

CLASSICS REVISITED

Uber Coca: Freud's Cocaine Discoveries

EDITOR'S INTRODUCTION

REGARDLESS OF THE ADJECTIVES used to describe contemporary cocaine use and/or abuse, the trend toward increased and more widespread use has been well documented (e.g., Gold, 1983). The history of cocaine goes back more than a millennium to the early use of the coca plant (*Erthroxylon coca*) in South America. Dyke (1981) suggests that the reasons for the early practice of chewing the coca plant leaves have been lost in antiquity, but that there is evidence from Indian burial sites that this activity began before the 6th century A.D. Dyke also notes that the coca leaves were considered "precious and were usually reserved for nobility and religious ceremonies" (1981, p. 158). Presently, it is estimated that over 4 million Peruvian and Bolivian Indians chew coca leaves regularly (Dyke, 1981).

Even though chewing the coca leaf could produce euphoria, this activity was not as popular in Europe as drinking tea or coffee, perhaps, Dyke (1981) suggests, because the leaves deteriorated during the long voyages between South America and Europe. In 1855 Gardeke was the first to extract the active ingredient of the coca leaf, which he called erythroxyton. According to Byck (1974), Niemann isolated the alkaloid 5 years later and named it cocaine. Once this psychoactive ingredient was isolated, there was a great flourish of personal experience and scientific experimentation with the substance.

Sigmund Freud, the "father of psychoanalysis," was initially responsible for the medical, scientific, and personal interest expressed by many of those who studied and used cocaine since the nineteenth century. In fact, Freud's work, *Uber Coca*, has been considered to be "the definitive description of the effects of cocaine in humans" (Dyke, 1981, p. 159) and reflects the history of the study and use of cocaine from the middle to the end of the nineteenth century.

Freud began his work with cocaine while he was a house officer at the Vienna General Hospital. His first reference to cocaine was expressed in a letter written on April 21, 1884 to his fiancée Martha Ber-

nays when he identified a "therapeutic project and a hope" (Byck, 1974, p. 5).

I have been reading about cocaine, the essential constituent of coca leaves which some Indian tribes chew to enable them to resist privations and hardships. A German has been employing it with soldiers and has in fact reported that it increases their energy and capacity to endure. I am procuring some myself and will try it with cases of heart disease and also of nervous exhaustion, particularly in the miserable condition after the withdrawal of morphium . . . Perhaps others are working at it; perhaps nothing will come of it. But I shall certainly try it, and you know that when one perseveres, sooner or later one succeeds. (Byck, 1974, pp. 5-6)

This letter indicates several things about Freud and the context in which he worked. First, it reflects the passion and achievement motivation that energized his creative life. Second, it hints at the willingness of Freud to fail, persevere, and ultimately succeed at an endeavor that had little positive consequence guaranteed. In addition, this letter reflects the lack of regulation surrounding the use of cocaine as well as the standard medical practice of that time for physicians to use and experiment with the drugs that they were studying or prescribing. Finally, Freud's willingness to experiment personally with cocaine indicates that he did not consider the drug experience as discontinuous from the rest of his life; perhaps, with his willingness to alter his own consciousness and accept the potential risks inherent to this experience, Freud was, unknowingly, laying the subjective groundwork for his conceptual development of the unconscious.

Uber Coca describes the history, pharmacology, animal and human effects, as well as the medicinal applications of cocaine. Although Freud described a variety of medical applications for cocaine, it was only later, in an addenda to this paper, that he considered the anesthetic properties of the substance and its application for eye surgery. Consequently, Karl Koller, a colleague of Freud, is considered by most sources to be the discoverer of local anesthesia (Byck, 1974).

Über Coca stands as a beacon to the understanding of cocaine and its natural history within a social and scientific context that was essentially unregulated, and therefore, not influenced by government intervention. In addition, *Über Coca* illustrates the naive tendency of some energetic investigators to believe that it is possible to "cure" chemical dependency to one drug simply by substituting another, i.e., treating the symptoms of morphine and alcohol dependence with cocaine. Freud displayed similar naivete—as have scores of other clinicians—by not recognizing the insidious and potent abuse potential of cocaine. Nevertheless, Freud's analysis of the psychological and physiological effects of cocaine remain as informative and precise as when these descriptions were originally formulated. As a result, Freud can

deservedly be considered as one of the founders of contemporary psychopharmacology (Byck, 1974).

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Über Coca

SIGMUND FREUD

I. The Coca Plant

The coca plant, *Erythroxylon coca*, is a bush four to six feet in height, similar to our blackthorn. It is cultivated extensively in South America, in particular in Peru and Bolivia. It thrives best in the warm valleys on the eastern slopes of the Andes, 5000–6000 feet above sea level, in a rainy climate free from extremes of temperature.¹ The leaves, which provide an indispensable stimulant for some 10 million people,² are egg-shaped, 5–6 cm long, stalked, undivided, and pruinose. They are distinguished by two linear folds, especially prominent on the lower surface of the leaf, which, like lateral nerves, run along the medial nerve from the base of the leaf to its point in a flat arc.* The bush bears small white flowers in lateral clusters of two or three, and produces red egg-shaped fruits. It can be propagated either by seed or by cuttings; the young plants are transplanted after a year and yield their first crop of leaves after eighteen months. The

leaves are considered ripe when they have become so stiff that their stalks break upon being touched.

They are then dried rapidly, either in the sun or with the aid of fire, and sewn into sacks (*cestos*) for transport. In favorable conditions a coca bush yields four or five leaf crops annually and will continue to produce a yield for between thirty and forty years. The large-scale production (allegedly 30 million pounds annually) makes coca leaves an important item of trade and taxation in the countries where they are grown.³

II. The History and Uses of Coca in its Country of Origin

When the Spanish conquerors forced their way into Peru they found that the coca plant was cultivated and held in high esteem in that country; and indeed that it was closely connected with the religious customs of the people. Legend held that Manco Capac, the divine son of the Sun, had descended in primeval times from the cliffs of Lake Titicaca, bringing his father's light to the wretched inhabitants of the country; that he had brought them knowledge of the gods, taught them the useful arts, and given them the coca leaf, this divine plant which satiates the hungry, strengthens the weak, and causes them to forget their misfortune.⁴ Coca leaves were offered in sacrifice to the gods, were chewed during religious ceremonies, and were even placed in the mouths of the dead in order to assure them of a favorable reception in the beyond. The historian of the Spanish conquest,⁵ him-

*I owe this description to Professor Vogl of Vienna, who has most kindly placed his notes and books about coca at my disposal.

"Über Coca." Von Dr. Sigm. Freud, Secundararzt im k.k. Allgemeinen Krankenhause in Wien. *Centralblatt für die ges. Therapie*. 2, 289–314, 1884 Juli.

On Coca. By Dr. Sigmund Freud, house officer of the General Hospital of Vienna.

Translated by Steven A. Edminster; additions to the translation by Frederick C. Redlich.

