

# The History of Anesthesiology

Reprint Series: Part Fourteen



## *The Introduction of Local Anesthesia*

Carl Koller (1857-1944), discoverer of surgical local anesthesia with cocaine in 1884. Left, in Vienna, 1885; right, in New York, 1920.



# The Introduction of Local Anesthesia

## FOREWORD

This set of reprints commemorates the advent of surgical local anesthesia in fin-de-siècle Vienna, one hundred years ago. It presents Koller and his epochal report on cocaine anesthesia of the eye in the context of precursors who foreshadowed but missed the discovery and innovative followers who soon extended it to nerve block, dental anesthesia, medication of the spinal cord, subarachnoid, sacral epidural, and intravenous routes to regional anesthesia, and, not least, the pioneering search for the active anesthesiophoric group which culminated in the synthesis of a much less toxic drug (novocaine) by Einhorn. Lastly, we reprint, by permission of *The Psychoanalytic Quarterly*, the fascinating account of the discovery and its aftermath, retold with exemplary filial scholarship by Hortense Koller Becker.

Rarely in the field of pain relief has so much been owed by so many to so few. The latter-day repercussions include the emergence of anesthesiology as an autonomous specialty of medical practice and, more recently, the burgeoning international assault on pain mechanisms and chronic pain. Fittingly, the Wood Library-Museum of Anesthesiology and the American Society of Anesthesiologists, who are responsible for its production, have made this commemorative set available for distribution to registrants of the IVth World Congress of the International Association for the Study of Pain, meeting in Seattle in 1984.

For perspective on the significance of the centennial, suppose for a moment that a congressional Big Brother took it into his head to ban all classes of drugs, save one to be selected by popular vote. Which would survive? Local anesthetics? Or go back to 1884 and allow the world just one medicinal plant. *Erythroxyllum coca*?

The discovery of surgical local anesthesia with cocaine intersected two major currents of biological thought of the second half of the nineteenth century, vitalism and reductionism. Vitalists held that anaerobic release of energy within the cell is a vital action, a chemical process inseparable from the life and organization of the cell. Cocaine, the active principle of *Erythroxyllum coca* leaf, had an occult power to release energy not otherwise available to the organism. That was why the Indians of the Andean altiplano chewed the leaf. How else would they be able to endure the cold, the fatigue and the hunger of their thin existence? Freud had a notion that the Indians' traditional coca chew could be turned into an effective and manageable medicinal psyche booster if taken neat in the form of cocaine. Freud's efforts to verify his exciting conjecture did not work out, but they had the inestimable importance of bringing the drug to the mouth of his colleague and close friend, Carl Koller, who had a narrower, reductionist goal. Reductionist physiologists thought that the organism's release of energy was from a wholly physical or chemical machine, exemplified in the electrical action of nerves demonstrated by DuBois-Reymond. If mechanical it must be controllable, and this, wittingly or not, underlay the conviction of Freud's junior colleague and friend, Carl Koller, that local anesthesia of the eye was within the realm of the possible. This idea had been implanted in Koller by Arlt, his professor of ophthalmology — ophthalmology, the first of the specialties — arousing in Koller the soaring ambition to become an assistant in the famous Viennese clinic, for which post he would qualify by making a notable discovery. Or so he hoped. He did make the discovery, for Koller's mind was well prepared and the time was ripe. But the appointment was denied him, as inexorably as in a Greek tragedy.

B. Raymond Fink



# The Introduction of Local Anesthesia

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## Concerning an Organic Base in Coca<sup>\*†</sup>

by W.

Coca, which consists of the leaves of *Erythroxylon* species, has been in general use in Peru and other South American countries ever since ancient times. The Indians chew it mixed with powdered chalk or ash, and this custom has made the coca bush an integral part of their culture.

The most wonderful tales are told about the physiological consequences of its use. (\*) See for example J.J. v. Tschudi's *Peru*, Vol II, p. 299) Enjoyed in moderation it acts as a stimulant able to substitute for food for long

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\* From the Reports of the G. A. Universitat and the Imperial Academy of Science in Gottingen, 21 March, 1860.

The article was signed 'W', for Friedrich Woehler (1800-1882), to whom Niemann was an assistant. It is clear from the text that Niemann was the first to observe and record the local anesthetic property of cocaine. He was also the first among the several outstanding investigators of cocaine - Schroff, Bennett, von Anrep, Hammond, Freud - who failed to appreciate the enormous importance of that property, until the fact dawned on Carl Koller. Koller was the one who, in 1884, realized and demonstrated the ability of cocaine to produce surgical local anesthesia. This landmark in humanity's long struggle against pain was one of the most important medical discoveries of the nineteenth century, or any century, and missed winning the Nobel Prize only because it was made a little too soon, and too convincingly (Liljestrand, G.: *Acta physiol. scand. Suppl* 299, 1967, p.5).

† Translated from *Ueber eine organische Base in der Coca*. Justus Liebig's *Annalen der Chemie*, 114:213-217, 1860.

periods and capable of making the severest exertion supportable. Its abuse, however, like that of morphine, often becomes a vice which, in those passionate coca chewers, the Coqueros, produces all the effects of narcotic poisons, an intoxication marked by visions, premature ageing, apathy and imbecility. These peculiar effects suggest the presence in this plant of a specific organic compound that constitutes the effective principle and which, in all probability, belongs to the class of organic bases. Indeed, several investigations into the active component have already been performed, though none has yet led to a positive result, perhaps because of an insufficient quantity of leaves or because of their deterioration with age. A chemist in La Paz, Bolivia, claims to have isolated a crystalline base; investigation of a sample of this supposed base which I obtained from Mr. v. Tschudi quickly convinced me that it consisted of nothing but plaster of paris). It became possible to avoid these particular difficulties through the generosity of my friend W. Haidinger in Vienna, who enabled me to procure a large quantity of fresh coca leaves. He arranged for Dr. Scherzer to bring them from Lima in the course of the well known expedition of the Austrian frigate Novara.

Being preoccupied by other matters, I was not able to undertake the intended study myself. I delegated it to one of the assistants in this laboratory, Mr. Niemann, who performed it with great skill and extreme perseverance. He succeeded in isolating from coca a characteristic specific crystallisable organic base, which, in accordance with accepted rules of nomenclature, may be termed cocaine. The work is still far from complete: although the existence and specificity of cocaine have been established, its compositional formula has not yet been definitely ascertained, and no investigation has yet been performed to determine whether it produces the physiological actions of coca, nor whether a suspected new tannic acid is present in other parts of the plant.

After many fruitless attempts Mr. Niemann found that the most effective procedure for isolating cocaine was the following. The coca leaved were cut into small pieces and digested for several days in 85 per cent alcohol acidified

with a little sulfuric acid. The resulting dark brown-green solution was expressed and filtered and then treated with weak calcium hydrate. This precipitated several substances, including part of the chlorophyll and a wax that could be rendered completely colorless. The alkaline liquid so obtained was filtered and neutralized with sulfuric acid, the alcohol was removed by distillation, and the remainder evaporated to dryness in a waterbath. The residue was mixed with water, resulting in the separation of a dark green, semiliquid mass containing the rest of the chlorophyll and in the formation of a yellowish brown solution which contained the cocaine as a sulfuric acid salt.

Cocaine was deposited by sodium carbonate, as a still impure brown precipitate. The base was taken up in ether, which, when diluted, yielded a yellowish, smelly, amorphous residue in which, however, concentric rings of crystals soon began to form. On repeating the treatment with alcohol entirely pure and colorless crystals were obtained.

Cocaine crystallizes in small colorless and odorless crystals. It is sparingly soluble in water, fairly soluble in alcohol, and very soluble in ether. Its reaction is strongly alkaline. It tastes bitter and produces a peculiar effect on the nerves of the tongue, inasmuch as the point of contact becomes deadened and very nearly insensitive. It melts at 98 degrees and solidifies again as crystals. At higher temperature most of it decomposes with the formation of ammoniacal products, only a small amount appearing to escape unchanged. When heated on platinum foil it burns with a brilliant flame, leaving no residue.

Cocaine neutralizes acids completely; most of its salts appear to remain amorphous and to crystallize only with difficulty. The hydrochloric acid salt is the one that crystallizes most readily; it forms with a strong evolution of heat when one treats cocaine with dry hydrochloric acid gas.

Although cocaine bears considerable similarity to atropine in reality it does differ, as has been shown by comparing their reactions and their provisional formulas. Their similarity extends to the similarity of their gold chloride salts, both of which are precipitated as

a flocculent, pale yellow precipitate from the hydrochloric acid salts and as fine yellow crystalline plates from warm, weak solutions. However, the gold salt of cocaine is characterized by its property of forming a large amount of benzoic acid when decomposed by heat, a property that is a strong clue to its probable composition. Furthermore, cocaine appears to have absolutely no effect on the pupil.

**Chemical and Physiological Researches on  
Peruvian Erythroxyton Coca and on Cocaine\***

THOMAS MORENO Y MAIZ

. . . . .

Experiment No. 10 reads as follows: The base of the heart of a lively frog was ligated. Six drops of cocaine acetate solution was injected at the left calf.

At 15 minutes, the frog spontaneously extends the (poisoned) left leg; even the strongest stimuli to the extended leg do not elicit its withdrawal, but pinching the (untreated) right leg does cause withdrawal of the left one.

At 20 minutes, the motility of the left leg has diminished: it only contracts partially on pinching of the other leg.

At 30 minutes, the left leg remains insensitive, since stimulation of this leg still does not cause its withdrawal; it is to be noted, however, that the skin of this thigh does retain its sensibility (a fact explained by the injection having been made at the calf). To verify this we inject two drops of the same solution at the thigh: The thigh in turn becomes insensitive.

At 2 hours 15 minutes, the sciatic nerve is exposed and stimulated with Pulvermacher forceps; this causes the muscles to contract. Shortly thereafter the frog seems to be dead.

In this experiment, notwithstanding that the spinal cord remains intact, we nevertheless observe disappearance of sensibility in the injected limb. It is therefore on peripheral sensibility that cocaine acetate appears to act. Furthermore, the local action of the substance is very evident.\*\*

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\* Excerpt translated from Moreno y Maiz, T.: *Recherches chimiques et physiologiques sur l'érythroxyton coca du Pérou et la cocaine*. Paris, 1868, p.77.

\*\* Could it be used as a local anesthetic? One cannot reply on the basis of so few experiments; it is the future that will decide.



## The Physiological Action of Cocaine \*

Dr. B. von ANREP

### Review of Literature on the Action and Use of Coca Leaves

According to the reports of travellers (von Tschudi) and others in America, coca leaves (*Erythroxylon coca*) are in widespread use, particularly in Peru and Chili. Apparently the leaves have a very remarkable physiological effect. It seems that the enjoyment of coca enables the natives to endure great hardships and protracted heavy labor in spite of lack of food. They take it up in their youth and continue with it until their death. The Indians value this pleasure so highly that they prefer to do without food rather than without coca; the leaves are usually chewed but are given to sick people as tea.

Dr. Unanue, of Lima, relates that during the siege of La Paz in Bolivia all the inhabitants succumbed, with the exception of those who had a sufficient supply of coca leaves to chew. These not only survived but were able to bear all privations with relative ease. von Tschudi tells of a sixty-two-year-old Indian whom he employed for very hard physical tasks, who worked day and night for five days without taking any nourishment and had only two hour's sleep, but chewed coca leaves incessantly. At the end of his service he accompanied Dr. von Tschudi on foot for 150 km through the mountains and was perfectly willing to continue without food provided he received an adequate supply of the leaves.

Moreno y Maiz has reported his own observation of a telegraph messenger who covered unheard of distances at a remarkable pace almost without a break for rest, and consumed nothing but coca leaves throughout these journeys.

