Coca has been used in folk medicine in South America for thousands of years both as a general stimulant and for more specific medical purposes. It remains one of the most commonly used medicines in some areas of Bolivia and Peru. The medical use of coca and cocaine in the industrial world has a more dramatic and varied history. Coca extract and cocaine were introduced as panaceas for a wide variety of complaints in the late 19th century. Cocaine was the first effective local anesthetic; prescription drugs, patent medicines, and soda drinks containing it were also popular. When its dangers became apparent and substitutes became available, its medical use went into decline, especially when, in the 1930s, amphetamine began to replace it for some purposes. Today its only generally accepted medical use is as a topical anesthetic in certain kinds of minor surgery and other clinical procedures. There are, however, some recent and so far uncertain signs of reviving interest in cocaine and even coca itself for other medical purposes, in research as well as in diagnosis and treatment.

Today the range of recognized medical uses for cocaine, outside of South American folk medicine, is very narrow. But the alkaloid was once used, and coca still is used, for a much wider variety of medicinal purposes. Like opiates, alcohol, amphetamines, and other drugs affecting the central nervous system, cocaine seemed to relieve the symptoms of many otherwise very different illnesses and functional disturbances. The use of the word panacea has long implied scorn, but before the full development of modern medicine, with its goal of influencing the underlying causes of clearly, usually etiologically, defined diseases instead of or in addition to providing symptomatic relief, the centrally acting cure-alls were among the most important items in the pharmacopoeia. Even 40 or 50 years after the heyday of the opiate- and cocaine-containing patent medicines, the amphetamines could be introduced to physicians and the public with a proposed range of applica-

tions very similar to that of cocaine in the 1880s and permitted to run the same gradual course of disillusionment in the medical community. Of the old panaceas only morphine retains some of its former range of application, and even it is used much more sparingly and under much stricter medical supervision than it once was.

So the history of the coca leaf and cocaine as medicines is on the whole one of gradual restriction and decline. Coca has been a medicine in South America for thousands of years, and today it is still used for specific medicinal purposes; but in general it is an everyday drug with somewhat the same status in the Peruvian and Bolivian highlands that coffee and tea have elsewhere. When cocaine was introduced to Europe and the United States in the 19th century, its stimulant properties were used in medicine, but it lost this status within a generation or two; and it now has only a few accepted medical uses. However, there are also some recent and so far uncertain signs of reviving interest in both coca and cocaine as medicines.

In the words of the 16th century chronicler Garcilaso de la Vega, coca "satisfies the hungry, gives new strength to the weary and exhausted and makes the unhappy forget their sorrows". This statement covers most of coca's everyday uses in Peru and Bolivia. But coca was also used for more specific medicinal purposes, and the Indians of Peru and Bolivia did not distinguish its curative powers from its magical uses. In the controversy about coca that followed the Spanish conquest, its detractors emphasized not only the supposed dangers to health but also its use in pagan healing and religious rites.

But coca proved too useful in the mines and on the plantations to be rejected. Eventually the forms of the Indian rituals in which it was used were Christianized; and it came into use as a medicine among the upper class of Peru as well. Only in the region that is now Ecuador was prohibitionist sentiment so strong that the use of coca disappeared entirely.

Horacio Fabrega, Jr. and Peter K. Manning, in a 1973 study entitled "Health maintenance among Peruvian peasants", analyzed the functions of coca and other herbal drugs in the village of Huaroeondo, Peru, population 6,000, located 25 miles north of Cuzco at an altitude of 12,500 feet. Most of the people chew coca. Fabrega and Manning listed the herbs in common use and the conditions socially defined in the village as amenable to herbal treatment. Then they interviewed a sample of 40 adult males, asking whether a given herb was useful for treating a given condition.

Coca in one form or another was a standard remedy for more problems than any other herb -- 8 out of a total of 18 listed. Not surprisingly, it was the accepted treatment for the symptoms of hunger (100 per cent) and to protect against cold (98 per cent). It was also used for two folk illnesses: el Soka, a condition of weakness, fatigue, and general malaise (73 per cent); and el Fiero, a chronic wasting illness (73 per cent). Coca was also the remedy of choice for stomach upset and pains (100 per cent) and for colic, or severe gastrointestinal disturbances including diarrhea, cramps, and nausea (73 per cent). Other herbs were preferred for acute high fever, headache, res
piratory infections, severe mental disturbances (*la Locura*), and gastrointestinal disturbances believed to be caused by emotional difficulties (*la Colerina*) (Fabrega and Manning, 1973).