Reprinted from *Cocaine Papers* (1974), R. Byck (Ed.). Stonehill Publishing Company, New York.

self a descendant of the Incas, reports that coca was at first a scarce commodity in the land and its use a prerogative of the rulers; by the time of the conquest, however, it had long since become accessible to everyone. Garcilasso endeavored to defend coca against the ban which the conquerors laid upon it. The Spaniards did not believe in the marvelous effects of the plant, which they suspected as the work of the devil, mainly because of the role which it played in the religious ceremonial. A council held in Lima went so far as to prohibit the use of the plant on the ground that it was heathenish and sinful. Their attitude changed, however, when they observed that the Indians could not perform the heavy labor imposed upon them in the mines if they were forbidden to partake of coca. They compromised to the extent of distributing coca leaves to the workers three or four times daily and allowing them short periods of respite in which to chew the beloved leaves. And so the coca plant has maintained its position among the natives to the present day; there even remain traces of the religious veneration which was once accorded to it.⁶

The Indian always carries a bundle of coca leaves (called *chuspa*) on his wanderings, as well as a bottle containing plant ash (*llicta*).⁷ In his mouth he forms the leaves into a ball, which he pierces several times with a thorn dipped⁸ in the ash, and chews slowly and thoroughly with copious secretion of saliva. It is said that in other areas a kind of earth, *tonra*, is added to the leaves in place of the plant ash.⁹ It is not considered immoderate to chew from three to four ounces of leaves daily. According to Mantegazza, the Indian begins to use this stimulant in early youth and continues to use it throughout his life. When he is faced with a difficult journey, when he takes a woman, or, in general, whenever his strength is more than usually taxed, he increases the customary dose.

(It is not clear what purpose is achieved through the admixture of the alkalis contained in the ash. Mantegazza claims to have chewed coca leaves both with and without *llicta* and to have noticed no difference. According to Martius¹⁰ and Demarle,¹¹ the cocaine, probably held in compound with tannic acid, is released by the action of the alkalis. A *llicta* analyzed by Bibra consisted of 29% carbonate of lime and magnesia, 34% potassium salts, 3% argillaceous earth and iron, 17% insoluble compounds of argillaceous earth, siliceous earth and iron, 5% carbon and 10% water.)

There is ample evidence that Indians under the influence of coca can withstand exceptional hardships and perform heavy labor, without requiring proper nourishment during that time.¹² Valdez y Palacios¹³ claims that by using coca the Indians are able to travel on foot for hundreds of hours and run faster than horses without showing signs of fatigue. Castel-

nau,¹⁴ Martius,¹⁵ and Scrivener¹⁶ confirm this, and Humboldt speaks of it in connection with his trip to the equatorial regions as a generally known fact. Often quoted is Tschudi's¹⁷ report concerning the performance of a *cholo* (half-breed) whom he was able to observe closely. The man in question carried out laborious excavation work for five days and nights, without sleeping more than two hours each night, and consumed nothing but coca. After the work was completed he accompanied Tschudi on a two-day ride, running alongside his mule. He gave every assurance that he would gladly perform the same work again, without eating, if he were given enough coca. The man was sixty-two years old and had never been ill.

In the *Journey of the Frigate 'Novara'*, similar examples are recounted of increased physical powers resulting from the use of coca. Weddell,¹⁸ von Meyen,¹⁹ Markham,²⁰ and even Poeppig²¹ (whom we have to thank for many of the slanderous reports about coca) can only confirm this effect of the leaf, which, since it first became known, has continued to be a source of astonishment throughout the world.

Other reports stress the capacity of the *coqueros* (coca chewers) to abstain from food for long periods of time without suffering any ill effects. According to Unanue,²² when no food was available in the besieged city of La Paz in the year 1781, only those inhabitants survived who partook of coca. According to Stewenson,²³ the inhabitants of many districts of Peru fast, sometimes for days, and with the aid of coca are still able to continue working.

In view of all this evidence, and bearing in mind the role which coca has played for centuries in South America, one must reject the view sometimes expressed, that the effect of coca is an imaginary one and that through force of circumstances and with practice the natives would be able to perform the feats attributed to them even without the aid of coca. One might expect to learn that the *coqueros* compensate for abstention from food by eating correspondingly more during the intervals between their fasts, or that as a result of their mode of life they fall into a rapid decline. The reports of travelers on the former point are not conclusive; as for the latter, it has been denied emphatically by reliable witnesses. To be sure, Poeppig painted a terrible picture of the physical and intellectual decadence which are supposed to be the inevitable consequence of the habitual use of coca. But all other observers affirm that the use of coca in moderation is more likely to promote health than to impair it, and that the *coqueros* live to a great age.²⁴ Weddell and Mantegazza too, however, point out that the immoderate use of coca leads to a cachexia characterized physically by digestive complaints, emaciation, etc., and mentally by moral depravity and a complete apathy toward everything not con-

nected with the enjoyment of the stimulant. White people sometimes succumb as well to this state, which bears a great similarity to the symptoms of chronic alcoholism and morphine addiction. It is not taken in wholly immoderate quantities, and never from a presumptive disproportion between the amount of nourishment taken and the amount of work performed by the *coqueros*.

III. Coca Leaves in Europe—Cocaine

According to Dowdeswell,²⁵ the earliest recommendation for coca is contained in an essay by Dr. Monardes (Seville, 1569) which appeared in English translation in 1596. Like the later reports of the Jesuit Father Antonio Julian,²⁶ and the doctor Pedro Crespo,²⁷ both of Lima, Monardes' essay extols the marvelous effect of the plant in combating hunger and fatigue. Both of the former authors had great hopes for the introduction of coca into Europe. In 1749 the plant was brought to Europe; it was described by A.L. de Jussieu and classed with the genus *Erythroxylon*. In 1786 it appeared in Lamarck's *Encyclopédie Méthodique Botanique* under the name of *Erythroxylon coca*. Reports of travelers such as Tschudi and Markham, among others, provided proof that the effect of coca leaves is not confined to the Indian race.

In 1859, Paolo Mantegazza, who had lived for a number of years in South America's coca regions, published his discoveries about the physiological and therapeutic effects of coca leaves in both hemispheres²⁸ Mantegazza is an enthusiastic eulogist of coca and illustrated the versatility of its therapeutic uses in reports of case histories. His report aroused much interest but little confidence. However, I have come across so many correct observations in Mantegazza's publication that I am inclined to accept his allegations even when I have not personally had an opportunity to confirm them.

In 1859, Dr. Scherzer, a member of the expedition in the Austrian frigate *Novara*, brought a batch of coca leaves to Vienna, some of which he sent to Professor Wöhler for examination. Wöhler's pupil Niemann²⁹ isolated the alkaloid cocaine from them. After Niemann's death, Lossen,³⁰ another pupil of Wöhler, continued the investigation of the substances contained in coca leaves.

Niemann's cocaine crystallizes in large, colorless, 4–6-sided prisms of the monoclinic type. It has a somewhat bitter taste and produces an anesthetic effect on the mucous membranes. It melts at a temperature of 98°C, is difficult to dissolve in water* but is

easily soluble in alcohol, ether, and dilute acids. It combines with platinum chloride and gold chloride to form double salts. On heating with hydrochloric acid it breaks down into benzoic acid, methyl alcohol, and a little-studied base called ecgonin. Lossen established the following formula for cocaine: $C_{17}H_{24}NO_4$. Because of their high degree of solubility in water, the salts which it forms with hydrochloric acid and acetic acid are particularly suitable for physiological and therapeutic uses.³¹

In addition to cocaine, the following substances have been found in coca leaves: cocatannic acid, a peculiar wax, and a volatile base, hygrine, which has a smell reminiscent of trimethylamine, and which Lossen isolated in the form of a viscous light yellow oil. Judging by reports from chemists, there are still more substances contained in coca leaves which have not yet been discovered.