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\* Translated from Anrep, B. von: Ueber die physiologische Wirkung des Cocain. Pflueger's Archiv fuer die gesamte Physiologie, 21:38-77, (29 Dec.) 1879.

## Cocaine.

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### Conclusions

1. Cold-blooded animals (Frogs) are more sensitive to cocaine than warm-blooded animals. Among the latter, carnivores manifest a greater sensitivity than herbivores.
2. Cocaine acts principally on the central nervous system.
3. In the frog (*Rana temporaria* and *R. esculenta*) cocaine paralyses the nerve endings and the nerve centers, and the sensory nerve endings are the first to be affected. Reflexes are first diminished and then completely paralyzed.

The increased reflex excitability observed with small doses appears to vary with the individual.

(Anrep lists fourteen additional conclusions from the experiments in the body of the paper, concerning the effects of systemic cocaine on respiration, circulation, striated muscle, the pupil, intestinal motility, temperature, mucous secretions, and, finally, respiratory paralysis, and ends as follows:)

After studying the physiological action of cocaine in animals I had intended to investigate it also in man. Various other activities have so far prevented me from doing so. Although the experiments on animals have not had any practical consequences I would recommend that cocaine be tested as a local anesthetic and in melancholia.

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most liable to occur between the ages of ten and thirty, when food is consumed in the largest quantity; and we may therefore assume that both affections depend upon a similar condition, and that the retention of indigestible materials in the cæcum and the catarrh so produced is the most usual cause. But as typhlitis and ulceration of the appendix are both common between the ages of twenty and thirty, although concretions are less common at that period than in the ten years before it, we are justified in supposing that a catarrhal condition of the cæcum, either by producing closure of the valve or by propagation of the inflammation to the appendix, often gives rise to ulceration, although no foreign body be present.

Most of the cases of ulcerated appendix in phthisical subjects occur at a later period of life than when it is due to the presence of concretions or catarrh, for out of those I have collected only one was below twenty years of age, seven were between twenty and forty, and three were above forty. All those connected with hernia were above forty years of age.

I have already mentioned the prevalent idea that the concretions so often found in the appendix are always the result of hardened feces, or of indigestible materials of the food, and if such were the case we should expect to find that most of the sufferers had been liable to constipation. Now, I have collected forty-three cases in which the previous state of health is recorded, and of these only three had been subject to a constipated state of the bowels. It is therefore evident that this theory derives but little support from facts. I should be more inclined to believe that the concretions are in most instances the result of an excessive secretion of the mucous membrane of the appendix arising from the stimulus afforded by an undue use of solid and indigestible food. This view derives support from the fact that of twenty-five cases in which a concretion was discovered twenty are described as having enjoyed robust health, and three had been delicate; whereas of eight in whom no concretion was discovered, only five had been robust and three delicate. The presence of a concretion produces no pain until catarrh or ulceration is excited, for out of twenty-five cases of concretion only two had previously complained of abdominal pain; whilst of eighteen in whom no concretion was recorded five, or 28 per cent., had suffered in this way. I have before mentioned that injuries to the abdomen are supposed by some authors to give rise to ulceration of the appendix, and this derives some support from the fact that three cases out of eighteen in which no concretion was discovered referred their complaint to blows or strains. In four instances out of forty-three there was a history of a previous attack of typhlitis from which the patient had perfectly recovered; in two of these the patients died from peritonitis only, and in the remaining two both abscess and peritonitis were discovered after death.

(To be concluded.)

## ON THE USE OF COCAINE FOR PRODUCING ANÆSTHESIA ON THE EYE.<sup>1</sup>

BY DR. CARL KOLLER.

TRANSLATED AND REVISED BY J. N. BLOOM, B.A., M.D.

GENTLEMEN,—I take the liberty of addressing you in order to inform you about some experiments which I have undertaken in order to produce anæsthesia on the eye. It is not the first communication which I have made on this subject. I have already addressed such a one, in order to preserve my priority in this discovery, to the Convention of German Oculists, which, as it annually does, met on the 15th and 16th of September in Heidelberg. Dr. Brettauer of Trieste was kind enough to bring my communication into notice and to repeat my experiments before the Convention, and since then the same have been repeated and confirmed in various other places.

It is a well known fact that cocaine, an alkaloid produced in 1859 by Nieman from the leaves of the erythroxylon coca, possesses the peculiar property, by its local application,

<sup>1</sup> A paper read at the meeting of the Vienna Royal Imperial Society of Physicians on Oct. 17th, 1884.

of anæsthetising the mucous membrane of the tongue. Prof. Schroff mentioned this fact for the first time in 1862 in a lecture on its nervous effect read before this assembly. It is also well known that cocaine narrows the peripheral arteries when taken internally; further, we know that cocaine dilates the pupil by means of its local application as well as by its internal use. We therefore see that cocaine has already been applied to the eye, but until now those phenomena have not been observed which I make the object of my discourse to-day. After repeated experiments with its internal use cocaine fell into discredit and disappeared from the scene. Dr. von Anrep in 1880 produced a comprehensive research into cocaine, at the end of which it was hinted that the local anæsthetising action of cocaine might in the future become of considerable importance. In Vienna, especially, cocaine has been brought to the front through the interesting therapeutical work of my colleague in the general hospital, Dr. Sigmund Freud.

I have started with the premise that a substance which paralyses the terminal sensory nerves of the mucous membrane of the tongue would not act very differently on those of the cornea and conjunctiva; so I undertook a series of experiments on animals, which I carried out in the laboratory of Prof. Stricker. My results, in brief, are as follows:—If a few drops of an aqueous solution of muriate of cocaine<sup>2</sup> are dropped upon the cornea of a guinea-pig, a rabbit or a dog, or if the solution is instilled in the usual way into the conjunctival sac, the animal blinks for a while, clearly as the result of a weak irritation. After a period of from thirty seconds to one minute the animal opens its eye, which gradually assumes a peculiar expression of rigidity. If one now touches the cornea of the animal with the head of a pin, being careful not to come in contact with the eyelashes, no reflex closure of the lids occurs, the bulb does not deviate, and the head is not thrown back, as would otherwise happen. On the contrary, the animal remains quiet, and by the employment of a stronger irritation we can convince ourselves that the cornea and conjunctiva are completely anæsthetised. For instance, I have scratched the cornea of the animals upon which I experimented with a needle, pricked the same, irritated the cornea with an induction current which was so strong that it produced a painful sensation in the fingers and was unbearable on the tongue, and canterised their cornea with a pencil of nitrate of silver until it became as white as milk; all without a single movement on the part of the animals. The last two experiments convinced me that the anæsthesia included the whole substance of the cornea, and not only its surface. However, after I had cut into the cornea, the animals showed decided signs of pain at the moment, when the aqueous humour gushed out and the iris prolapsed. Even in my later experiments on animals I was unable to determine whether the iris also could not be anæsthetised by the instillation of the solution into the corneal wound, or by a continued instillation into the conjunctival sac, begun and kept up for some time before the operation; for experiments testing sensibility of animals which are not narcotised are very difficult, and, especially if they are in the slightest degree complicated, are apt to give equivocal results. I had yet to find out experimentally whether cocaine could produce anæsthesia of the inflamed cornea, and this question was answered in the affirmative, when the animals upon which I produced an artificial keratitis, by means of a foreign body, showed the same anæsthesia of the cornea as the healthy ones. Complete anæsthesia lasts on the average ten minutes, when a 2 per cent. solution is used.

After such successful experiments I did not hesitate to apply cocaine to the human eye. At first I experimented upon myself and a few colleagues; later, on a large number of other individuals; the results of which without exception proved that the cornea and the conjunctiva were thoroughly anæsthetised by its use. The sequence of the symptoms is as follows:—When a few drops of a 2 per cent. solution are introduced into the conjunctival sac, or, better still, if they are allowed to run over the cornea, together with an increased secretion of tears, a slight burning sensation is felt, which disappears after an interval of from thirty seconds to a minute, to give way to an obscure feeling of dryness. To the observer an eye thus treated has a peculiar rigid expres-

<sup>2</sup> A solution of cocaine in water, up to 5 per cent., can be made without the addition of an acid. The solution is always cloudy. The addition of an acid is to be avoided, as even a very small quantity of an acid causes a very strong burning sensation. When filtered the solution becomes as clear as distilled water.

sion, very like that which I noticed as remarkable on the animals upon which I experimented. This expression arises from a decided widening of the palpebral fissure, the explanation of which I shall give later. If now the head of a pin is brought in contact with the cornea we note the absence not only of the pain usually associated, but we absolutely do not feel the contact, and all reflexes are absent. The same holds good for the conjunctiva, which loses its sensibility to heat and cold. Without any inconvenient sensation, or the slightest reflex movement on the part of the patient thus treated, we can grasp the conjunctiva of the bulb with a toothed forceps, or we can pit the cornea by pressure. In this connexion the only thing to be observed is that the appearance of objects becomes indistinct, which naturally is caused by the changed curvature of the cornea. This complete anæsthesia lasts from seven to ten minutes, to give way to the normal condition after a considerable period of subnormal sensibility. From fifteen to twenty minutes after the instillation the pupil begins to dilate; the dilatation reaches its maximum during the first hour, decreases decidedly in the second hour, and disappears completely in a few hours more. The dilatation is never a maximal one, and during the whole time the pupil reacts promptly to light and on convergence; therefore the feeling of dazzlement which is connected with atropia-mydriasis is either entirely wanting or is present to a slight degree only. With mydriasis there appears and disappears a very slight paresis of accommodation; the near point of myself and one other person whom I examined for this purpose was lengthened half an inch. I have observed in the normal conjunctiva, especially in the conjunctiva palpebrarum, a decided ischæmia, about the duration of which I can say nothing certain. I shall for the present pass over certain other observations not yet completely confirmed, as, for instance, those concerning the appearances shown by the ophthalmoscope, only stating that I have never seen any symptoms of irritation arise from the use of cocaine. As for the previously mentioned widening of the palpebral fissure, the symptom precedes in point of time, at any rate, its action on the iris and ciliary muscles, and as it appears almost simultaneously with the anæsthesia of the cornea and conjunctiva, I have referred it to the anæsthesia as a cause, and explained it by the disappearance of the irritations which normally affect the cornea and conjunctiva and cause the usual width of the palpebral fissure. As regards the anæsthesia, I have still some practical and important points to bring forward.

1. The anæsthetic effect of cocaine can be increased to a certain limit—that is, if cocaine is dropped into the eye after the partial cessation of the anæsthesia, a second complete anæsthesia results which lasts longer than the first. In this way I have produced complete anæsthesia lasting from fifteen to twenty minutes from the last application by a continuous repetition of the application at intervals of five minutes. 2. The anæsthetic effect is pre-eminently a local one—i.e., it is stronger on those places to which the solution has been directly applied and where it has been for some time in contact. 3. Since, as may be proved, cocaine is absorbed, and after every instillation a quantity, even though small, reaches the anterior chamber, one would *a priori* expect that the deeper portions of the eye could be rendered anæsthetic were it possible to introduce larger quantities of cocaine into it. But as, on the one hand, a certain time is necessary for its absorption, and on the other the anæsthetic effect in point of time is limited, the anæsthesia of the cornea would be over when the iris and ciliary body began to be affected; it would therefore be necessary to anæsthetise the cornea again. I believe I can meet both of these conditions, as the following will show. By means of a continuous application repeated every five minutes with a 5 per cent. solution kept up for some time (about half an hour) I succeeded in producing such an effect upon the deeper parts of the bulb that its sensibility to strong pressure was very decidedly diminished.