Coca is also reported to be used in the form of leaf powder or tea for toothache, stomach ulcers, rheumatism, asthma, and even malaria. Coca tea is a remedy for the nausea, dizziness, and headache of *soroche* or altitude sickness, and it is often served to tourists arriving at hotels and inns in the high Andes. The juice from the chewed leaf may be applied to the eye to soothe irritation, or gargled for hoarseness and sore throat. Coca also contains vitamin C and some B vitamins, and it is sometimes said to be an important source of these nutrients in the Andean diet.

This description of the uses of coca in folk medicine has been brief, because the subject will be covered more fully by other speakers and because there is not a great deal of history to be written: the ways coca is used now are the ways it has been used for over a thousand years. The story of the medicinal uses of coca and cocaine in Europe and the United States has more dramatic ups and downs.

By the 19th century coca had become so respectable that Peruvians began to promote its use as a medicine in Europe and the United States. Nineteenth century foreign travelers also reported favorably on the medicinal powers of coca, but it did not become popular in Europe until after cocaine had been isolated in 1860. Throughout the late 19th century both coca itself (that is, an extract from the leaf including all its alkaloids) and the pure chemical cocaine were used as medicines and for pleasure—the distinction was not always carefully made—in a variety of ways. The neurologist Paolo Mantegazza recommended coca in 1859 for toothache, digestive disorders, hysteria, melancholia, and other illnesses—even as an aphrodisiac and a benign substitute for caffeine. In 1863 Angelo Mariani, a Corsican chemist, patented a preparation of coca extract and wine, "Vin Mariani," which eventually made his fortune: it became one of the most popular prescription medicines of the age. As early as 1865 Dr. Charles Fauvel of Paris was prescribing Mariani preparations for various complaints, including soreness of the larynx and pharynx. He called coca "la tenseur par excellence des cordes vocales." (Freud, quoted in Byck, 1974). In 1876 there was a flurry of interest in the British medical press when several men, including the 78-year-old Dr. Robert Christison of Edinburgh, reported that coca had enabled them to walk long distances without food or sleep and with no serious after-effects. The *British Medical Journal* prophesied in an editorial that coca would prove to be "a new stimulant and a new narcotic: two forms of novelty in excitement which our modern civilization is likely to esteem." (Editorial, *British Medical Journal*, 1876). The literature was fairly extensive by the time Bordier reviewed it in the *Dictionnaire encyclopédique des sciences médicales* in 1876 and recommended the use of coca by armies and in industry (Bordier, 1876).

By 1878 coca was being recommended in advertisements in the United States for "young persons afflicted with timidity in society" and as "a power-
ful nervous excitant” (Caldwell, 1970). In the same year, W. H. Bengley began to promote it as a cure for morphine addiction. Between 1880 and 1884 the Detroit Therapeutic Gazette published 16 reports of cures of the opium habit by coca. The fluid extract of coca was admitted to the U.S. Pharmacopoeia in 1882. But the annum mirabilis was 1884. Until then, possibly because the diversity of claims about its effects was confusing and possibly because preparations were of unreliable quality, cocaine had not attained the renown some thought it deserved. The decisive events were the publication of Sigmund Freud’s paper “On Coca” in July and Karl Koller’s rediscovery in September of the anesthetic power of cocaine, which meant the advent of local anesthesia in surgery. On the authority of various physicians and from his own experience, Freud recommended coca or cocaine for a variety of illnesses, and especially for the syndrome of fatigue, nervousness, and small physical complaints known as neurasthenia. Probably the most significant passage in this paper was his praise of cocaine as a cure for morphine addiction and alcoholism, based on the American reports and his own observation (Byck, 1974). It was in reference to the writings of Freud that the Parke Davis Company’s pamphlet Coca Erythroxylon and Its Derivatives declared: “If these claims are substantiated . . . [cocaine] will indeed be the most important therapeutic discovery of the age, the benefit of which to humanity will be incalculable.” (Byck, 1974).