Since the discovery of cocaine numerous observers have studied the effects of coca on animals as well as on healthy and sick human beings; they sometimes used a preparation described as cocaine, and sometimes the coca leaves themselves, either in an infusion or after the manner of the Indians. In Austria, Schroff senior carried out the first experiments on animals in 1862; other reports on coca have come from Frankl (1860), Fronmüller (1863), and Neudörfer (1870). As for work carried out in Germany, the therapeutic recommendations of Clemens (1867), von Anrep's experiments on animals (1880) and Aschenbrandt's experiments on exhausted soldiers (1883) may be mentioned.

In England A. Bennett carried out the first experiments on animals in 1874; in 1876 the reports of the president of the British Medical Association, Sir Robert Christison, created a considerable stir; and when a correspondent of the *British Medical Journal* claimed that a Mr. Weston (who had astonished scientific circles in London by his remarkable walking feats) chewed coca leaves, coca became, for a time, a subject of general interest. In the same year (1876) Dowdeswell published the results of a completely ineffective experiment carried out in the laboratory of University College, after which coca seems to have found no one in England willing to undertake further research.*

From the French literature on the subject, the following should be mentioned: Rossier (1861), De-

*There is very little agreement among authors about the solubility of cocaine in water. It is evident that various preparations of "cocaine" came on the market and were brought into use.

*For the collation of literature, I relied on the article, "Erythroxylon coca" in the Index Catalogue of the Library of the Surgeon-General's office, vol. IV, 1883, which can almost be considered as a complete index of the literature. Because of the inadequacy of our own public libraries, I was able to acquaint myself with a part of the literature which I have referred to on coca only by way of references and second-hand reports; I hope, however, that I have read enough to achieve my aim in this essay: to gather together all the existing information on coca.

16. Loc. cit.
17. *Travel sketches from Peru in 1838 and 1842*.
18. Loc. cit.
19. *Journey Round the World*, 1835.
20. *Travels in Peru and India*, 1862.
21. *Journey in Chile, Peru and on the Amazon River*, 1827-32.
22. *Disertacion sobre el aspecto, cultivo, comercio y virtudes de la famosa planta del Peru nombrado Coca*. Lima: 1794.
23. *Historical and descriptive narrative of twenty years residence in South America*. 1825.
24. Fronmüller. Loc. cit.
25. "The Coca Leaf." *Lancet*. 1876.
26. *Disertacion sobre Hayo o Coca*. Lima: 1793.
27. *Memoria sobre la coca*. Lima: 1793.
28. Mantegazza, "Sulle virtù igieniche e medicinali della coca. Memoria onorata del Premio dell'Acqua nel concorso di 1858, estratto dagli Annali Universali di Medicina 1859." A short paper contained in the *Oesterreichische Zeitschrift für praktische Heilkunde*, of the same year.
29. *Annal. d. Chemie u. Pharmac.* 114, and *Vierteljahresschrift für praktische Pharmacie*, 9.
30. *Annalen. d. Chemie und Pharmacie*, 133.
31. Husemann and Higler. "Plant Substances, etc." 1884; Girtler. "On Coca, extract of coca and cocaine." *Wiener Med. Wochenschrift*: 1862.
32. "On the physiological effects of cocaine," *Pflügers Archiv*, XXI, 1880.
33. "Preliminary report on cocaine," *Wochenblatt der Gesellschaft der Aerzte in Wien*, 1862.
34. *Recherches Chimiques et physiologiques sur l'Erythroxyton Coca du Pérou*, 1868.
35. "Cocaine and Diabetes," 1872 (Russian).
36. "Contribution to the study of the effects of cocaine on the animal organism." (Russian).
37. "On the physiological effects and the therapeutic use of cocaine," 1872 (Russian).
38. "An experimental inquiry into the physiological action of Theine, etc., etc." *Edinburgh Medical and Surgical Journal*, 1874.
39. "Coca and its alkaloid cocaine," *New York Medical Record*, 1876.
40. *Finska läkaresällsk. handl.* XX, 1878.
41. "De la coca et de ses véritables propriétés thérapeutiques," *L'Union Médicale*, 1877.
42. "Sur l'action physiologique des feuilles de coca," *Echo Medical Suisse*, 1861.
43. *Essai sur la coca du Pérou*, Thesis, Paris: 1862.
44. "Note sur l'emploi de la coca." *Bulletin de Thérapeutique*, 1866.
45. "Observations on the effect of cuca, or coca, etc." *British Medical Journal*, 1876.
46. "Experiences in connection with the therapeutic use of coca leaves," *Deutsche Klinik*, 1867.
47. J. Collan, *Finska läkaresällsk. handl.* XX, 1878-from *Schmidt's Yearbooks*, 87, 1880.
48. "Erythroxyton coca; its physiological effects, etc." *Boston Medical and Surgical Journal*, 1882.
49. "The physiological effects of *cocainum muriaticum* on the human body and their significance. Observations carried out during the autumn maneuvers of the Third Bavarian Army Corps in 1883," *Deutsche med. Wochenschrift*, December 12, 1883.
50. Loc. cit.
51. Ploss. *Zeitschrift für Chirurgie*, 1863.
52. *Philadelphia Medical and Surgical Reporter*, 1883.
53. *Detroit Therapeutic Gazette*, February 1883.
54. "Review of some of our later remedies." *Detroit, Th.G.*, December, 1880.
55. "Ricerche sperimentali sull'azione fisiologica e terapeutica della cocaina," *Rendiconti del R. Ist Lombardo*, XIV, 1882.
56. *Pharmakologisch-Therapeutisches Handbuch*, Erlangen, 1862.
57. "Communication on coca," by Dr. Josef Frankl, spa doctor in Marienbad. *Zeitschrift der K. Gesellschaft der Aerzte*, 1860.
58. "Erythroxyton coca in the treatment of typhus and typhoid fevers, and also of other febrile diseases." *British Medical Journal*, v. 1 for 1887.
59. *Detroit Therapeutic Gazette*, July, 1880.
60. "Coca Erythroxyton in exhaustion." *Detroit, Th.G.* October, 1880.
61. *Detroit, Th.G.* September, 1880, based on the *Louisville Medical News*.
62. Marvaud. *Les aliments d'epargne*. Paris: 1874.
63. "Physiology of general metabolism." 1881, *Hermann's Handbuch*, VI, 1.
64. "Erythroxyton coca, its physiological effect especially its effect on the excretion of urea by the kidneys." *Boston Med. and Surgical Journal*, 1882.
65. *Comptes rendus de l'Académie des Sciences*, II, 1870.
66. In Marvaud.
67. "Pathology and Treatment in venereal diseases." In *Detroit, Th.G.* February 1884.
68. Loc. cit.
69. "Erythroxyton coca in the Opium and alcohol habits." *D.T.G.* September, 1880.
70. *D.T.G.* November, 1880.
71. J. Brenton, *T.G.* March, 1881; G.H. Gray, from "The medical brief," *T.G.* June, 1881; H. Leforger, Dec. 1872.
72. E.C. Huse, *T.G.* September, 1880; Henderson, *T.G.* February, 1881.
73. R. Taggart, *T.G.* May, 1881; A.F. Stimmel, *T.G.* July, 1881.
74. W.H. Bentley, *T.G.* September (18)80; Volum. January 1881; H. Warner, March (18)81; Stimmel, April and July, (18)81.
75. *Travels in Peru and India*, 1862.
76. "The Erythroxyton coca in asthma." *Philadelphia Medical and Surgical Reporter*, 1881.
77. *T.G.*, Dec. 1880.
78. "De la coca et de ses véritables propriétés thérapeutiques." *L'Union médicale*, 1877.