Through the kindness of Professor von Reuss, who placed at my disposal for experimental purposes the material of his (formerly Jaeger's) clinic, I was able for two or three weeks to test the effect of cocaine upon the pathological eye. From the very beginning I held cocaine to be valuable therapeutically for two purposes: one for its use as a narcotic in painful diseases of the eye; the other as an anæsthetic in operations on the eye. As for its use in the first instance, I expected much good from its action, especially in diseases of the cornea and conjunctiva, where there is much pain and

intolerance of light. Indeed, I used cocaine in a 2 per cent. solution on a large number of patients with conjunctivitis pustulosa (herpes corneæ). Several minutes after the instillation all the patients thus treated expressed an improvement as regards their subjective condition. The pain was diminished and the intolerance of light was decidedly lessened. With the same unanimity the patients complained that the pain and intolerance of light returned two or three hours after the instillation. We would expect that the pain and intolerance of light could be done away with, or at least diminished, by a frequent application. This method of application could not be carried out up to the present time because of the expense of the drug. I have not observed any influence, beneficial or otherwise, on the course of the disease in the experiments I have made as given above.

Similar results were obtained by me with the use of cocaine in the case of a man with painful erosions on the limbus. I hope also to control the pain in iritis by the use of cocaine, since I believe I have previously shown that its anæsthetic action includes to a certain extent the iris and the ciliary body. The mydriatic effect would not be of so much importance; still one might expect an influence upon the course of the disease from the vaso-constricting power of the drug; perhaps combined with atropine it might be successful. Up to the present time I have had no opportunity of using it in this disease.

The pain connected with cauterisation of the conjunctiva with nitrate of silver is entirely done away with, or, at least, decidedly lessened, by the previous instillation of cocaine. Most of the patients thus treated experimentally expressed themselves as having experienced no pain. In some cases, after a period of latency, the pain appeared, but after a fresh instillation it disappeared. One patient asserted that the pain, although much less than usual, lasted longer. I have little, and, in part, contradictory experience in the use of cocaine with the sulphate of copper treatment; at any rate, in this latter use it must be applied much stronger than in cauterisation with nitrate of silver.

I come now to the second use of cocaine—namely, as an anæsthetic in operations on the eye. Cocaine is used with excellent results in the removal of foreign bodies from the surface and substance of the cornea, an operation which is often rendered so difficult by the restlessness of the patient. I anæsthetised a considerable number, almost thirty, of such patients, making each, either seated or standing, look downwards, and allowing two drops of a 2 per cent. solution to flow down the cornea. After a period varying from three to five minutes the instillation was repeated. All the patients thereupon asserted that they had lost the sensation of a foreign body in the eye, and believing it was removed, prepared to go home. They held their bulb quiet during the extraction of the splinter by means of needles, and when asked what they had felt answered that they had felt nothing at all. Cocaine was used with the same good results in a case of tattooing of cicatrices on the cornea, and in the operation of pterygium. Good results might be obtained with cocaine in cauterisation of corneal ulcers with the actual cautery in the puncture of the cornea and discissio cataractæ.

Dr. Reuss performed the operation for staphyloma upon two children—one a boy, aged ten years, the other a girl of seven—without narcosis, using only cocaine in the manner to be described later on. The children remained perfectly quiet, and, according to their own confession, experienced no pain. Dr. von Reuss kindly allowed me to employ cocaine in several cases of iridectomy and cataract operations after Graefe, which he performed. In general, I only wish to state that these cases, one and all, ran their course without any irritation, and this, to say the least, calls for further trials of the drug. The experimental use of cocaine gave results which were more or less favourable according to the strength of the solution and the manner in which it was employed. The most favourable and almost completely satisfactory results as regards painlessness in operations were given by the cases in which the following method was carefully observed. For at least half an hour before the operation two drops of a 5 per cent. solution are instilled every five minutes. The patient is placed horizontally (without a pillow under the head), the upper lid is elevated, and, while the patient is told to look towards his feet, the solution is dropped upon the sclera just above the cornea.

Among those so treated was a woman, upon whom a linear extraction was made and who was questioned during each

stage of the operation; she answered that she felt absolutely no pain from the corneo-scleral incision, the seizure and cutting off of the iris caused her but little pain. During the whole operation there were no reflex movements. A like result was obtained in the case of an idiotic woman upon whom the same operation was performed, and upon whom Dr. von Reuss hesitated to operate because she was in other respects very sensitive.

The following case appears to me to be worthy of notice on account of its peculiar circumstances. Iridectomy was performed upon the left eye of a man with a bilateral *seclusio pupillæ*. Cocaine was employed. The man did not move in the slightest degree during the operation, and asserted he did not feel the corneo-scleral incision at all; that he felt the seizure and cutting off of the iris, but it did not pain him. Eight days later the other eye was operated upon, but this time without the use of cocaine; he writhed and "bore down," so that the operation was rendered decidedly more difficult. Although a large majority of people who have to undergo such operations are torpid individuals and bear their pain with patience, nevertheless, the last case appears to me to prove that even in such cases an anæsthetic might be of excellent service.

The translator of the above paper on the anæsthetic use of cocaine has been requested by the author to add the following short notice, the results of later experience in the use of the drug. Lack of time and space prevent details. Operations for cataract are almost painless when performed with cocaine. Hence in those cases of prominence of the bulbs, where there is great danger of escape of the vitreous humour during the operation, the elevator has been dispensed with. The importance of this will be appreciated by oculists. As predicted by Dr. Koller when he wrote his article, the operations of puncture of the cornea, *discissio cataractæ* and cauterisation of corneal ulcers have since been frequently performed under the cocaine anæsthesia, and absolutely painlessly.

That cocaine is of great value in relieving pain in iritis, the following case, given in brief, will show:—

A woman, M. F., forty-five years old, in Dr. von Reuss's wards, suffered so much pain from iritis as to be unable to sleep. The insomnia was complete, and had lasted seven days and nights. Atropine had been employed continuously. Cocaine in 5 per cent. solution was instilled six times in half an hour in the manner already detailed. The pain disappeared completely but reappeared three hours later. Cocaine was again instilled; this time three times in fifteen minutes. The pain vanished and the patient slept comfortably for the rest of the night. The next day on the reappearance of the pain a third instillation was used, and the pain disappeared and did not return.

In the clinic of Dr. von Reuss nearly all the operations are now performed under the cocaine anæsthesia according to the method already given in detail.

#### NOTE ON THE

### VALUE OF HYDROCHLORATE OF COCAINE IN OPHTHALMIC SURGERY.

By J. CRAWFORD RENTON, M.D. EDIN.,  
SURGEON TO THE EYE INFIRMARY, GLASGOW.

FOLLOWING the recommendation of Dr. Koller of Vienna, which was brought under my notice by Mr. Marcus Gunn of London, I have recently been using the hydrochlorate of cocaine in all operations on the cornea. Two per cent. and four per cent. solutions, some made with distilled water alone, others with boracic acid and glycerine to prevent putrefaction, have been used, as also the discs of the strength of  $\frac{1}{10}$  gr., made by Savory and Moore on the suggestion of Mr. Nettleship, and I have no hesitation in saying that my best corneal anæsthetic results have been obtained with the discs, two being quite sufficient to produce complete anæsthesia in six minutes, and being maintained from fifteen to twenty minutes. The 2 per cent. solution in distilled water acted well, but that made with glycerine was not satisfactory. One patient, who had both solutions used in a double iridectomy he required for lamellar cataract, stated that he felt no pain whatever with the plain solution, but slight pain with the glycerine preparation. In cataract extractions and

needle operations the anæsthesia of the cornea is most satisfactory, and patients state that they feel no pain. For the removal of foreign bodies from the cornea the cocaine promises to be most serviceable. As a mydriatic, in some patients it is very decidedly so, our present house-surgeon, Dr. McIntosh, who kindly allowed me to use it in his eye, found that his pupil remained fully dilated for a week. As a controller of ciliary pain I have not yet found the cocaine of much value, nor have I been able to satisfy myself that the conjunctiva or skin is much affected by it; but its value in preventing pain during an operation and keeping the eye soothed for some time after cannot fail to conduce to good results in ophthalmic surgery.

Glasgow.

### CHOLERA.

By MAX VON PETTENKOFER, M.D.,  
OF MUNICH.

(Continued from page 905.)

THE same considerations hold good in India. The famous places of pilgrimage, whose sanctuaries are annually visited by many millions of individuals, always have some cases of cholera amongst them, but it is only occasionally that an epidemic breaks out, and then it is only at those times when the predisposition to cholera exists—periods, be it noted, which do not for the most part coincide with the time when the number of pilgrims is at its greatest, nor when the principal feasts are in progress. For instance, Bryden has drawn up tables showing the number of admissions into the hospital at Puri in the neighbourhood of the sanctuary called *Dschagganath* for the years 1842 to 1866, and these statistics show the number of receptions of cases of cholera for each month of the year. This journal, extending over so many years, must give a good idea of the frequency of cholera in pilgrimage even though the numbers be but small. The principal feasts, when the chariot of the deity is drawn over the breasts of the faithful, occur in the middle of March, but the period at which cholera is at its height is in June, when there are many fewer pilgrims assembled. Altogether there were 313 cases in March during twenty-five years, whilst the number was 1155 for June, or nearly four times as many admissions for cholera into the hospitals. Puri lies on the south-west border of the territory where cholera is endemic, and has the same rhythm so far as cholera is concerned as Madras. Hardwar lies in the north-west of India, where the chief feast occurs in April, the principal day being the 12th, and often hundreds of thousands of pilgrims, if not millions, stream together here; yet cholera only breaks out in an epidemic form when the regions are predisposed to it. It will be interesting to go further into detail on this question. Hardwar is situate about 1000 feet above the level of the sea where the Ganges quits the Himalayas, and belongs to the holiest of places which the Hindus worship. Cholera only occurs occasionally in an epidemic form. In the last century (1783) a severe epidemic was known to have occurred amongst the pilgrims at Hardwar. From 1858 to 1867 the feasts passed on without the occurrence of any epidemic of cholera, and this immunity was believed to be due to the soundness of the arrangements which were enforced by the Government. In 1867 the whole prophylactic armour was thrown aside. But already in November, 1866, an epidemic of cholera was approaching the neighbourhood of Hardwar from Agra. The pilgrims began to arrive at Hardwar on April 1st. On April 3rd the majority had assembled, although the stream of pilgrims continued to increase till the 12th. The whole number of pilgrims reached about three millions. On April 9th the first case of cholera was detected by Dr. Kindall and taken into hospital. Other cases soon followed. On April 12th, on holy day, the pilgrims bathed from sunrise to sunset in the Ganges, in a holy fort which is separated from the torrent of the river by a rail, so that the people could not be drowned. Through this fort there was an incessant movement of men all day long. The water became thick and muddy, partly from the ashes of the dead which the pilgrims had brought with them to strew in the stream, and partly from the washing of the clothes and persons of the bathers. Every time a pilgrim entered the holy fort he dipped himself three times under, drinking the

## Contribution to Knowledge of the Action of Coca<sup>\*</sup>

DR. SIGM. FREUD

In the July issue of the Centralblatt fuer Therapie, edited by Dr. Heitler, I published a study on the coca plant and its alkaloid, cocaine.\*\* It included a review of the literature and some of my own experiments and brought this long neglected remedy to the attention of the profession. I may say that my article stimulated an entirely unexpected and profound consequence. At my suggestion, Dr. L. Koenigstein tested the ability of cocaine to relieve pain and reduce secretion in diseases of the eye. Meanwhile, my hospital colleague Dr. Karl Koller, quite independently of any suggestion of mine, conceived the happy idea of using the long-known, sensibility-obtunding property of cocaine to produce complete anesthesia and analgesia of the cornea and conjunctiva.\*\*\* He demonstrated the great practical value of this local anesthetic in experiments on animals and operations on patients. As a result of the communication by Koller describing his work at this year's Congress of Ophthalmologists in Heidelberg, cocaine has come into general use as a local anesthetic.