Freud’s article was influential, but the discovery of the use of cocaine in surgery by Koller, the friend and colleague whose interest in the drug he had aroused, was of more permanent importance. It had been known for a long time that cocaine was a local anesthetic. Folk medicine in South America makes use of this property, and skulls have been found on archaeological sites in the Andes with holes indicating that trepanation was performed, possibly with the help of coca’s pain-deadening effect. By 1865 Fauvel was using coca to soothe sore throats. Moreno y Maiz (1868) and Alexander Bennett (1874) demonstrated its anesthetic effect on the mucous membranes. Von Anrep (1878) also proposed its use as an anesthetic. In 1880 Coupart and Bordereau described anesthesia of the cornea of animals’ eyes with cocaine (Freud, in Byck, 1974).

But somehow no one thought of the seemingly obvious application to surgery until Koller introduced it as a topical anesthetic in eye operations (Becker, 1963). This filled a desperate need, because previously surgeons had had to use a general anesthesia, which made the patient’s cooperation impossible, or else had to operate without anesthesia, a difficult and painful procedure. The use of cocaine anesthesia was quickly extended to other areas of surgery: rhinology, laryngology, gynecology, urology, dentistry. In 1884 William Halsted of Johns Hopkins invented nerve block or conduction anesthesia by injecting cocaine into nerve trunks. In 1885 J. Leonard Corning introduced regional anesthesia. Later Carl Ludwig Schleich produced infiltration anesthesia by subcutaneous injection (1892), and August Bier originated spinal anesthesia (1898). It was not until 1905 that Einhorn synthesized procaine (Novocain), a substitute without cocaine’s stimulant effect.
Meanwhile, especially in the early years, cocaine was triumphing as what would now be disparagingly called a panacea. The same Corning who invented regional anesthesia declared, “Of all the tonic preparations ever introduced to the notice of the professions, this is undoubtedly the most potent for good in the treatment of exhaustive and irritative conditions of the central nervous system.” (Becker, 1963). From July to December of 1885, there were 27 articles, notes, and letters on cocaine in the New York Medical Journal, recommending it for seasickness and trigeminal neuralgia, among other conditions. The drug house Parke Davis brought out its 101-page pamphlet, *Coca Erythroxylon and Its Derivatives*, in that year. Cocaine was adopted as the remedy of choice by the Hay Fever Association and recommended for head colds and what was then called “catarrh”. William A. Hammond, a former Surgeon General of the United States Army, suggested coca wine for stomach irritability, “cerebral hyperemia due to excessive mental exertion”, “the mental depression that accompanies hysteria in the female”, and other morbid conditions of the central nervous system (Hammond, 1887).

The book *Peru: History of Coca*, published in 1901 by the American physician W. Golden Mortimer, sums up the favorable side of medical opinion about coca. Mortimer’s recommendations for coca wine or coca extract and occasionally for cocaine are even more varied than Mantegazza’s or Freud’s. He approvingly mentions its use by French bicyclists and by a championship lacrosse team. (Apparently he saw no ethical problems in the use of drugs by athletes.) Contradicting Mantegazza’s view that coca acts as a stimulant on the heart, he contends that it is primarily a regulator, calming an over-excited heart and strengthening a weak one. He believes that Mantegazza noticed only the central nervous system effect produced by cocaine and failed to observe the direct tonic effect of other coca alkaloids on the heart muscle (Mortimer, 1901).

Freud’s list of therapeutic uses includes “nervous stomach disorders”, asthma, diseases of the vocal cords, sexual disinterest, and convalescence from typhoid fever; Mortimer’s includes uremia, vomiting in pregnancy, convalescence from yellow fever, skin conditions, stimulation of uterine contractions in childbirth, and appeasing thirst in diabetes. But, except for morphine addiction, alcoholism, and surgical anesthesia, 19th century medicine covers largely the same ground as the Peruvian Indians. In an appendix to his book on coca, Mortimer lists the responses to a letter he sent to “a selected set” of over 5000 physicians in 1897 asking for their observations on coca. Of the 1206 replying, 369 said that they had used coca in their own practices. (By that time doctors were suspicious of coca because they were familiar with the dangers of cocaine abuse.) Common observations were that coca increased appetite (113 of 369 responding), raised blood pressure (88), stimulated circulation (107), strengthened the heart (117), improved digestion (104), stimulated the mind (109) and the muscles (89), improved respiration (40), and served as an aphrodisiac (60). Only 44 of the 369 claimed failure to get results. The most popular therapeutic applications were debil-
ity, exhaustion, neurasthenia, and overwork. Smaller numbers recommended coca for anemia, melancholia, bronchitis, angina pectoris, and other conditions. Only 21 physicians thought there was a dangerous tendency to form a “coca habit” (Mortimer, 1901).

