragments.—Pr. xxxiv.128.

In labour pain attending the dilatation of the os in primiparæ relieved by painting the os and cervix with 12 per cent. solution.—B.M.J. ii./85,473.

In supra-orbital neuralgia, a 10 or 20 per cent. solution in oil of cloves rubbed into the part affords immediate

relief; with summary of its medical uses.—Pr. xxxiv. 59; M.R. 1884,516.

In sea sickness, several cases, $\frac{1}{16}$ grain doses every two or three hours in aqueous solution were successful. A girl of 18 had been sick 24 hours before it was tried; she had a double dose every half-hour with "truly magical effect."—L. ii./85,451; B.M.J. ii./85,627.

German and Russian recommendations of its use in sea sickness.—L. ii./85,912.

Sea sickness effectually checked by two lozenges each containing $\frac{1}{12}$ grain of hydrochlorate of cocaine taken when first threatened and two more in twenty minutes. One grain doses in solution also effectual.—P.J.1886,712.

Thimble-shaped pessaries, composed of cocaine and oil of theobroma, relieved the pains of the first stage of labour, when inserted into the dilated os uteri. B.M.J. ii./85,1140,1159.

Morphine habit of three years' standing, 8½ grains taken during three days was successful in curing.—B.M.J. ii./85, 1112.

Poisonous effects attributed to local use in fourteen eye cases and three hypodermic injections.—B.M.J. ii./85, 983.

A man fainted when solution of cocaine salt was applied to his eye.—B.M.J. ii./85,1060.

Another similar case.—B M J. i./86, 67.

In eye operations, the diminished elasticity produced by cocaine may be a source of inconvenience.—L. ii./85, 1158.

Dangers from use of cocaine in eye cases supposed to be due to decomposition accompanying fungoid growth. Graefe recommends the cocaine salt to be dissolved in solution of mercuric chloride 1 in 20,000.—L. ii./85, 863,996,1070,1119,1167; B.M.J. ii./85,971,1184.

Sterilizing by boiling also recommended.—Amer.Drug. 1886,29.

Cocaine craving, 5 to 7 drachms per day of 4 per cent. solution caused a state of system allied to delirium tremens.—L. ii./85,732.

Facial neuralgia relieved by quarter of a grain of salicylate of cocaine.—L. ii./85,733.

Hay fever, it fails when it is severe.—L. ii./85,820.

Hydrocele, medical cure of, a preliminary injection of cocaine solution before the injection of iodine recommended.—L. ii./85,829.

Earache, a 2 per cent. solution of the hydrochlorate on wool is useful.—B.M.J. i./86,87.

Toe-nail ingrowing, removal of, local injections should precede.—B.M.J. ii./85,1060.

Larynx painted with 20 per cent solution, a state of spasm was caused which required chloroform to subside it.—L. ii./85,946.

Whooping-cough, 15 to 20 per cent. solution a valuable pigment to the larnyx.—B.M.J. ii./85,981,992.

For removal of a pile, after bathing it with hot water, some dry hydrochlorate was dusted over it, and one grain injected into its base; in 10 minutes after on applying the clamp and cautery, it was painlessly removed; the patient was next day able to attend his business; also found useful in many minor operations.—L. i./86, 527.

General résumé of its effects and uses. B.M.J. i./86, 527,574.

Thigh successfully amputated under the influence of Cocaine, 1 per cent. solution injected into the skin and a half per cent. solution into the deeper parts; only during the sawing of the bone did the man complain of pain.—L. i/86,561 *ex Med. Jour.* N.Y., Feb. 20th.

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