Continuing my own studies on cocaine, I have investigated the remarkable general action of this alkaloid of elevating mood and increasing endurance and capacity for work.

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\* Translated from Freud, S.: Beitrag zur Kenntniss der Cocawirkung. Wiener medizinische Wochenschrift, 85: 130-133, (31 January) 1885. The original was inscribed "To his dear friend Coca Koller".

\*\* "Ueber Coca", Centralbl. f.d. ges. Therapie, Vol. 2, No. 7, July (not August, as often erroneously cited) 1884.

\*\*\* The seventh of the therapeutic applications of cocaine which I discussed was local use. I concluded as follows: "It is likely that further applications exploiting the anesthetising property of cocaine will be found."



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1884

reference to the subject of Asiatic cholera." Action was taken in accordance with these suggestions, and a practitioner's license was revoked for "unprofessional and dishonorable conduct."

**The Death of Dr. Fauvel, of Paris**, is announced as having taken place on the 6th inst.

**Army Intelligence.**—*Official List of Changes in the Stations and Duties of Officers serving in the Medical Department, United States Army, from November 9, 1884, to November 22, 1884:*

BYRNE, C. C., Major and Surgeon. Granted four months leave of absence from November 16, 1884. S. O. 265, A. G. O., November 11, 1884.

TREMAINE, W. S., Major and Surgeon. Granted leave of absence for one month on surgeon's certificate of disability. S. O. 233, Department of the East, November 12, 1884.

WILSON, WILLIAM J., Captain and Assistant Surgeon. Granted leave of absence for four months, with permission to go beyond sea, to take effect when his services can be spared by his department commander. S. O. 262, A. G. O., November 7, 1884.

SHUFELDT, R. W., Captain and Assistant Surgeon. Assigned to duty as post surgeon at Fort Wingate, N. M. S. O. 217, Department of the Missouri, November 4, 1884.

OWEN, WILLIAM O., JR., First Lieutenant and Assistant Surgeon. Relieved from duty at Fort Canby, Washington Territory, and ordered to Fort Spokane, Washington Territory, for duty. S. O. 169, Department of Colorado, November 4, 1884.

McKEE, JAMES C., Major and Surgeon. Leave of absence extended one month. S. O. 273, A. G. O., November 20, 1884.

GODDARD, C. E., Major and Surgeon. Assigned to duty at Fort Yates, Dakota Territory. S. O. 138, Department of Dakota, November 15, 1884.

COWDREY, S. G., Captain and Assistant Surgeon. Granted leave of absence for one month. S. O. 237, Department of the East, November 17, 1884.

HAYARD, VALERY, Captain and Assistant Surgeon. Granted leave of absence for four months. Permission to go beyond sea. To take effect when his services can be dispensed with at his present station. S. O. 268, A. G. O., November 14, 1884.

TAYLOR, A. W., First Lieutenant and Assistant Surgeon. Relieved from duty at Fort Omaha, Neb., and ordered for duty at Fort D. A. Russell, Wyoming Territory. S. O. 101, Department of the Platte, November 19, 1884.

PHILLIPS, JOHN L., First Lieutenant and Assistant Surgeon. Assigned to duty at Fort Keogh, Montana Territory. S. O. 134, Department of Dakota, November 5, 1884.

**Naval Intelligence.**—*Official List of Changes in the Medical Corps of the United States Navy for the two weeks ending November 22, 1884:*

BEARDSLEY, GROVE S., promoted to the grade of Medical Inspector, April 24, 1884. November 14, 1884.

HEFFENGER, A. C., Passed Assistant Surgeon. Assigned to duty at Portsmouth, N. H., to continue till December 12, 1885. November 11, 1884.

WIEBER, F. W. F., Assistant Surgeon. Ordered to the receiving ship Vermont, at New York, November 12, 1884.

AMES, HOWARD E., Passed Assistant Surgeon. Detached from the Greely relief steamer Bear, and assigned to special duty in New York. November 17, 1884.

BRIGHT, GEORGE A., Surgeon. Detached from the Galena and placed on waiting orders. November 19, 1884. daigua, N. Y.

CLERBORNE, C. J., Medical Inspector. Assigned to duty at Philadelphia, Pa., as member of Medical Examining Boards. November 21, 1884.

DU BOIS, F. L., Surgeon. When detached from the Naval Examining Board, November 29th, is ordered to the Galena. November 20, 1884.

GREEN, EDWARD H., Passed Assistant Surgeon. Detached from the Greely relief steamer Thetis, and assigned to special duty in New York. November 17, 1884.

HALL, J. H., Surgeon. Detached from Navy Yard, Mare Island, and assigned to duty at the Naval Hospital at that yard. November 19, 1884.

HUGG, JOSEPH, Surgeon. Assigned to the Minnesota as relief of Surgeon Woolverton. November 15, 1884.

MARTIN, WILLIAM, Assistant Surgeon. Ordered to special duty in connection with the New Orleans Exposition. November 19, 1884.

NASH, F. S., Passed Assistant Surgeon. Detached from the Greely relief steamer Alert, and assigned to special duty in New York. November 17, 1884.

SIMON, W. J., Surgeon. Ordered to the Philadelphia Hospital for treatment. November 17, 1884.

WOOLVERTON, T., Surgeon. Detached from the Galena, and placed on waiting orders for sea service. November 15, 1884.

#### Society Meetings for the Coming Week:

MONDAY, *December 1st*: Medico-Chirurgical Society of German Physicians of New York; Morrisania Medical Association, New York (private); Brooklyn Anatomical and Surgical Society (private); Utica, N. Y., Medical Library Association; Boston Society for Medical Observation; Providence, R. I., Medical Association; Hartford City, Conn., Medical Society.

TUESDAY, *December 2d*: New York Obstetrical Society (private); New York Neurological Society; Elmira, N. Y., Academy of Medicine; Buffalo Medical and Surgical Association; Ogdensburg, N. Y., Medical Association; Medical Societies of the Counties of Herkimer and Saratoga, N. Y., and Hudson, N. J.

WEDNESDAY, *December 3d*: Medical Society of the County of Richmond, N. Y.

THURSDAY, *December 4th*: New York Academy of Medicine (Nominations of Officers; Paper by Dr. Joseph E. Winters, entitled "Is the Operation of Tracheotomy in Diphtheritic Croup Dangerous? When should the Operation be Performed?"); Society of Physicians of the Village of Canandaigua, N. Y.; Boston Medico-Psychological Association.

FRIDAY, *December 5th*: Practitioners' Society, New York (private).

SATURDAY, *December 6th*: Manhattan Medical and Surgical Society, New York (private); Miller's River, Mass., Medical Society.

#### Letters to the Editor.

##### HYDROCHLORATE OF COCAINE IN MINOR SURGERY.

SOUTH NORWALK, CONN., November 22, 1884.

To the Editor of the New York Medical Journal:

SIR: As a contribution showing the efficacy of hydrochlorate of cocaine in minor surgery, the following case is of interest at the present time:

A. B., a phlegmatic German, about forty years of age, on Friday, the 14th inst., while cleaning a revolver, accidentally shot himself in the

right hand. The ball (.22 caliber) entered the palm of the hand opposite the third carpo-phalangeal articulation, and, passing outward under the flexor tendons of the hand, lodged against the first phalanx (inner surface) of the little finger, about half an inch in front of the articulation with the corresponding bone. Twenty-four hours after the accident the man came to my office to have the wound dressed. At that time the hand, which naturally was very large and thick, was considerably swollen and inflamed; there was also considerable pain. I gave him a hypodermic injection of five minims of a two-per-cent. solution of the hydrochlorate of cocaine on the back of the hand, at the inner side of the last metacarpal bone—deeply injected, so as to bring the drug as near as possible to that branch of the ulnar nerve supplying the inner side of the little finger. Five minutes later another hypodermic of the same amount was given along the back of the first phalanx of the little finger, the solution being thrown in as the needle was withdrawn. He said that the introduction of the needle the second time gave not the slightest pain, the first one having hurt him and been followed by smarting (probably due to the alcohol). After waiting five minutes longer, I made the necessary incision, an inch or an inch and a half long and quite deep, owing to the size of his finger and its swollen condition. Neither the cut nor the subsequent manipulation in the removal of the ball, nor the dressing, gave him *any pain whatever*. He described his sensations in the hand as being “numb or asleep.”

Without the cocaine, the little operation would have been quite painful, owing to the inflamed condition of the parts. I have performed two or three other slight operations upon mucous membranes, where the drug was applied on a pledget of cotton soaked in the solution, held against the part for ten or fifteen minutes, which were equally painless.

Yours sincerely,  
W. C. BURKE, JR.

#### HYDROCHLORATE OF COCAINE IN DERMATOLOGICAL PRACTICE.

14 EAST THIRTY-FIRST STREET, November 24, 1884.

To the Editor of the *New York Medical Journal*:

SIR: Much has been published of late concerning the local anæsthetic effect of the hydrochlorate of cocaine, mainly by the ophthalmologists. It is from the dermatological standpoint that I wish to make this contribution.

Epilation by means of electrolysis is often, to some patients, rather a painful procedure, especially about the upper lip, near the nose, and over the jaw bone, between its angle and the chin. These regions offered a good field for testing cocaine. Accordingly, I had a four-per-cent. ointment of cocaine and oleic acid (not an oleate, you will perceive) made by my druggist, Mr. Fingerhut, of No. 404 Fourth Avenue, the hydrochlorate used being from a lot that had proved active in ophthalmological practice. I first tried it on the back of one of my wrists, rubbing it in for some five minutes. I found that pulling on the hairs of the part rubbed was much less painful than elsewhere. Then I had an intelligent patient, whose superfluous hairs I was removing by electrolysis, rub it well into the left side of her upper lip and into her cheek, between the angle of the jaw and the chin. In about five minutes the anæsthetic effect was well marked, and she allowed the hair in those regions to be extracted with a current from twelve cells of a freshly charged battery without evincing any signs of pain. Two days before, the operation had been very painful, although only nine cells were used, and on the same day the corresponding regions on the other side of the face were very sensitive. The anæsthetic effect lasted for the whole time I was working, probably thirty minutes. The patient said that some hairs were removed without her feeling it, and that the pain attending the extraction of the others did not amount to anything.

One case is not much to build upon, and I only report this

to encourage others to try cocaine in similar cases. I certainly feel encouraged to try again.

Yours,  
GEORGE THOMAS JACKSON.

#### A POINT ON LIGATURES.

INDIANAPOLIS, IND., November 1, 1884.

To the Editor of the *New York Medical Journal*:

SIR: I recently sewed up a bad cut on a boy's hand with one of the three strands of ordinary surgeon's silk, unwaxed and not antiseptised, purposely. In four days there was nothing unabsorbed but the knot. Dirt and air were excluded by two layers of silk isinglass plaster.

I removed an egg-sized adipose submaxillary tumor, a few weeks ago, through a three-inch incision. The wound was closed with clean, new,  $\frac{3}{8}$  surgeon's silk, without plaster or external application of any kind, the suture material unwaxed or otherwise treated. The lips of the external wound were perfectly united, without a drop of pus about the wound, and the *subcutaneous part of the ligatures was almost gone from absorption* on the fifth day, when the knots were removed. Silk is formed animal tissue, and, without being rendered a foreign body by wax or other treatment, may be the much needed ligature we seek. My opportunities for testing this matter are so limited I ask you to use the hint (if you think best), since I find several good surgeons here have not heretofore appreciated the point, as possibly some of your distinguished experimenters have.

Truly yours, L. D. WATERMAN, M. D.

#### Proceedings of Societies.

##### NEW YORK SURGICAL SOCIETY.

Meeting of November 11, 1884.