Doctors still commonly prescribe psychoactive drugs for very general functional disturbances; amphetamines and tranquillizers have been used in the same ways as coca, opium, and alcohol. But it was even easier to use drugs this way at a time when pharmacological theories were more speculative and confused than they are now. It was a time of trial, groping, and uncertainty in medicine. Where drugs acting on the central nervous system are concerned, we may not have emerged from that stage of tentativeness as much as we sometimes think we have.

Mortimer dedicated his book to Angelo Mariani, the chemist and entrepreneur whose coca preparations were one of the most popular medicines of the era. Mariani wrote several articles and monographs on coca which combine historical, botanical, and medical information with the promotion of company’s product. The most important of these was Coca and Its Therapeutic Applications (Mariani, 1890) which went through several editions. He carefully pointed out that his drug was “introduced solely through physicians” (his italics) and could provide a list of about 3000 physicians who recommended it. It won prizes and medals at various expositions, including one from England that called it “wine for athletes”, and it received what Mariani says was an unsolicited recommendation from the Academy of Medicine of France (Mariani, 1890).

Mariani’s products were as popular with the public as with physicians. From the testimonials of eminent people he put together a “encyclopedia of contemporary biography” with a biographical sketch and portrait of each famous man or woman who testified to the virtues of Vin Mariani. Thomas Edison (famous for his insomniac habits) was among them, and so was Pope Leo XIII, who presented Mariani with a gold medal and habitually carried a flask of the wine at his belt. The Czar of Russia, Jules Verne, Emile Zola, Henrik Ibsen, and the Prince of Wales also endorsed Mariani’s wine. Mariani reports that doctors gave General Ulysses Grant, the former President of the United States, Thé Mariani, one teaspoon to a cup of milk per day, for five months during his last illness, in 1885. In their opinion, it prolonged life and enabled him to complete his famous Memoirs (Mariani, 1890).

One of the most popular drinks containing coca extract was Coca-Cola, which was first concocted in 1886 by John Styth Pemberton, a Georgia pharmacist. Pemberton sold Coca-Cola as a medicine: a headache remedy and stimulant that contained the “wonder drug” of those years, coca, as main active principle. Asa Griggs Candler, another pharmacist, bought the rights to Coca-Cola in 1891 and founded the Coca-Cola Company in 1892. He advertised it throughout the 1890s as a “sovereign remedy” as well as an enjoyable drink. But the men who ran the Coca-Cola Company were commercially astute enough to sense the change in public opinion that was to make cocaine a social outcast, and by the time the Pure Food and
Drug Act was passed in 1906 they had taken it out of their drink and replaced it with caffeine.

The fusion of the health-giving and the pleasure-giving is not necessarily unreasonable but may lead to disaster. That is what happened in the case of cocaine almost as soon as doctors began to use it. Cocaine abuse was described as "a habit that develops more easily and destroys the body and soul faster than morphine" (Maier, 1926, p. 52). The earliest serious cases of abuse involved morphine addicts who took the cocaine cure recommended by Bentley and Freud. Albrecht Erlenmeyer was probably the most important of the physicians who early observed the symptoms of acute and chronic cocaine intoxication and warned against the use of cocaine in morphine addiction. He admitted that cocaine itself produced few abstinence symptoms except depression, but he concluded that of all drugs only alcohol could be as devastating (Erlenmeyer, 1886).

The growing fear of cocaine changed attitudes toward coca, just as fear of morphine and heroin made opium smoking seem more dangerous. Advocates of coca then began to fight a rearguard action in its defense. They insisted (correctly) that coca never caused the kinds of disturbances that were giving the reputation of the pure chemical cocaine, and (with less-obvious justification) that it was not the cocaine in coca but the peculiar mixture of alkaloids that produced its characteristic effects. Mortimer even extravagantly contended that cocaine no more fully represents the effect of peaches than the prussic acid in peach pits represents the effect of peaches.