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of morphine. I am rather inclined to assume that coca has a directly antagonistic effect on morphine, and in support of my view I quote the following observations of Dr. Josef Pollak on a case in point:

"A thirty-three-year-old woman has been suffering for years from severe menstrual migraine which can be alleviated only by morphia injections. Although the lady in question never takes morphia or experiences any desire to do so when she is free of migraine, during the attacks she behaves like a morphine addict. A few hours after the injection she suffers intense depression, biliousness, attacks of vomiting, which are stopped by a second morphine injection; thereupon, the symptoms of intolerance recur, with the result that an attack of migraine, along with all its consequences, keeps the patient in bed for three days in a most wretched condition. Cocaine was then tried to combat the migraine, but the treatment proved unsuccessful. It was necessary to resort to morphine injections. But as soon as the symptoms of morphine intolerance appeared, they were quickly relieved by 1dg of cocaine, with the result that the patient recovered from her attack in a far shorter time and consumed much less morphine in the process."

Coca was tried in America for the treatment of chronic alcoholism at about the same time as it was introduced in connection with morphine addiction, and most reports dealt with the two uses conjointly.⁷⁴ In the treatment of alcoholism, too, there were cases of undoubted success, in which the irresistible compulsion to drink was either banished or alleviated, and the dyspeptic complaints of the drinkers were relieved. In general, however, the suppression of the alcohol craving through the use of coca proved to be more difficult than the suppression of morphomania; in one case reported by Bentley the drinker became a *coquero*. One need only suggest the immense economic significance which coca would acquire as a "source of savings" in another sense, if its effectiveness in combating alcoholism were confirmed.

e) *Coca and asthma*. Tschudi and Markham⁷⁵ report that by chewing coca leaves they were spared the usual symptoms of the so-called mountain sickness while climbing in the Andes; this complex of symptoms includes shortness of breath, pounding of the heart, dizziness, etc. Poizat⁷⁶ reports that the asthmatic attacks of a patient were arrested in every case by coca. I mention this property of coca because it appears to admit of a physiological explanation. Von Anrep's experiments on animals resulted in early paralysis of certain branches of the vagus; and altitude asthma, as well as the attacks characteristic of chronic bronchitis, may be interpreted in terms of a reflex excitation originating in the pulmonary branches of the vagus. The use of coca should be considered for the treatment of other vagus neuroses.

f) *Coca as an aphrodisiac*. The natives of South America, who represented their goddess of love with coca leaves in her hand, did not doubt the stimulative effect of coca on the genitalia. Mantegazza confirms that the *coqueros* sustain a high degree of potency right into old age; he even reports cases of the restoration of potency and the disappearance of functional weaknesses following the use of coca, although he does not believe that coca would produce such an effect in all individuals. Marvaud emphatically supports the view that coca has a stimulative effect; other writers strongly recommend coca as a remedy for occasional functional weaknesses and temporary exhaustion; and Bentley reports on a case of this type in which coca was responsible for the cure.⁷⁷

Among the persons to whom I have given coca, three reported violent sexual excitement which they unhesitatingly attributed to the coca. A young writer, who was enabled by treatment with coca to resume his work after a longish illness, gave up using the drug because of the undesirable secondary effects which it had on him.

g) *Local application of coca*. Cocaine and its salts have a marked anesthetizing effect when brought in contact with the skin and mucous membrane in concentrated solution; this property suggests its occasional use as a local anesthetic, especially in connection with affections of the mucous membrane. According to Collin,⁷⁸ Ch. Fauvel strongly recommends cocaine for treating diseases of the pharynx, describing it as "*le tenseur par excellence des chordes vocales*." Indeed, the anesthetizing properties of cocaine should make it suitable for a good many further applications.

NOTES

1. O.R. Markham. *Peruvian Barks*, London: 1880.
2. According to Bibra's estimate. *Narcotic Stimulants*, 1885.
3. Weddell. *Voyage dans le Nord de la Bolivie*, 1853.
4. Scrivener, "On the coca leaf and its use in diet and medicine," *Medical Times and Gazette*, 1871.
5. Garcilasso de la Vega. *Commentarios reales de los Incas*. 1609-1617.
6. Christison, "Observations on the effect of cuca, or coca, the leaves of Erythroxylon Coca." *British Medical Journal*, 1876. Bibra. Loc. cit.
7. Mantegazza, "*Sulle virtu igieniche e medicinali della coca*." Milan: 1859.
8. Scrivener. Loc. cit.
9. According to Ullo, whom Bibra copies.
10. *Systema mat. med. brasil.*, 1843.
11. *Essai sur la coca du Pérou*, Thesis. Paris: 1862.
12. cf. Fronmüller. "Coca and Cat." *Prager Vierteljahresschrift für praktische Heilkunde*, v. 79, 1863.
13. *Viagem de cidade de Cuzco a de Belem*, 1840.
14. *Expédition dans les parties centrales de l'Amerique du Sud*, 1851.
15. Spix's and Martius' *Journal in Brazil*, 1831.

marle (1862), Gosse's monograph on *Erythroxylon coca* (1862), Reiss (1866), Lippmann's *Etude sur la coca du Pérou* (1868), Moréno y Maiz (1868), who provided certain new facts about cocaine, Gazeau (1870), Collins (1877), and Marvaud in the book *Les aliments d'épargne* (1874), the only of the above essays at my disposal.

In Russia Nikolsky, Danini (1873), and Tarkhanov (1872) concentrated particularly on studying the effects of cocaine on animals. Many reports, all of which have been published in the *Detroit Therapeutic Gazette*, have emerged from North America in recent years on the successful therapeutic use of cocaine preparations.

The earlier of the investigations referred to here led, on the whole, to great disillusionment and to the conviction that effects from the use of coca such as had been reported so enthusiastically from South America could not be expected in Europe. Investigations such as those carried out by Schroff, Frömmüller, and Dowdeswell produced either negative or, at the most, insignificant results. There is more than one explanation for these failures. Certainly the quality of the preparations used was largely to blame.† In a number of cases the authors themselves doubt as to the quality of their preparations; and to the extent that they believe the reports of travelers on the effects of coca, they assume that these effects must be attributed to a volatile component of the leaf. They base this assumption on the report of Poeppig, among others, that even in South America leaves which have been stored for a long time are considered worthless. The experiments carried out recently with the cocaine prepared by Merk [sic] in Darmstadt alone justify the claim that cocaine is the true agent of the coca effect, which can be produced just as well in Europe as in South America and turned to good account in dietetic and therapeutic treatment.

IV. The Effect of Coca on Animals

We know that animals of different species—and even individuals of the same species—differ most markedly from one another in those chemical characteristics which determine the organism's receptivity to foreign substances. We would, therefore, as a matter of course, not expect to find that the effect of coca on animals in any way resembled the effects which it has been described to have on man. We may be satisfied with the results of our inquiry to the extent that we

can comprehend the way cocaine affects both man and animals from a unified standpoint.

We are indebted to von Anrep³² for the most exhaustive experiments regarding the effects of coca on animals. Before him, such experiments were carried out by Schroff senior,³³ Moréno y Maiz,³⁴ Tarkhanov,³⁵ Nikolsky,³⁶ Danini,³⁷ A. Bennett,³⁸ and Ott.³⁹ The majority of these authors introduced the alkaloid either orally or subcutaneously.