The President, Dr. ROBERT F. WEIR, in the chair.

**Simultaneous Incomplete Wound of the Femoral Artery and Vein; Ligation of both Vessels in the Wound; Recovery.**—Dr. L. S. PILCHER presented a man, aged thirty-four, a butcher, who, in the evening of May 17th last, accidentally stabbed himself with a sharp, long, narrow-bladed knife, the blade entering the upper and front part of the right thigh, a little below the line of Poupart's ligament. The overwhelming hæmorrhage which at once followed was fortunately quickly controlled by pressure at the hands of Dr. N. B. Sizer, of Brooklyn, who happened to be within hail at the moment of the accident. This pressure was then assisted by the insertion of a tampon into the wound until the arrival of Dr. Pilcher, and thus time was afforded to make the necessary arrangements for the permanent arrest of the hæmorrhage. The parts adjacent to the wound were shaved and cleansed, and as full an effort was made to conduct the required operative procedures without septic contamination as was possible under the circumstances. The original wound was a transverse cut of only three fourths of an inch in extent. A longitudinal incision of some inches in length was made, extending above and below the stab cut, while pressure was kept up at the point from which hæmorrhage proceeded. The femoral vessels in Scarpa's space having been fully exposed, it became evident that the knife had pierced the femoral vein about an inch and a half below Poupart's ligament, and, having divided its outer half, had also divided the adjacent inner half of the femoral artery, inflicting thus an incomplete wound upon both the main vascular trunks of the limb. While pressure was still directed upon the vein wound, the artery, being compressed above, was completely divided at the point of



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FRANK P. FOSTER, M. D.

NEW YORK, SATURDAY, DECEMBER 6, 1884.

THE NEW LOCAL ANÆSTHETIC.

FOR several weeks past the medical press, including this journal, has teemed with testimony to the wonderful anæsthetic effects of the hydrochlorate of cocaine. Under ordinary circumstances, we should have waited for as many months to elapse before formally granting the truth of such allegations as are commonly put forth in behalf of any new remedy. But, although the available supply of the salt has thus far continued to be exceedingly limited, but a very small quantity has been needed to establish its marvelous power, and that little has been used to good purpose. We have no longer any hesitation, therefore, in proclaiming the announcement of the anæsthetic power of cocaine to be the most important that has been made in therapeutics since Morton astonished the world with his demonstration of the power of ether—the first and still the best of general anæsthetics.

Until within the past few weeks, coca had been known and used chiefly—almost exclusively—as a stimulant, and it is therefore not a little remarkable that its alkaloid should suddenly have made a brilliant reputation as a nullifier, for the time being, of the function of sentient nerves. On the other hand, as Dr. Squibb pointedly remarks, in his admirable article on the subject, in the November number of the "Ephemeris," it is almost as unaccountable that the full anæsthetic power of the drug was not brought to light before, seeing that its dilating effect on the pupil was well known, and that it was even in use to some extent by the laryngologists to benumb the throat so that it would admit of readier manipulation. But this latter consideration should not detract in the least from the credit to be given the medical student, Koller, for his discovery.

Even if it had turned out to be the case, as was at first supposed, that the anæsthetic effect was limited to the tissues that had actually imbibed the solution—and therefore to such small areas that the anæsthesia would scarcely have been available outside of ophthalmic practice—the great advantage of the agent would have remained unquestioned. That the range of its application would have been thus hampered is not disproved, practically speaking, by even so startling a fact as that laparotomy has been performed with no other anæsthesia than that produced by it, for we take it that the performance of abdominal section under local anæsthesia is at best but a curiosity, and not at all likely to become a settled practice. What is possible is not always the most desirable, and it seems to us extremely doubtful if surgeons will be willing to dispense with general anæsthesia as a rule in major operations. Leaving these out of account, however, there is a wide range of operative procedures in which it is necessary to have a considerable area anæsthe-

tized, but in which there is no need of abolishing the patient's consciousness. These cases could not well have been met by a local anæsthetic acting merely by imbibition, and it is for that reason that the newly discovered fact that the parts supplied by a sensory nerve may be made insensitive by an injection of cocaine in the immediate neighborhood of the trunk of that nerve is of an importance that can not be overestimated. That discovery seems to have been well established by the experiments performed by Dr. Halsted and Dr. Hall, recounted in the latter gentleman's letter, which we publish in another column; and we must not omit to credit Dr. Burke, of South Norwalk, Conn., with having practically hit upon the same idea, as may be gathered from his letter which we published last week.

No doubt much yet remains to be done in the way of experiment and observation before the precise sphere of the new anæsthetic can be defined, and it would be prudent for those who may undertake to furnish us with these data not to count too much upon the innocuousness of the drug, for it should be noted that Dr. Hall experienced marked constitutional symptoms from an injection of thirty-two minims of a four-per-cent. solution of the hydrochlorate. While caution is to be observed, therefore, the teachings of even our present limited experience with cocaine ought to go far toward silencing the senseless babble so often indulged in about the uselessness of experimenting with the comparatively unknown substances of the vegetable materia medica. Here was an alkaloid supposed to be well-nigh worthless, but it has suddenly been raised to the first rank. Who can doubt that our knowledge of its power would have been considerably delayed but for the work of the pharmacists? Had the Darmstadt laboratory remained, even up to the present time, the sole available source of its supply, much of what has already been accomplished with cocaine would unquestionably have been blocked by the sheer impossibility of obtaining the drug. We have all along been loath to believe that American chemists were unable to produce it, and we are gratified to be able to note that the potent product with which Dr. Halsted and Dr. Hall conducted their experiments was made by Messrs. Parke, Davis & Co. This aspect of the matter is not without its economic bearings, for we learn from Dr. Squibb's article that one of the chief obstacles to the production of the drug on a large scale in this country is the enormous tax which the Government sees fit to levy on alcohol and ether, those substances being the chief solvents used in the separation of the alkaloid.

MINOR PARAGRAPHS.

KOCH'S REPLY TO HIS OPPONENTS.

THE "Deutsche Medizinal-Zeitung" publishes a long letter by Koch, in which he replies to the objections urged against the specific character of the comma bacillus, and discusses chiefly the counter-experiments by Lewis and Finkler and Prior. We have not space to quote the letter at length, but would refer the reader to the original. The main point urged is, that all the gentlemen who have questioned the writer's results have not shown sufficient care in the conduct of their own experiments. He sees no reason as yet to lose faith in the importance of his discovery. One statement which he makes is of great weight

**Army Intelligence.**—*Official List of Changes in the Stations and Duties of Officers serving in the Medical Department, United States Army, from November 23, 1884, to November 29, 1884:*

LORING, L. G., Captain and Assistant Surgeon. Assigned to duty as Post Surgeon, San Diego Barracks, San Diego, Cal. S. O. 135, Department of California, November 19, 1884.

WILSON, GEORGE F., First Lieutenant and Assistant Surgeon. Granted one month's leave of absence, from November 20th. (Vancouver Barracks, Wyoming Territory.) S. O. 180, Department of the Columbia, November 18, 1884.

WALES, PHILIP G., First Lieutenant and Assistant Surgeon. Now at Fort Cœur d'Alcène, Idaho Territory, ordered for temporary duty at Vancouver Barracks, Wyoming Territory. S. O. 179, Department of the Columbia, November 17, 1884.

#### Society Meetings for the Coming Week:

MONDAY, *December 8th*: New York Ophthalmological Society (private); New York Medico-Historical Society (private); Boston Society for Medical Improvement; Gynecological Society of Boston; Burlington, Vt., Medical and Surgical Club.

TUESDAY, *December 9th*: New York Medical Union (private); New York Surgical Society; Newark, N. J., Medical Association (private); Trenton, N. J., Medical Association (private); Medical Societies of the Counties of Morris, N. J., and Penobscot, Me.

WEDNESDAY, *December 10th*: New York Pathological Society; American Microscopical Society of the City of New York; Medico-Legal Society, New York (election); Medical Societies of the Counties of Cayuga, Chemung, Cortlandt, and Montgomery, N. Y., and Middlesex, N. J.; Pittsfield, Mass., Medical Association (private); Strafford District, N. H., Medical Society.

THURSDAY, *December 11th*: Harlem Medical Association of the City of New York; New York Laryngological Society (private); Society of Medical Jurisprudence and State Medicine, New York (election); Brooklyn Pathological Society; South Boston, Mass., Medical Club (private); Medical Society of the County of Addison, Vt.

FRIDAY, *December 12th*: Yorkville Medical Association, New York (private); Medical Society of the Town of Saugerties.

SATURDAY, *December 13th*: New York Medical and Surgical Society (private).

## Letters to the Editor.

### HYDROCHLORATE OF COCAINE.

17 EAST FORTY-NINTH STREET, November 26, 1884.

To the Editor of the *New York Medical Journal*:

SIR: Wishing to use the hydrochlorate of cocaine in some small operations at the Roosevelt Hospital Out-door Department, I made some experiments on myself, to determine the best mode of using it. The preparation was a four-per-cent. solution made by Parke, Davis & Co. Injecting subcutaneously six minims on the dorsal surface of the forearm, at the junction of the middle and upper thirds, near the ulnar border, caused complete loss of sensation over an area extending downward as far as the lower end of the ulna, from three quarters of an inch to an inch wide above, and half an inch wide below, obviously following the distribution of a cutaneous branch of the ulnar nerve. There was no diminution of sensibility above the point at which the needle was introduced. A number of subsequent

experiments showed that the anæsthesia extended over the region supplied by the cutaneous nerves near or into which the injection was made. Thus, in a number of experiments made by Dr. Halsted and myself, we have found that, injected subcutaneously into the leg or forearm, not in the neighborhood of any large nerve-trunk, it will cause anæsthesia for a distance of two or three inches below the point of injection. An injection into the musculo-cutaneous nerve of the leg, at the point where it pierces the deep fascia, caused anæsthesia over all that portion of the leg and foot supplied by this nerve. An injection of eight minims into my left ulnar nerve at the elbow had no effect. An injection of thirty-two minims into the right ulnar nerve at the elbow caused, in two or three minutes, numbness and tingling down the forearm and little finger, and in five or six minutes anæsthesia extending down the ulnar border of the forearm and hand and over the little finger, with much reduction of the sensibility on the ulnar border of the ring-finger. There was an anæsthetic area over the olecranon and the posterior surface of the external condyle, which we should not expect to be supplied by the ulnar nerve. There was no apparent diminution of muscular power, and no anæsthesia of the skin at the point where the injection was given. We have noticed that, when the needle is thrust into the deeper layers of the subcutaneous connective tissue, there is usually no loss of sensibility at the point where the needle was introduced.

With the anæsthesia, marked constitutional symptoms appeared; about six minutes after the injection there was giddiness, at first slight, then well marked, so that I could not walk without staggering; and finally there was quite severe nausea, which would have been much worse, I think, had not the stomach been empty. At the same time, the skin was covered with cold perspiration, and the pupils were dilated. The nausea passed off, with the local anæsthesia, in about twenty minutes, leaving some dizziness for an hour or so longer.

The same evening Dr. Halsted removed a small congenital cystic tumor, situated directly over the outer third of the left supra-orbital ridge, and believed to be a meningocele, the communication of which with the cranial cavity had become shut off. Nineteen minims of the four-per-cent. solution were given hypodermically in divided doses, one external to the tumor, and the others close to the supra-orbital notch. In about five minutes the anæsthesia was complete. The incision through the skin and the earlier steps of the operation were not felt at all, but, in consequence of the close adhesions of the sac and its extensive prolongations, especially into the upper lid, the operation was somewhat protracted, and the anæsthesia had passed off to a considerable extent before it was completed. I was informed of a case, occurring on the same day, in which cocaine was injected, preparatory to performing a small plastic operation, in the same region, but no anæsthesia of the field of operation was produced. On inquiry, I was told that the injections had been given above the point where the incisions were to be made.