Probably the most famous case of cocaine abuse by a physician is that of the great surgeon William Halsted of Johns Hopkins (1852 - 1922), who invented nerve-block anesthesia. It appears that Halsted cured himself of a craving for cocaine, which was ruining his career, by means of morphine, which allowed him to function normally (as opiates often do), and paid the price of physical addiction.

The greatest mind among the medical men who underwent the influence of cocaine belonged to Sigmund Freud. He started using it himself, called it a "magical drug", sending some to his fiancée Martha "to make you strong and give your cheeks a red color." (Byck, 1974, p. 10). In May of 1884 he began administering cocaine to his friend Ernst von Fleischl-Marxow to substitute for the morphine he had been using to deaden phantom pain in an amputated thumb. In general, small doses of cocaine had little effect on Freud when he was in generally good health but made him feel normal for four or five hours when he was below par. As far as its effects on himself were concerned, he never had any reason to criticize cocaine. But his friend Fleischl took larger and larger amounts of the drug and began to suffer toxic symptoms. So when Erlenmeyer denounced cocaine as the "third scourge of mankind" and criticized Freud for encouraging its use, feelings of sorrow and guilt as well as concern for his professional reputation were involved in the response.

This last of Freud's cocaine papers, "Craving for and Fear of Cocaine", published in July 1887, is an interesting professional and personal document.
It retreats from some of his former positions and defends others. He admits that cocaine should not be used in morphine addiction because the habit that may ensue is “a far more dangerous enemy to health than morphine”, producing quick physical and mental deterioration, paranoia, and hallucinations. But he insists that “all reports of addiction to cocaine and deterioration resulting from it refer to morphine addicts... Cocaine has claimed no other, no victim of its own.” (Of course, he did not know about Halsted.) He recommended abandoning subcutaneous injection except as an anesthetic. Appended to the paper was a summary of a report to the New York Neurological Society by William Hammond, which recommended a wine spiked with cocaine as a tonic and stimulant for dyspepsia and injections of cocaine for “female melancholia with mutism” (Byck, 1974, p. 171 - 176). This paper was Freud’s last professional publication on cocaine. He seldom referred to the cocaine episode later in his life.

In the use of coca and cocaine as medicines, it is often hard to separate the central stimulant from the digestive, respiratory, and local-anesthetic effects. The singer or actor who drank Mariani’s wine could hardly know how much of the improvement he thought he noticed was caused by local anesthesia or constriction of blood vessels in the throat and how much by euphoria and a feeling of mastery. As for stomach and intestinal upset, the gastrointestinal tract is probably the most common site of psychosomatic symptoms. The use of coca or cocaine in convalescence from long-lasting, debilitating diseases, or for relief of misery in situations like General Grant’s last illness, represents a similar combination of central and peripheral effect.

It might seem that the book has long been closed on the question of using cocaine for these purposes; the medical community has decided that the dangers and the availability of alternatives make any possible benefits unimportant. But the decision has not been entirely unequivocal; for example, cocaine was still often prescribed through the 1920s for many of the conditions mentioned by Freud and Mortimer. Even today it is occasionally prescribed for non-surgical purposes; for example, in eyedrops. Some physicians, including Dr. Andrew Weil, have expressed interest recently in reintroducing coca chewing gum or oral cocaine for stomach upset and as a respiratory stimulant and tonic for the vocal cords. In effect, this would be a return to the days of preparations like Mariani’s wine and the original Coca-Cola.

Although cocaine was thus used as a prescription medicine even after criminal laws and other restraints made it less easily available, its use gradually declined until by about 1930 it almost dropped out of sight, at least in the United States, except as a surgical anesthetic. It is interesting to note, incidentally, that the early history of cocaine had what amounted to a repeat showing in the career of the amphetamines from 1940 to 1970. Not having learned from history, we were condemned to repeat it.