The most general result of such experiments is that, in small doses, coca has a stimulating, and in larger doses a paralyzing, effect on the nervous system. In the case of cold-blooded animals the paralyzing effect is particularly noticeable, while in warm-blooded animals symptoms of stimulation are the most apparent.

According to Schroff, cocaine produces in frogs a soporific condition accompanied by paralysis of the voluntary muscles. Moréno y Maiz, Danini, Nikolsky, and Ott made fundamentally the same discovery; Moréno y Maiz alleges that the general paralysis ensuing from moderate doses is preceded by tetanus; under the same conditions Nikolsky describes a stage of excitation of the muscular system, while Danini, on the other hand, never observed any spasms.

Von Anrep likewise reports a paralyzing effect of cocaine on frogs after a short period of excitation. At first the sensory nerve endings and later the sensory nerves themselves are affected; breathing is at first accelerated and then brought to a standstill; and the functioning of the heart is slowed down until the point of diastolic failure is reached. Doses of 2mg suffice to provoke symptoms of poisoning.

According to Schroff's accounts of his experiments with rabbits (which in detail are fraught with contradictions), coca produces multiple spasms in rabbits, increased respiration and pulse rate, dilation of the pupils, and convulsive death. The effectiveness of the poisoning depended to a large extent on the mode of application. According to Danini, cocaine poisoning in warm-blooded animals produces at first agitation, which manifests itself in continuous jumping and running, then paralysis of the muscular functions, and finally spasmodic (clonic) cramps. Tarkhanov discovered an increase of mucous secretion in dogs dosed with coca, and also sugar in the urine.

In von Anrep's experiments, the effect of cocaine, even in large doses, on warm-blooded animals manifested itself first of all in powerful psychic agitation and an excitation of the brain centers which control voluntary movement. After doses of 0.01g of cocaine per kg, dogs show obvious signs of happy excitement and a maniacal compulsion to move. From the character of these movements von Anrep sees evidence that all nerve centers are affected by the stimulation, and he interprets certain swinging motions of the head as an irritation proceeding from the semi-

†The cocaine content of coca leaves varies, according to Lossen, between 0.2% and 0.02%. 0.05g of *cocainum muriaticum* appears to be the minimum dose which is effective in man. According to Lippmann (*Etude sur la coca du Pérou*, Thesis. Strasbourg: 1868), a dried coca leaf weighs 1dg.

circular canals. Further manifestations of cocaine intoxication are accelerated respiration, a great increase in the pulse rate owing to early paralysis of the N. vagi, dilation of the pupils, an acceleration of intestinal movement, a great increase in blood-pressure, and diminution of secretions. Even after doses large enough to produce eventual convulsions, symptoms of paralysis and death due to paralysis of the respiratory center, the striated muscle substance remains intact. Von Anrep does not establish the lethal dose for dogs; for rabbits it is 0.10g and for cats 0.02g per kg.*

When the spinal cord is severed from the oblongata, cocaine produces neither cramps nor a rise in blood-pressure (Danini); when the dorsal portion of the spinal cord is severed, cocaine spasms occur in the front but not in the rear extremities (von Anrep). Danini and von Anrep assume, therefore, that cocaine affects primarily the vital area of the medulla oblongata.

I should add that only the elder Schroff refers to cocaine as a narcotic and classes it with opium and cannabis, while almost everyone else ranks it with caffeine, etc.

V. The Effect of Coca on the Healthy Human Body

I have carried out experiments and studied, in myself and others, the effect of coca on the healthy human body; my findings agree fundamentally with Mantegazza's description of the effect of coca leaves.*

The first time I took 0.05g. of *cocainum muriaticum* in a 1% water solution was when I was feeling slightly out of sorts from fatigue. This solution is rather viscous, somewhat opalescent, and has a strange aromatic smell. At first it has a bitter taste, which yields afterwards to a series of very pleasant aromatic flavors. Dry cocaine salt has the same smell and taste, but to a more concentrated degree.

A few minutes after taking cocaine, one experiences a sudden exhilaration and feeling of lightness. One feels a certain furriness on the lips and palate, followed by a feeling of warmth in the same areas; if one now drinks cold water, it feels warm on the lips and cold in the throat. On other occasions the predominant feeling is a rather pleasant coolness in the mouth and throat.

During this first trial I experienced a short period of toxic effects, which did not recur in subsequent experiments. Breathing became slower and deeper and I felt tired and sleepy; I yawned frequently and felt somewhat dull. After a few minutes the actual cocaine euphoria began, introduced by repeated cooling eructation. Immediately after taking the cocaine I noticed a slight slackening of the pulse and later a moderate increase.

I have observed the same physical signs of the effect of cocaine in others, mostly people of my own age. The most constant symptom proved to be the repeated cooling eructation. This is often accompanied by a rumbling which must originate from high up in the intestine; two of the people I observed, who said they were able to recognize movements of their stomachs, declared emphatically that they had repeatedly detected such movements. Often, at the outset of the cocaine effect, the subjects alleged that they experienced an intense feeling of heat in the head. I noticed this in myself as well in the course of some later experiments, but on other occasions it was absent. In only two cases did coca give rise to dizziness. On the whole the toxic effects of coca are of short duration, and much less intense than those produced by effective doses of quinine or salicylate of soda, they seem to become even weaker after repeated use of cocaine.

Mantegazza refers to the following occasional effects of coca: temporary erythema, an increase in the quantity of urine, dryness of the conjunctiva and nasal mucous membranes. Dryness of the mucous membrane of the mouth and of the throat is a regular symptom which lasts for hours. Some observers (Marvaud, Collan)⁴⁰ report a slight cathartic effect. Urine and feces are said to take on the smell of coca. Different observers give very different accounts of the effect on the pulse rate. According to Mantegazza, coca quickly produces a considerably increased pulse rate which becomes even higher with higher doses; Collin,⁴¹ too, noted an acceleration of the pulse after coca was taken, while Rossier,⁴² Demarle,⁴³ and Marvaud experienced, after the initial acceleration, a longer lasting retardation of the pulse rate. Christison noticed in himself, after using coca, that physical exertion caused a smaller increase in the pulse rate than otherwise; Reiss⁴⁴ disputes any effect on the pulse rate. I do not find any difficulty in accounting for this lack of agreement; it is partly owing to the variety of the preparations used (warm infusion of the leaves, cold cocaine solution, etc.), and the way in which they are applied,* and partly to the

*Administered in subcutaneous injection.

*Like Aschenbrandt (*Deutsche med. Wochenschrift*, Dec., 1883) I used the hydrochloric preparation of cocaine as described by Merk [sic] in Darmstadt. This preparation may be bought in Vienna in Haubner's Engalapothke am Hof at a price which is not much higher than Merk's [sic], but which must, nevertheless, be regarded as very high. The management of the pharmacy in question is trying, as they have been kind enough to inform me, to lower the price of the drug by establishing new sources of supply.

*For the results obtained from subcutaneous injections see Morselli's and Buccola's work.

experiment carried out by history itself, and reported by Unanuè—seems to contradict this conclusion, however, for the inhabitants who had partaken of coca are said to have escaped death by starvation. In this connection one might recall the fact that the human nervous system has an undoubted, if somewhat obscure, influence on the nourishment of tissues; psychological factors can, after all, cause a healthy man to lose weight.