This afternoon, having occasion to have the left first upper incisor tooth filled, and finding that the dentine was extremely sensitive, I induced Dr. Nash, of No. 31 West Thirty-first Street, to try the effects of cocaine. The needle was passed through the mucous membrane of the mouth to a point as close as possible to the infra-orbital foramen, and eight minims were injected. In two minutes there was complete anæsthesia of the left half of the upper lip and of the cheek somewhat beyond the angle of the mouth (as I was in the dentist's chair, I could not determine the exact limits), involving both the cutaneous and the mucous surfaces; also of the left side of the lower border of the septum nasi and of the anterior surface and lower border of the gums, extending from the median line to the first molar tooth. Forcing the teeth apart with a wedge caused no pain except

when the wedge impinged on the unaffected mucous membrane of the posterior surface of the gums. Dr. Nash was then able to scrape out the cavity in the tooth, which had previously been so exquisitely sensitive, and to fill it, without my experiencing any sensation whatever. The anæsthesia was complete until twenty-six minutes after the injection, and sensibility was much diminished for ten or fifteen minutes longer. Piercing the mucous membrane with the needle caused pain like the prick of a pin, but its subsequent introduction until it struck the bone and the injection of the solution were not felt. In the same way, the introduction of the needle into the ulnar nerve caused quite severe pain, with tingling down to the little finger, but the injection of the fluid gave rise to no sensation. In the experiment on the teeth, it surprised me that the incisor tooth should be rendered insensitive, as the anterior-superior dental nerve is given off in the infra-orbital canal. I can only suppose that the effect extends some distance along the nerve centrally, or that the fluid traveled along the sheath of the nerve into the canal.

We have already used this mode of administration successfully in a number of cases in the Roosevelt Hospital Out-door Department, and it is obvious that, when the limits of safety have been determined, it may find very wide application. For instance, in addition to the usual application to the conjunctiva, in operations on the eye, an injection into the orbit, in the neighborhood of the ciliary nerves, would doubtless diminish the liability to a very grave accident, which, I understand, has already occurred several times in the city—namely, the extrusion of the lens, from blepharospasm, occurring during iridectomy performed with the aid of cocaine. We have injected twenty minims a number of times, without causing any constitutional symptoms.

Very truly yours,

R. J. HALL, M. D.

*Postscript, December 1st.*—Since the foregoing was written we have made some additional experiments which seem of interest. Dr. Halsted gave Mr. Locke, a medical student, an injection of nine minims, trying to reach with the point of the needle the inferior dental nerve where it enters the dental canal. In from four to six minutes there was complete anæsthesia of the tongue, on the side where the injection had been given, extending to the median line and backward to the base as far as could be reached with a pointed instrument. There was, further, complete anæsthesia of the gums, anteriorly and posteriorly, to the median line, and all the teeth on that side were insensitive to blows. The soft palate and the uvula, on the same side, were anæmic and quite insensitive. Mr. Locke thought also that there was some diminution of sensibility in the domain of the auriculo-temporal nerve.

In four or five other cases where the injection was made in the same way, from fifteen to twenty minims being used, the fluid seemed to have come nearer the lingual than the inferior dental. In all, the tongue was affected sooner than the gums; the anæsthesia extended as far back as the epiglottis, and the sense of taste was abolished on the affected side; and the posterior surface of the gums was earlier and more completely anæsthetized than the anterior.

This evening Dr. Halsted gave me an injection of seventeen minims, the needle being introduced along the internal surface of the left ramus until it touched the inferior dental nerve, causing a sharp twinge along the whole line of the lower teeth. In three minutes there was numbness and tingling of the skin, extending from the angle of the mouth to the median line, and also of the left border of the tongue. In six minutes there was complete anæsthesia of the left half of the lower lip, on both the cutaneous and the mucous surfaces, extending from the median line to the angle of the mouth and downward to the inferior

border of the jaw. A pin thrust completely through the lip caused no sensation whatever. There was also complete anæsthesia of the posterior surface of the gums and of the lower teeth on the left side, exactly to the median line; hard blows upon the teeth with the back of a knife caused no sensation. The anterior surface of the gums was anæsthetic only from the median line to the first bicuspid. There was a small area of complete anæsthesia, about the middle third of the left border of the tongue, not more than an inch in diameter. A slight return of sensation began twenty-five minutes after the injection, and five minutes later no complete anæsthesia remained anywhere. I should mention that fifteen to twenty minims in this region caused, in two or three cases, slight constitutional symptoms similar to those previously described.

#### HYPODERMIC INJECTIONS OF PHENIC ACID IN MALARIAL FEVER.

46 WEST THIRTY-SECOND STREET, November 12, 1884.

To the Editor of the *New York Medical Journal*:

SIR: Under "Therapeutical Notes," in your last issue (November 8th), you report from "Union médicale" one case of intermittent fever successfully treated by hypodermic injections of phenic acid—1 to 100. Will you allow me to bring to your notice, and that of the readers of your valuable journal, that this method of treatment is by no means new in this country? Ever since 1871 I have cured by that system hundreds of cases where both quinine and arsenic had failed.

I do not claim to be the only one who employs the treatment here. I know that, since 1876 or 1877, Dr. Glover C. Arnold, to whom I then communicated my results with the phenic acid, has from that time given it the preference over all other febrifuges in intermittent fever. No less enthusiastic is Dr. Charles F. Roberts, who, but a few days ago, was telling me of his unvarying success in like cases.

It has been said by some that the injection is liable to cause abscesses. All I can say is, that I never had any, and I doubt the liability if a pure article is made use of. I always use a solution of phenic acid—freed from cresylic acid, rosolic acid, and rosanilin—which has been deoxidized and combined in its nascent state. Furthermore, I will state that I use a two-per-cent. solution, injecting one hundred drops at a time. Within a few weeks, sometimes in less than a week, I obtain a normal temperature, and, what is more, it remains such.

Very respectfully,

GIBSLANI DURANT, M. D.

### Proceedings of Societies.

NEW YORK ACADEMY OF MEDICINE.

Meeting of November 20, 1884.

The President, FORDYCE BARKER, M. D., LL. D., in the chair.

A **New Syringe** for washing out the bladder, abscess-cavities, etc., was shown by Dr. ALFRED C. POST. It was made by the Messrs. Tiemann & Co., of hard rubber, and admitted of ready inspection of the piston from either end.

The President introduced Dr. Wile, of Connecticut, and Dr. Price, of San Francisco, and invited them to seats on the platform.

The **Surgical Management of Rhachitic Deformities of the Lower Extremities** was the title of the paper of the evening, read by Dr. V. P. Gibney. [See pages 606 and 637.]

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FRANK P. FOSTER, M. D.

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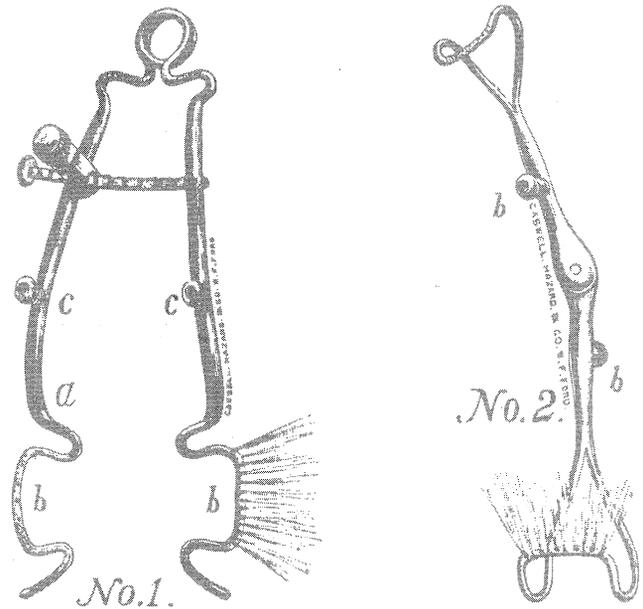
NEW YORK:  
D. APPLETON AND COMPANY.  
1, 3, AND 5 BOND STREET.  
1885.

it to their use. The irrigation will have to be repeated as often as may be indicated by the quantity and quality of the discharge. If there is much swelling of the eyelids, the outer canthus should be cut. The application of cold should not be made with ice-bags. Pledgets of linen—to be burned after use—should be laid on a piece of ice at the bedside, and this application of cold requires care and a constant attendant.

In the severe forms of gonorrhœal conjunctivitis—and this disease is nearly always very severe—when not seen very early and treated at once, the cornea runs great risk. The eyelids are intensely swollen, and when the ocular conjunctiva is much infiltrated the cornea is in great danger of suppuration, and the treatment should be directed to the reduction of the pressure on the eyeball and diminution of the secretion already formed. The pressure caused by the chemosis and swollen lids compresses the vessels which supply the margin of the cornea, causing an insufficient circulation. In order to remove this factor, the outer commissure should be divided to its fullest extent, together with the canthal ligament. The late Mr. Critchett, of London, proposed to divide the upper lid vertically to the orbital margin in severe cases, evert the flap and fix it to the skin above, and he says the cornea does not suppurate when this is done. Fuchs\* has modified this operation. He divides the outer commissure to such an extent as to relieve also the symptoms of pressure. He then puts a suture through the lower lid and attaches it on the cheek, ectropionizing it entirely. He detached the suture, in the case he reports, at the end of the fifth day, and the healing was good. If the cornea is involved, it requires special attention in addition to the use of atropine. A thorough removal of the secretion from the upper *cul-de-sac* is not possible by the ordinary means; this may, however, be done by means of a simple instrument which I have devised for the purpose. The instrument is an eye-speculum, the arms of which are hollow and the claw deeper than in the ordinary eye-speculum; it has a number of perforations for the passage of the fluid, which is supplied by a fountain syringe. It is inserted between the lids with great gentleness, and care should be taken not to injure the cornea with it. The lids should be gently lifted from the eyeball by means of the speculum, and the spray of fluid allowed to play upon the upper *cul-de-sac*. Even when the lids are extremely painful, it is a relief to have them gently lifted from the eyeball and the stream of fluid allowed to play upon the upper conjunctival *cul-de-sac*.

Of course the use of this instrument should not be entrusted to an ordinary nurse, but the physician can at least perform the operation twice daily, and keep up the irrigation for from ten to fifteen minutes. The solution of carbolic acid in the case of adults, when the inflammation is intense, may be as strong as three per cent.—to be diluted as the disease improves; this is astringent as well as antiseptic. And the silver I would apply, according to the exigency of the case, in four-per-cent. or twelve-per-cent. solutions, and neutralize with salt and water, and then apply the medicated vaseline to the conjunctiva, and over the lids the iced

cloths. Iodoform has not met with much favor in this disease. Quinine in solution has also been used, but it has no



The instrument shown in Fig. 1 may be used for either eye, the tube with the water-supply being attached at *c*, and to the upper branch only in case it is desired to irrigate the upper *cul-de-sac* alone. Fig. 2 represents a folding lid-elevator (of large and small size) designed for the same purpose as the spring-speculum. The tube of the fountain syringe is attached at *b*.\*

advantage over the carbolic acid. Dr. H. Linds Ferguson (Dublin) reports cases of gonorrhœal conjunctivitis in which he has had good results from the use of finely powdered boric acid. The bichloride of mercury has no claim to advantage over the boric acid.

DIPHTHERITIC CONJUNCTIVITIS.—Measures of prophylaxis based upon bacteriology must lie in the future. We must be content with the enforcement of general hygienic laws. Mr. Tweedy † used one-per-cent. solutions of quinine in this disease, and did not see any serious damage to the cornea when it was used. Iodoform does not seem to be of much use in diphtheritic conjunctivitis. Vossius ‡ recommends a four-per-cent. solution of salicylic acid in glycerin.