The only recognized medical uses for cocaine today are as a topical anesthetic in eye, ear, nose, and throat surgery and in endoscopy of the upper respiratory and digestive tracts. These uses have recently been defended
as safe, effective, and necessary in the face of suggestions that it should be stopped because adequate substitutes are available (Schenk, 1975). In fact, according to a recent survey (Johns et al., 1977) cocaine is the anesthetic of choice in nasal surgery, used by about 90% of otolaryngologists in the United States. The dosage ranges from 50 to 3000 mg; deaths and even minor complications seem to be rare, even at high doses, and the incidence of complications is not related to dose. Equally important is its use in fibre-tube optical examinations of the larynx, pharynx, bronchi, esophagus, and stomach to prevent retching and pain. Cocaine combines intense vasoconstriction (important whenever bleeding must be prevented), long duration of anesthesia (an hour), applicability to the mucous membranes, and relatively low toxicity in a way no synthetic topical anesthesia can duplicate. It is no longer used in infiltration anesthesia (submucous or subcutaneous injection), in nerve-block anesthesia (injection into or near a nerve trunk), or in spinal anesthesia.

Cocaine has also been used in Great Britain and Canada, but not in the United States, as an ingredient in Brompton's mixture, a preparation for treating the chronic pain of terminal cancer. The drink contains 10 mg of cocaine, 5 - 20 mg of morphine, and 2.5 ml of alcohol in a 20-ml solution with sugar syrup (Melzack et al., 1976; Mount et al., 1976). The cocaine is supposed to prevent too much sedation. But a recent controlled study in a hospice in England shows that cocaine with morphine provides no advantage over morphine alone, so this practice is likely to die out (Twyeross, 1977).

A few other uses of cocaine should be mentioned. It has been tested only briefly as a treatment for severe depression - Freud comments cautiously on the subject in one of his papers - but the idea is unlikely to be revived, since amphetamines have proved a failure for this purpose. Cocaine has also been used experimentally for diagnostic purposes in depression and schizophrenia, mostly in the 1920s and 1930s.

After a hiatus of over 30 years, Robert M. Post and his colleagues have recently revived experimentation with cocaine on depressed patients. In one controlled, double-blind study of 16 depressed patients, intravenous cocaine infused over a 90-second period) starting at 2.5 - 8 mg and working up to 25 mg had marked, highly correlated effects on mood and vital signs like temperature, pulse, blood pressure, and respiration. Post and his colleagues include that infusions of cocaine producing moderate physiological arousal create a sense of well-being, while higher doses mobilize intense mixed affect, combination of elation and uneasiness about uncontrolled release of feelings. In another experiment, cocaine administered orally starting at 35 - 60 mg a day and gradually increased to 65 - 200 mg twice a day at 9.00 a.m. and 10.00 a.m. produced no consistent mood changes or physiological effects (Post et al., 1974a; Post et al., 1974b).

A major recent use of stimulants in medical research is the study of model psychoses (Ellinwood, 1974; Grinspoon and Bakalar, 1976, pp. 167 - 75). Cocaine and amphetamines mimic functional psychoses more closely than any other drugs. The sensitization of animals to certain effects of
cocaine and the progressive changes in their behavior after prolonged use may correspond to the development of a functional psychosis in human beings under chronic stress. By analogy with the lowering of the threshold for convulsions by repeated electrical stimulation of the limbic system, it has been proposed that cocaine produces a kind of pharmacological kindling of the mechanisms that cause hyperactivity and stereotyped movements in animals, and, presumably, psychosis in human beings (Post, 1977; Post et al., 1976). The effect probably involves the neurotransmitter dopamine; the peculiar pharmacological properties of cocaine as opposed to amphetamines (Groppetti and di Giulio, 1976; Scheel-Kruger et al., 1977) may prove relevant in this research.

In recreational drug use there is often an element of self-medication, since the line between the pleasurable and the medicinal is not always easy to draw. Now that the recreational use of cocaine has increased so much in the U.S., interest in its specific medical uses may also revive, as it has revived in the case of marihuana. For example, there are recent anecdotal reports that cocaine has been found useful in treating arthritis; controlled studies will no doubt soon be arranged. Another new development is the interest in "natural drugs" — drug substances just as they come from the plants, as opposed to pure alkaloids or synthetic drugs. This has led to Andrew Weil's new research on the medical potential of coca. Coca and cocaine will never again be so widely used medicinally as they once were, but the possibilities today are more open than they have been for many years.

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