The therapeutic quality of coca which we took as our argument at the outset does not, therefore, deserve to be rejected out of hand. The excitation of nerve centers by cocaine can have a favorable influence on the nourishment of the body afflicted by a consumptive condition, even though that influence might well not take the form of a slowing down of metabolism.

I should add here that coca has been warmly praised in connection with the treatment of syphilis. R.W. Taylor⁶⁷ claims that a patient's tolerance of mercury is increased and the mercury cachexia kept in check when coca is administered at the same time. J. Collan⁶⁸ recommends it as the best remedy for *stomatitis mercurialis* and reports that Pagvalin always prescribes it in conjunction with preparations of mercury.

d) *Coca in the treatment of morphine and alcohol addiction.* In America the important discovery has recently been made that coca preparations possess the power to suppress the craving for morphine in habitual addicts, and also to reduce to negligible proportions the serious symptoms of collapse which appear while the patient is being weaned away from the morphine habit. According to my information (which is largely from the *Detroit Therapeutic Gazette*), it was W.H. Bentley⁶⁹ who announced, in May 1878, that he had substituted coca for the customary alkaloid in the case of a female morphine addict. Two years later, Palmer, in an article in the *Louisville Medical News*, seems to have aroused the greatest general interest in this treatment of morphine addiction; for the next two years "*Erythroxylon coca* in the opium habit" was a regular heading in the reports of the *Therapeutic Gazette*. From then on information regarding successful cures became rarer: whether because the treatment became established as a recognized cure, or because it was abandoned, I do not know. Judging by the advertisements of drug dealers in the most recent issues of American papers, I should rather conclude that the former was the case.

There are some sixteen reports of cases in which the patient has been successfully cured of addiction; in only one instance is there a report of failure of coca to alleviate morphine addiction, and in this case the doctor wondered why there had been so many warm recommendations for the use of coca in cases of morphine addiction.⁷⁰ The successful cases vary in

their conclusiveness. Some of them involve large doses of opium or morphine and addictions of long standing. There is not much information on the subject of relapses, as most cases were reported within a very short time of the cure having been effected. Symptoms which appear during abstinence are not always reported in detail. There is especial value in those reports which contain the observation that the patients were able to dispense with coca after a few weeks without experiencing any further desire for morphine.⁷¹ Special attention is repeatedly called to the fact that morphine cachexia gave way to excellent health, so that the patients were scarcely recognizable after their cure.⁷² Concerning the method of withdrawal, it should be made clear that in the majority of cases a gradual reduction of the habitual dose of the drug, accompanied by a gradual increase of the coca dose, was the method chosen; however, sudden discontinuation of the drug was also tried.⁷³ In the latter case Palmer prescribes that a certain dose of coca should be repeated as often during the day as the desire for morphine recurs.* The daily dose of coca is lessened gradually until it is possible to dispense with the antidote altogether. From the very beginning the attacks experienced during abstinence were either slight or else became milder after a few days. In almost every case the cure was effected by the patient himself, whereas the cure of morphine addiction without the help of coca, as practiced in Europe, requires surveillance of the patient in a hospital.

I once had occasion to observe the case of a man who was subjected to the type of cure involving the sudden withdrawal of morphine, assisted by the use of coca; the same patient had suffered severe symptoms as a result of abstinence in the course of a previous cure. This time his condition was tolerable; in particular, there was no sign of depression or nausea as long as the effects of coca lasted; chills and diarrhea were now the only permanent symptoms of his abstinence. The patient was not bedridden, and could function normally. During the first days of the cure he consumed 3dg of *cocainum muriaticum* daily, and after ten days he was able to dispense with the coca treatment altogether.

The treatment of morphine addiction with coca does not, therefore, result merely in the exchange of one kind of addiction for another—it does not turn the morphine addict into a *coquero*; the use of coca is only temporary. Moreover, I do not think that it is the general toughening effect of coca which enables the system weakened by morphine to withstand, at the cost of only insignificant symptoms, the withdrawal

**T[herapeutic] G[azette]*, July 1880. The preparation used was mostly the fluid extract, manufactured by Parke, Davis and Co.

o'clock, apart from a slight headache, he was normal, even cheerful, and walked for an hour. He could not sleep until 3:00 AM, but that did not distress him. He awoke the next morning healthy, ready for work, and with a good appetite."

The effect of cocaine on the stomach—Mantegazza assumes this as well—is two-fold: stimulation of movement and reduction of the organ's sensitivity. The latter would seem probable not only because of the local sensations in the stomach after cocaine has been taken but because of the analogous effect of cocaine on other mucous membranes. Mantegazza claims to have achieved the most brilliant successes in treatments of gastralgia and enteralgia, and all painful and cramping afflictions of the stomach and intestines, which he attributes to the anesthetizing properties of coca. On this point I cannot confirm Mantegazza's experiences; only once, in connection with a case of gastric catarrh, did I see the sensitivity of the stomach to pressure disappear after the administration of coca. On other occasions I have observed myself, and also heard from other doctors, that patients suspected of having ulcers or scars in the stomach complained of increased pain after using coca; this can be explained by the increased movement of the stomach.

Accordingly, I should say that the use of coca is definitely indicated in cases of atonic digestive weakness and the so-called nervous stomach disorders; in such cases it is possible to achieve not merely a relief of the symptoms but a lasting improvement.

c) *Coca in cachexia*. Long-term use of coca is further strongly recommended—and allegedly has been tried with success—in all diseases which involve degeneration of the tissues, such as severe anemia, phthisis, long-lasting febrile diseases, etc.; and also during recovery from such diseases. Thus McBean⁵⁸ noted a steady improvement in cases of typhoid fever treated with coca. In the case of phthisis, coca is said to have a limiting effect on the fever and sweating. Peckham⁵⁹ reports with regard to a case of definitely diagnosed phthisis that after fluid extract of coca had been used for seven months there was a marked improvement in the patient's condition. Hole⁶⁰ gives an account of another rather serious case in which chronic lack of appetite had led to an advanced condition of emaciation and exhaustion; here, too, the use of coca restored the patient to health. R. Bartholow⁶¹ observed, in general, that coca proved useful in treating phthisis and other "consumptive processes." Mantegazza and a number of other authorities attribute to coca the same invaluable therapeutic quality: that of limiting degeneration of the body and increasing strength in the case of cachexia.

One might wish to attribute such successes partly to the undoubted favorable effect of coca on the digestion, but one must bear in mind that a good

many of the authors who have written on coca regard it as a "source of savings"; i.e., they are of the opinion that a system which has absorbed even an extremely small amount of cocaine is capable, as a result of the reaction of the body to coca, of amassing a greater store of vital energy which can be converted into work than would have been possible without coca.⁶² If we take the amount of work as being constant, the body which has absorbed cocaine should be able to manage with a lower metabolism, which in turn means a smaller intake of food.