40 WEST TWENTY-FOURTH STREET, NEW YORK.

## SPINAL ANÆSTHESIA AND LOCAL MEDICATION OF THE CORD.

By J. LEONARD CORNING, M.D.

It is my desire on this occasion to draw attention to a procedure in therapy which, so far as I am aware, possesses the merit of novelty. The arguments which I shall advance in its favor are twofold in kind: First, I shall cite certain physiological facts with which the procedure in question stands in immediate relationship; and, secondly, I shall endeavor to record conscientiously the actual phenomena evoked by the use of the method itself.

To take up the argument in this order, I would remark, then, that, when a certain quantity of a remedy, say strychn-

\* These instruments are made by Mr. W. F. Ford, of Messrs. Caswell, Hazard & Co.

† London "Lancet," 1882, No. 1.

‡ "Klin. Monatsbl. f. Augenheilk.," Bd. xix, p. 423.

\* "Centralblatt f. prakt. Augenheilkunde," 1881, p. 198.

nine, is thrown under the skin of a frog, certain phenomena make their appearance which show indubitably that the functions of the spinal cord are profoundly affected. The animal is thrown into violent convulsions, and assumes a rigid attitude, and we have presented the picture of an artificial tetanus. This is a spectacle of the physiological laboratory, and one with which we are all familiar.

If, now, we remove the posterior arches of three or four of the vertebræ of the animal, and, seizing the membranous coverings of the cord, insert the end of a hypodermic needle so that we are able to inject a small quantity of a solution of strychnine, we shall find, first, that not only are the convulsive phenomena immediately produced, but, secondly, that a smaller quantity of the fluid is required to evoke them than when the drug is placed under the skin at a point remote from the spinal cord.

It was formerly supposed that this phenomenon was due to the direct contact of the strychnine with the nervous elements of the cord, but Harley\* has shown that the poison can act only through the intermediation of the blood-vessels, since, when the latter are separated from the cord, the solution remains entirely inert, the convulsions failing to appear.

From the foregoing considerations, it is clear that, in order to obtain the most immediate, direct, and powerful effects upon the cord with a minimum quantity of a medicinal substance, it is by no means necessary to bring the substance into direct contact with the cord; it is not necessary to inject the same beneath the membranes, as in the case of the frog, since the effects are entirely due to the absorption of the fluid by the minute vessels. On the other hand, in order to obtain these local effects, it is first necessary to inject the solution in the vicinity of the cord, and, secondly, to select such a spot as will insure the most direct possible entry of the fluid into the circulation about the cord. Is there in man a locality which fulfills these conditions? Instead of answering this question at once, I will rather detail some recent experiments performed by myself, by means of which, I trust, all doubts on the subject will be effectually set at rest.

PROTOCOL OF EXPERIMENTS.—Some time since I began a series of experiments with a view to determining whether the local medication (anæsthetization) of the spinal cord was within the range of practical achievement. The drug made use of was the hydrochlorate of cocaine. As the introduction of a hypodermic needle beneath the membranes of the medulla spinalis is not practicable without removal of the arches of the vertebræ (on account of the danger of wounding the cord), I decided to inject the anæsthetic between the spinous processes of the lower dorsal vertebræ. I was led to resort to this expedient from a knowledge of the fact that in the human subject numerous small veins (*venæ spinosæ*) run down between the spinous processes of the vertebræ, and, entering the spinal canal, join the more considerable vessels of the plexus spinalis interna. From these theoretical considerations I reasoned that it was highly probable that, if the anæsthetic was placed between the

spinous processes of the vertebræ, it (the anæsthetic) would be rapidly absorbed by the minute ramifications of the veins referred to, and, being transported by the blood to the substance of the cord, would give rise to anæsthesia of the sensory and perhaps also of the motor tracts of the same. To be more explicit, I hoped to produce artificially a temporary condition of things analogous in its physiological consequences to the effects observed in transverse myelitis or after total section of the cord. I therefore anticipated a more or less local action of the drug upon the cord. My hopes in this regard were based somewhat upon the well-known lethargy of the circulation in the cord, particularly at its lower portion—a condition of things highly promotive of the local action of the drug.

*Experiment I.*—This was performed on a young dog. At ten o'clock, A. M., I injected twenty minims of a two-per-cent. solution of the hydrochlorate of cocaine into the space situated between the spinous processes of two of the inferior dorsal vertebræ. Five minutes after the injection there were evidences of marked inco-ordination in the posterior extremities; the dog threw his hind-legs about aimlessly, holding them far apart, much after the manner of some ataxic patients. A few minutes later there was marked evidence of weakness in the hind-legs, but there were no signs whatever of feebleness in the anterior extremities. I now tested the condition of sensibility by means of a powerful faradaic battery, one of the conducting cords of which was attached to a fine wire brush. When the wire brush was applied to the hind-legs, there was no reflex action whatever on the part of the latter, at least such was the case except when the most powerful currents were employed. But, on the other hand, when I applied the wire brush to either of the anterior extremities, the limb was drawn away violently, and the animal set up the most dismal howls. Similar effects were observed on pinching and pricking the limbs.

These phenomena persisted for a considerable length of time, and traces of inco-ordination were observed two hours after the injection had been made. After the lapse of about four hours, however, the dog seemed to have recovered his usual health, and walked about without difficulty.

During the duration of the experiment nothing of an abnormal nature was observed in the fore-legs. I infer from this fact that the action of the anæsthetic was practically local, being confined, for the most part, to that portion of the cord situated immediately beneath the point of injection. It is conceivable, however, that, had the quantity of anæsthetic fluid injected been greater, the anterior limbs might also have been affected. An *absolute* localization of the anæsthesia is indeed hardly within the range of possibilities, on account of the numerous blood-vessels. It is true, nevertheless, as we have seen, that the local action of the drug is greatly favored, at least so far as the inferior segment of the cord is concerned, by reason of the lethargy of the circulation at this point.

*Experiment II.*—This was performed on a man who had long been a sufferer from spinal weakness and seminal incontinence, and who for many years had been addicted to masturbation and other forms of sexual abuse. Without entering into the details of the case, which are devoid of any special interest, I will proceed at once to give an account of the experimental observation which constitutes its only claim to attention.

As in the case of the dog previously referred to, I was bent upon abolishing reflex action and annulling sensory conduction

\* "A Hand-book of Therapeutics," by Sydney Ringer, M. D., New York, 1870, p. 387.

in the cord. To this end I injected thirty minims of a three-per-cent. solution of the hydrochlorate of cocaine into the space situated between the spinous processes of the eleventh and twelfth dorsal vertebra. As there was no numbness, tingling, or other evidence of modified sensibility after the lapse of six or eight minutes, I again injected thirty minims of the solution at the same spot and in the same manner. About ten minutes later the patient complained that his legs "felt sleepy"; and, on making a careful examination with the wire brush, I found that sensibility was greatly impaired. Currents which caused lively sensations of pain and reflex contractions in the upper extremities were disregarded and barely perceived in the lower limbs. The same was true of the prick of a needle. Fifteen or twenty minutes later the anæsthesia had increased in intensity, and, although there were some evidences of diffusion on the part of the anæsthetic, the impairment of sensibility was principally limited to the lower extremities, the lumbar regions, the penis, and the scrotum. About this time I applied the wire brush to the soles of the feet and to the toes, using about the maximum strength of a powerful faradaic battery, without causing either pain or reflex contractions, while a current of half the strength evoked intense pain and reflex contractions in the upper limbs. Some time later I fancied that I could discern some obtuseness of sensibility in the upper limbs; but on this point I feel compelled to speak with reserve. When the patient closed his eyes he experienced some dizziness while standing, but there was no inco-ordination or motor impairment discernible in the gait. The power of distinguishing differences in pressure seemed also to be preserved; but I regret to say that I did not test the sensibility to variations of temperature. The passage of a sound, though usually accompanied by considerable pain, remained almost unperceived, and an urethral electrode caused no inconvenience, even when strong currents were used. The sensibility of the scrotum and glans penis was also impaired to a marked degree, as proved by repeated tests with the electric brush. The pupils were but slightly dilated.

When the patient left my office, an hour or more after the injections, sensibility was still impaired to a marked degree, but otherwise he seemed none the worse for his experience. The patellar tendon reflexes were, however, abolished.

The therapeutic advantages afforded by such local medication would seem to be great in a large number of morbid conditions of the cord. There is, indeed, no reason why strychnine and other remedies should not be employed in this local manner as well as cocaine. In strychnine poisoning, tetanus, and hydrophobia, it should also render good service. I will merely add that on the morning succeeding the injections the patient informed me that he had experienced tingling sensations and numbness in the lower limbs until nightfall. There was also dryness of the throat and mouth, accompanied by mental exhilaration. I could hear nothing of any cardiac disturbances.

On making an examination with the electric brush, sensibility was found to be normal in the lower limbs, scrotum, and glans penis. The passage of the sound was, as formerly, accompanied by some pain, and the urethral electrode provoked unpleasant sensations, even when mild currents were employed.

The only constitutional symptoms complained of were headache and slight vertigo, already referred to. At no time was there nausea.

Whether the method will ever find an application as a

substitute for etherization in genito-urinary or other branches of surgery, further experience alone can show. Be the destiny of the observation what it may, it has seemed to me, on the whole, worth recording.

26 WEST FORTY-SEVENTH STREET, October 27, 1885.

## SEASICKNESS AND ITS TREATMENT.

BY ADOLPH KESSLER, M. D.,

NEW YORK.

IN the "New York Medical Journal" of September 20th I find a therapeutical note, taken from the "Berlin. klin. Wochenschrift" and "Lancet," in which Manassein recommends the use of cocaine in seasickness, and speaks of the gratifying results obtained in several cases. Unaware of the fact that it had been recommended and used in seasickness, I gave it a pretty extensive trial this summer, merely prompted by its general physiological and anæsthetic effects, but with results far from gratifying. It does not act as a palliative, much less as a curative; on the contrary, its use does actual harm. The effect of cocaine upon seasickness, as a combination of the most varied bodily and mental sensations, is purely negative, except for a decided increase and aggravation of certain symptoms. The most striking effect of the medicine is an intense and persistent nausea, which becomes the more distressing as all efforts, mechanical or otherwise, of obtaining relief by vomiting prove unavailing. Now, any one that has ever suffered the pangs of seasickness will agree with me that this very nausea, *unrelieved by vomiting*, forms the most distressing and depressing feature of the mysterious disorder, and that the act of vomiting is the only efficacious means by which temporary relief is afforded and comparative physical and mental comfort restored to the sufferer.

The cocaine seems to exercise a paralyzing influence upon the motor-nerve apparatus of the stomach, thereby hindering vomiting and preventing the display of the only function which is apt to give any relief, and which nature itself has beneficently instituted as a *vis medicatrix*. This characteristic and uncomfortable condition is further aggravated by a total loss of appetite and an invincible repugnance to food in every form and shape—an inertia of the digestive organs, in fact, that is very rarely experienced in ordinary and even severe yet uncomplicated cases of seasickness. But the influence of the drug does not stop here; it reaches further yet and extends to the whole length of the alimentary tract, giving rise to great torpidity of the intestines; defecation becomes almost impossible without artificial measures, and is even then slow, difficult, and painful, and reacting unfavorably upon the entire system.

However favorably cocaine might affect the nervous system, intellect, and mind, under ordinary circumstances when taken on land, I have certainly failed to notice its brightening and inspiring effects during the reign of seasickness, except that it sharpened the pangs of the latter by keeping the suffering victims wide awake and unable to find rest and oblivion in sleep.