This assumption was obviously made to account for the, according to von Voit,⁶³ unexplained effect of coca on the Indians. It does not even necessarily involve a contradiction of the law of conservation of energy. For labor which draws upon food or tissue components involves a certain loss, either in the utilization of assimilated food or in the conversion of energy into work; this loss could perhaps be reduced if certain appropriate steps were taken. It has not been proved that such a process takes place, however. Experiments designed to determine the amount of urine eliminated with and without the use of coca have not been altogether conclusive; indeed, these experiments have not always been conducted in such conditions that they could furnish conclusive results. Moreover, they seem to have been carried out on the assumption that the elimination of urine—which is known not to be effected by labor—would provide a measure of metabolism in general. Thus Christison noted a slight reduction in the solid components of his urine during the walks on which he took coca; Lippmann, Demarle, Marvaud, and more recently Mason⁶⁴ similarly concluded from their experiments that the consumption of coca reduces the amount of urine elimination. Gazeau,⁶⁵ on the other hand, established an *increase* of urine elimination of 11–24% under the influence of coca. A better availability of materials already stored in the body explains, in his opinion, the body's increased working power and ability to do without food when under the influence of coca. No experiments have been carried out with regard to the elimination of carbon dioxide.

Voit proved that coffee, which also rated as a "source of savings," had no influence on the breakdown of albumen in the body. We must regard the conception of coca as a "source of savings" as disproven after certain experiments in which animals were starved, both with and without cocaine, and the reduction of their body weight and the length of time they were able to withstand inanition were observed. Such experiments were carried out by Cl. Bernard,⁶⁶ Moréno y Maíz, Demarle, Gazeau, and von Anrep. The result was that the animals to which cocaine had been administered succumbed to inanition just as soon—perhaps even sooner—than those which had received no cocaine. The starvation of La Paz—an

varying reactions of individuals. With coca this latter factor, as Mantegazza has already reported, is in general of very great significance. There are said to be people who cannot tolerate coca at all; on the other hand, I have found not a few who remained unaffected by 5cg, which for me and others is an effective dose.

The psychic effect of *cocainum muriaticum* in doses of 0.05–0.10g consists of exhilaration and lasting euphoria, which does not differ in any way from the normal euphoria of a healthy person. The feeling of excitement which accompanies stimulus by alcohol is completely lacking; the characteristic urge for immediate activity which alcohol produces is also absent. One senses an increase of self-control and feels more vigorous and more capable of work; on the other hand, if one works, one misses that heightening of the mental powers which alcohol, tea, or coffee induce. One is simply normal, and soon finds it difficult to believe that one is under the influence of any drug at all.*

This gives the impression that the mood induced by coca in such doses is due not so much to direct stimulation as to the disappearance of elements in one's general state of well-being which cause depression. One may perhaps assume that the euphoria resulting from good health is also nothing more than the normal condition of a well-nourished cerebral cortex which "is not conscious" of the organs of the body to which it belongs.

During this stage of the cocaine condition, which is not otherwise distinguished, appear those symptoms which have been described as the wonderful stimulating effect of coca. Long-lasting, intensive mental or physical work can be performed without fatigue; it is as though the need for food and sleep, which otherwise makes itself felt peremptorily at certain times of the day, were completely banished. While the effects of cocaine last one can, if urged to do so, eat copiously and without revulsion; but one has the clear feeling that the meal was superfluous. Similarly, as the effect of coca declines it is possible to sleep on going to bed, but sleep can just as easily be omitted with no unpleasant consequences. During the first hours of the coca effect one cannot sleep, but this sleeplessness is in no way distressing.

I have tested this effect of coca, which wards off hunger, sleep, and fatigue and steels one to intellectual effort, some dozen times on myself; I had no opportunity to engage in physical work.

A very busy colleague gave me an opportunity to observe a striking example of the manner in which

cocaine dispels extreme fatigue and a well justified feeling of hunger; at 6:00 P.M. this colleague, who had not eaten since the early morning and who had worked exceedingly hard during the day, took 0.05g of *cocainum muriaticum*. A few minutes later he declared that he felt as though he had just eaten an ample meal, that he had no desire for an evening meal, and that he felt strong enough to undertake a long walk.

This stimulative effect of coca is vouched for beyond any doubt by a series of reliable reports, some of which are quite recent.

By way of an experiment, Sir Robert Christison⁴⁵—who is seventy-eight years old—tired himself to the point of exhaustion by walking fifteen miles without partaking of food. After several days he repeated the procedure with the same result; during the third experiment he chewed 2 drams of coca leaves and was able to complete the walk without the exhaustion experienced on the earlier occasions; when he arrived home, despite the fact that he had been for nine hours without food or drink, he experienced no hunger or thirst, and woke the next morning without feeling at all tired. On yet another occasion he climbed a 3000-foot mountain and arrived completely exhausted at the summit; he made the descent upon the influence of coca, with youthful vigor and no feeling of fatigue.

Clemens⁴⁶ and J. Collan⁴⁷ have had similar experiences—the latter after walking for several hours over snow; Mason⁴⁸ calls coca "an excellent thing for a long walk"; Aschenbrandt⁴⁹ reported recently how Bavarian soldiers, weary as a result of hardships and debilitating illnesses, were nevertheless capable, after taking coca, of participating in maneuvers and marches. Moréno y Maiz⁵⁰ was able to stay awake whole nights with the aid of coca; Mantegazza remained for forty hours without food. We are, therefore, justified in assuming that the effect of coca on Europeans is the same as that which the coca leaves have on the Indians of South America.

The effect of a moderate dose of coca fades away so gradually that, in normal circumstances, it is difficult to define its duration. If one works intensively while under the influence of coca, after from three to five hours there is a decline in the feeling of well-being, and a further dose of coca is necessary in order to ward off fatigue. The effect of coca seems to last longer if no heavy muscular work is undertaken. Opinion is unanimous that the euphoria induced by coca is not followed by any feeling of lassitude or other state of depression. I should be inclined to think that after moderate doses (0.05–0.10g) a part at least of the coca effect lasts for over twenty-four hours. In my own case, at any rate, I have noticed that even on the day after taking coca my condition compares favorably with the norm. I should be inclined to ex-

*Wilder's account of the effects of cocaine on himself coincide most closely with my own observations. (*Detroit Therapeutic Gazette*. Nov., 1882).

plain the possibility of a lasting gain in strength, such as has often been claimed for coca by the totality of such effects.

It seems probable, in the light of reports which I shall refer to later, that coca, if used protractedly but in moderation, is not detrimental to the body. Von Anrep treated animals for thirty days with moderate doses of cocaine and detected no detrimental effects on their bodily functions. It seems to me noteworthy—and I discovered this in myself and in other observers who were capable of judging such things—that a first dose or even repeated doses of coca produce no compulsive desire to use the stimulant further; on the contrary, one feels a certain unmotivated aversion to the substance. This circumstance may be partly responsible for the fact that coca, despite some warm recommendations, has not established itself in Europe as a stimulant.

The effect of large doses of coca was investigated by Mantegazza in experiments on himself. He succeeded in achieving a state of greatly increased happiness accompanied by a desire for complete immobility; this was interrupted occasionally, however, by the most violent urge to move. The analogy with the results of the animal experiments performed by von Anrep is unmistakable. When he increased the dose still further he remained in a *sopore beato*: His pulse rate was extremely high and there was a moderate rise in body temperature; he found that his speech was impeded and his handwriting unsteady; and eventually he experienced the most splendid and colorful hallucinations, the tenor of which was frightening for a short time, but invariably cheerful thereafter. This coca intoxication, too, failed to produce any state of depression, and left no sign whatsoever that the experimenter had passed through a period of intoxication. Moréno y Maiz also experienced a similar powerful compulsion to move after taking fairly large doses of coca. Even after using 18 drams of coca leaves Mantegazza experienced no impairment of full consciousness. A chemist who attempted to poison himself by taking 1.5g of cocaine⁵¹ became sick and showed symptoms of gastroenteritis, but there was no dulling of the consciousness.

VI. The Therapeutic Uses of Coca

It was inevitable that a plant which had achieved such a reputation for marvelous effects in its country of origin should have been used to treat the most varied disorders and illnesses of the human body. The first Europeans who became aware of this treasure of the native population were similarly unreserved in their recommendation of coca. On the basis of wide medical experience, Mantegazza later drew up a list of the therapeutic properties of coca, which one by one received the acknowledgment of other doctors. In the

following section I have tried to collate the recommendations concerning coca, and, in doing so, to distinguish between recommendations based on successful treatment of illnesses and those which relate to the psychological effects of the stimulant. In general the latter outweigh the former. At present there seems to be some promise of widespread recognition and use of coca preparations in North America, while in Europe doctors scarcely know them by name. The failure of coca to take hold in Europe, which in my opinion is unmerited, can perhaps be attributed to reports of unfavorable consequences attendant upon its use, which appeared shortly after its introduction into Europe; or to the doubtful quality of the preparations, their relative scarcity and consequent high price. Some of the evidence which can be found in favor of the use of coca has been proved valid beyond any doubt, whereas some warrants at least an unprejudiced investigation. Merk's [sic] cocaine and its salts are, as has been proved, preparations which have the full or at least the essential effects of coca leaves.

a) *Coca as a stimulant.* The main use of coca will undoubtedly remain that which the Indians have made of it for centuries: it is of value in all cases where the primary aim is to increase the physical capacity of the body for a given short period of time and to hold strength in reserve to meet further demands—especially when outward circumstances exclude the possibility of obtaining the rest and nourishment normally necessary for great exertion. Such situations arise in wartime, on journeys, during mountain climbing and other expeditions, etc.—indeed, they are situations in which the alcoholic stimulants are also generally recognized as being of value. Coca is a far more potent and far less harmful stimulant than alcohol, and its widespread utilization is hindered at present only by its high cost. Bearing in mind the effect of coca on the natives of South America, a medical authority as early as Pedro Crespo (Lima, 1793) recommended its use by European navies; Neudörfer (1870), Clemens (1867) and Surgeon-Major E. Charles⁵² recommended that it should be adopted by the armies of Europe as well; and Aschenbrandt's experiences should not fail to draw the attention of army administrators to coca. If cocaine is given as a stimulant, it is better that it should be given in small effective doses (0.05–0.10g) and repeated so often that the effects of the doses overlap. Apparently cocaine is not stored in the body; I have already stressed the fact that there is no state of depression when the effects of coca have worn off.

At present it is impossible to assess with any certainty to what extent coca can be expected to increase human mental powers. I have the impression that protracted use of coca can lead to a lasting improvement if the inhibitions manifested before it is taken

are due only to physical causes or to exhaustion. To be sure the instantaneous effect of a dose of coca cannot be compared with that of a morphine injection; but, on the good side of the ledger, there is no danger of general damage to the body as is the case with the chronic use of morphine.

Many doctors felt that coca would play an important role by filling a gap in the medicine chest of the psychiatrists. It is a well-known fact that psychiatrists have an ample supply of drugs at their disposal for reducing the excitation of nerve centers, but none which could serve to increase the reduced functioning of the nerve centers. Coca has consequently been prescribed for the most diverse kinds of psychic debility—hysteria, hypochondria, melancholic inhibition, stupor, and similar maladies. Some successes have been reported: for instance, the Jesuit, Antonio Julian (Lima, 1787) tells of a learned missionary who was freed from severe hypochondria; Mantegazza praises coca as being almost universally effective in improving those functional disorders which we now group together under the name of neurasthenia; Fliessburg⁵³ reports excellent results from the use of coca in cases of “nervous prostration”; and according to Caldwell,⁵⁴ it is the best tonic for hysteria.

E. Morselli and G. Buccola⁵⁵ carried out experiments involving the systematic dispensation of cocaine, over a period of months, to melancholics. They gave a preparation of cocaine, as prescribed by Trommsdorf, in subcutaneous injections, in doses ranging from 0.0025–0.10g per dose. After one or two months they confirmed a slight improvement in the condition of their patients, who became happier, took nourishment, and enjoyed regular digestion.*

On the whole, the efficacy of coca in cases of nervous and psychic debility needs further investigation, which will probably lead to partially favorable conclusions. According to Mantegazza coca is of no use, and is sometimes even dangerous, in cases of organic change and inflammation of the nervous system.

b) *The use of coca for digestive disorders of the stomach.* This is the oldest and most firmly founded use of coca, and at the same time it is the most comprehensible to us. According to the unanimous assertions of the oldest as well as the most recent authorities (Julian, Martius, Unanuè, Mantegazza, Bingel,⁵⁶ Scrivener,[†] Frankl, and others) coca in its most various forms banishes dyspeptic complaints and the disorders and debility associated therewith,

and after protracted use results in a permanent cure. I have myself made a series of such observations.

Like Mantegazza** and Frankl,⁵⁷ I have experienced personally how the painful symptoms attendant upon large meals—viz, a feeling of pressure and fullness in the stomach, discomfort and a disinclination to work—disappear with eructation following small doses of cocaine (0.025–0.05). Time and again I have brought such relief to my colleagues; and twice I observed how the nausea resulting from gastronomic excesses responded in a short time to the effects of cocaine, and gave way to a normal desire to eat and a feeling of bodily well-being. I have also learned to spare myself stomach troubles by adding a small amount of cocaine to salicylate of soda.

My colleague, Dr. Josef Pollak, has given me the following account of an astonishing effect of cocaine, which shows that it can be used to treat not merely local discomfort in the stomach but also serious reflex reactions; one must therefore assume that cocaine has a powerful effect on the mucous membrane and the muscular system of this organ.

“A forty-two-year-old, robust man, whom the doctor knew very well, was forced to adhere most strictly to a certain diet and to prescribed mealtimes; otherwise he could not avoid the attacks about to be described. When traveling or under the influence of any emotional strain he was particularly susceptible. The attacks followed a regular pattern: They began in the evening with a feeling of discomfort in the epigastrium, followed by flushing of the face, tears in the eyes, throbbing in the temples and violent pain in the forehead, accompanied by a feeling of great depression and apathy. He could not sleep during the night; toward morning there were long painful spasms of vomiting which lasted for hours. Round about midday he experienced some relief, and on drinking a few spoonfuls of soup had a feeling ‘as though the stomach would at last eject a bullet which had lain in it for a long time.’ This was followed by rancid eructation, until, toward evening, his condition returned to normal. The patient was incapable of work throughout the day and had to keep to his bed.

“At 8:00 PM on the tenth of June the usual symptoms of an attack began. At ten o’clock, after the violent headache had developed, the patient was given 0.075g *cocainum muriaticum*. Shortly thereafter he experienced a feeling of warmth and eructation, which seemed to him to be ‘still too little.’ At 10:30 a second dose of 0.075g of cocaine was given; the eructations increased; the patient felt some relief and was able to write a long letter. He alleged that he felt intensive movement in the stomach; at twelve

*Their assertions about the physiological effects of cocaine accord with those of Mantegazza. They observed, as an immediate effect of cocaine injections, dilation of the pupils, temperature heightened by up to 1.2 degrees, quickening of the pulse and respiration. There is never an attack of sickness.

†*Loc. cit.* “an excellent tonic in weakness of the stomach.”

**Mantegazza’s exhaustive medical case-histories impress me as being thoroughly credible.