The bromides have enjoyed a certain reputation in the treatment of seasickness since the late and lamented

## The Local Anesthetic Action of Benzoyl Derivatives \*

PROFESSOR DR. WILHELM FILEHNE

...Although I have been luckier than others in finding substances with local anesthetic action, my researches have not yet produced any surrogate of cocaine that has any practical value. They have, however, shown the direction in which such substances are likely to be found, and have demonstrated to which of the constituent components of the cocaine molecule the local anesthetic action can be attributed. In this work I have enjoyed the indefatigable support of Lucius Bruening, manager of the Dyestuffs Industry at Hoechst-on-Main. I express my heartiest thanks to the directors of the company, and particularly to my friend Dr. von Gerichten.

The initial ideas were the following:

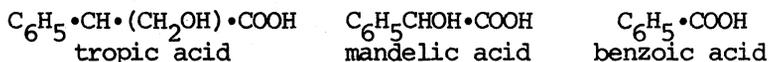
1. As shown by Lossen, the same agents that split off tropic acid and tropine from atropine (in aqueous solution) yield benzoic acid and ecgonine from cocaine (in methyl alcoholic solution). Moreover, similar reactions reconstitute atropine (Ladenburg) and cocaine (Merck, Skraup) from the respective constituents of the alkaloids (with dehydration. In the case of cocaine a methyl group must also be introduced).

This fact in itself seemed sufficient to justify a search for analogues with cocaine-like activity within the atropine group.

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\* Abridged and translated from: W. Filehne, II. Die local-anaesthesirende Wirkung von Benzoylderivaten. Berliner klinische Wochenschrift 24: 107-108, 1887. The search for the active group in cocaine initiated by Filehne was a notable innovation. It represented the first attempt to identify such a group in a complex natural pharmacological substance.

2. Before the advent of cocaine atropine was considered to be a reliable, slowly acting local anesthetic, for example in the treatment of painful inflammations of the cornea, fissure in ano, cardialgia secondary to gastric ulcer, etc.
3. Unlike atropine, which has a slightly stimulating action on the eye (hyperemia, or even inflammation when used in eye drops), homatropine has been found to be entirely without stimulating properties.
4. Homatropine is formed from mandelic acid and tropine under the same conditions as atropine is formed from tropic acid and tropine.
5. Mandelic acid is intermediate between tropic acid and benzoic acid:



I found that atropine had a weak though distinct paralyzing action on peripheral sensory fibers, but that in the case of homatropine the action was quite obvious. \*\*

On the other hand I determined that ecgonine, obtained from cocaine by Dr. Lossen, who very kindly gave me a supply, was entirely devoid of anesthetic action. It was thus obvious that the anesthetizing principle in cocaine could not be ecgonine as such, but that activity depended on its combination with benzoic acid.

We therefore propose provisionally - but entirely tentatively - that the conjunction with benzoic acid is the effective factor. We take into account that the conjunction

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\*\* In experimental tests one must allow for the greater diffusibility of homatropine. Compared with atropine, homatropine is removed much more quickly from the site of application by the blood stream. Consequently, if one fails to eliminate the effect of the circulation, one may often conclude erroneously that atropine is the more active drug. Experiments on frogs must therefore be performed with prior removal of the heart, as well as the brain.

with tropic acid in atropine (with tropine taking the place of ecgonine) results in clear though moderate local anesthetic activity, and that homatropine, in which mandelic acid replaces tropic acid, is still stronger in this respect. We recall, finally, that in the sequence, tropic acid, mandelic acid, benzoic acid (as indicated in No. 5 above), there is a transition from complex to simple aromatic acid. It would therefore not come as a complete surprise if benzoyltropine - i.e. the compound formed from benzoic acid and tropine - were a stronger local anesthetic than atropine or homatropine.

This expectation has been fully confirmed experimentally. Benzoyltropine is an exquisitely active local anesthetic. Its other property, the only one previously known and which is shared by all tropeines, is to dilate the pupil and impair accommodation.

The further conjecture then arises that the role of ecgonine in the cocaine molecule is relatively indifferent, and that it may be possible to obtain cocaine-like activity from molecules in which ecgonine and tropine have been substituted by other alkaloids.



## Lumbar Puncture for Hydrocephalus\*

H. QUINCKE

At the last Congress for Internal Medicine I described a procedure for lowering abnormal pressure in the cerebral ventricles by puncturing the subarachnoid space in the lumbar region. In the following I present some additional experience.

The procedure is based on the anatomical and experimentally demonstrated facts that the cerebral and spinal subarachnoid spaces communicate with each other and with the cerebral ventricles. In adults the spinal cord extends only to the third lumbar vertebra, in children only to the second. The point of a puncture cannula introduced through the third or fourth lumbar intervertebral space therefore does not reach the spinal cord but ends up among the nerve roots of the cauda equina floating in the cerebrospinal fluid. I originally feared that the needle point might cause some injury to the cauda, but in this I was mistaken: Puncture has never been followed by motor disturbances, and the pain that some patients complained of for several days probably was due to other causes. The anatomical relations in the spinal canal are even more favorable in the child than in the adult, because the nerve root bundles are looser; they are generally arranged in two symmetrical strands separated by a space containing only cerebrospinal fluid and about a fingerbreadth in width.

Of greatest significance for the successful performance of the puncture are the size and shape of the space between the vertebral arches. I have investigated these on the skeleton in 20 adults and 12 children. The spaces are relatively large in children, where they are generally oval

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\* Translated from Quincke, H.: Die Lumbalpunktion des Hydrocephalus. Berliner klinische Wochenschrift, 28:929-933 (21 Sept.) 1891.

or diamond-shaped. With increasing age the spaces become smaller and their direction of access changes; the vertebral spines are horizontal in children but are directed downwards in adults and therefore cover the space between the arches to a greater or lesser degree. The generally oval outline seen on projection against the posterior surface of the body can thereby be greatly affected. The crista may sometimes project downwards from the root of the vertebral spine and encroach on the gap between the arches. Significant individual variations occur to such an extent that simple relations with respect to age, sex, or physique simply cannot be formulated. In general the size of the first and second interspaces is exceeded by that of the third and fourth; the fifth again is smaller, but wider. Transversely the spaces between the arches measures 18-20 mm, vertically, 10-15 mm. It is only quite exceptionally that the space between arches is too narrow for the introduction of a needle. The best site for the skin puncture is 10-15 mm from the midline. In children this should be made at the level between two spinous processes, in adults, at the level of the lower third or lower border of the spinous process. The direction of the needle is inclined so that the point will reach the dura in the median plane. In the adult the tile-like vertebral arch requires that the needle be at the same time inclined slightly cranially rather than the reverse. If the gap between the arches is not located at the first attempt the needle should be redirected in a slightly different direction.

The depth to which one must introduce the needle is about 2 cm in children and 4 to 6 cm in adults. Appreciation of the relevant dimensions and feel is acquired with practice. With few exceptions I have been able to enter the dural sac without having to make a second skin puncture.

The puncture is performed from a paramedian approach at the indicated level and during strong forward flexion of the lumbar spinal column. General anesthesia is never of advantage.

The appropriate diameter of the hollow needles varies from 0.6 to 1.2 mm. The wider needles were fitted with a stylet whose point was flush with the oblique end of the needle, but liquid under high pressure still managed to

trickle past. After removal of the stylet a conical adapter is fitted to the cannula and connected via a piece of rubber tubing to a glass tube that reads the pressure. The glass tube is then lowered, the required amount of fluid is collected, the cannula is removed and the site of the puncture covered with cotton and iodoform collodion. If blood or fluid at first continue to escape brief pressure suffices to stop the leak. The patient must rest in bed for 24 hours following the puncture.

The level of the liquid in the glass tube indicates the mean cerebrospinal fluid pressure at the corresponding level in the subarachnoid space. Respiratory and often also pulsatile fluctuations of up to 1 mm are visible in the level, although their amplitude and timing are modified by the narrow bore of the cannula. The fluid level may also show slower changes in level of 10 to 20 mm (over one or more minutes), caused by change of position, muscular tension, or perhaps even vascular innervation. Immobility of the fluid level signifies that the opening of the cannula is obstructed by a nerve root or by connective tissue; patency can usually be restored by a slight twist of the needle or a change in posture.

If one allows fluid to drain the pressure will fall correspondingly and will usually show a tendency to recover when the outflow ceases.

To achieve a more prolonged pressure relief of the subarachnoid space I used a needle whose orifice had been enlarged to a lanceolate shape about 2 mm long and attempted to create a slit in the dura on withdrawal (case 2, punctures 3,4,5). That continued leakage of fluid did occur was evidenced by the slight edema that developed around the site of the puncture. A more effective way of attaining this result was achieved with punctures 5 and 6 when I introduced a slender lancet (4 mm wide) through the dura in the midline: after 8 days the pressure in the subarachnoid space was still several centimeters lower than previously, and after the second lancet stab the edema of the surrounding tissues clearly testified to the continuing escape of cerebrospinal fluid. Case No. 5 indicated, to be sure, that such an opening can become obstructed by arachnoid membrane or by clot.

My procedure is similar to that of Essex Wynter,\*\* who drained the dura at the level of the 1st and 2nd lumbar vertebrae in cases of meningeal tuberculosis. In two cases he did this with a narrow trocar after incising in the skin, in two others he removed the vertebral arch and incised the dura.

(The article concludes with several pages of case reports).

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\*\* The Lancet, 1891, May 2, pg. 981.

## Researches on Cocainization of the Spinal Cord\*

DR. AUGUST BIER

General anesthesia is dangerous, and its scope has fortunately and none too soon been greatly reduced by the advent of Schleich's infiltration anesthesia and Oberst's regional method of cocainization. However, for truly major operations those two approaches have only limited application. I have therefore sought to render large areas of the body insensitive to pain by cocainizing the spinal cord. This was investigated as follows:

Lumbar puncture was undertaken by Quincke's technique in suitable patients. One selects a very fine hollow needle. After penetrating the dural sac one removes the occluding wire and immediately places a finger over the opening in order to minimize the escape of cerebrospinal fluid. The desired solution of cocaine is then injected with a Pravaz syringe that exactly fits the needle. One must of course include enough extra volume to fill the lumen of the needle (one and one-half divisions of the syringe in the case of our needle). To avoid escape of cocaine through the dural puncture site into the tissues one leaves the needle and attached syringe in place for two minutes before removing them. The skin puncture is then sealed with collodion.

The lumbar puncture is performed painlessly with the aid of Schleich infiltration anesthesia, infiltrating first the skin and then, with a long needle, the soft tissues down to the vertebral column.

The cocaine spreads in the cerebrospinal fluid and reaches not only the surface of the cord but, most importantly, the unsheathed nerves that traverse the space, and also the ganglia. I am of the opinion that the striking abolition of pain achieved by small amounts of cocaine solution injected into the subarachnoid space is brought about by an action on these nerves and perhaps also on the ganglionic cells. The term "cocainization of the spinal cord" is a conveniently brief way of describing this.

The following are the cases in which I have performed cocainization of the spinal cord:

1. A 34-year old laborer who was hopelessly riddled with tuberculosis in many parts of the body. He had previously undergone many operations. Although no general improvement could be expected, a resection was necessitated by high fever and painful, deep-seated tuberculous ulceration of the foot.

He had suffered many complications from the earlier general anesthetics and dreaded another one. I therefore proposed spinal cocainization to him, and he accepted. On August 16, 1898, at 8:35 a.m. I injected 3 cc. of a 0.5 per cent solution of cocaine (a total of 0.015 g) as described above, and waited twenty minutes. By then the lower half of the body had lost all sensibility, including that of touch. Pinprick, pinching and other painful stimuli were appreciated only as ill-defined pressure. I carried out the resection of the ankle joint. The talus was removed, the lower ends of the leg bones were sawn off, and the tuberculous capsule excised. The patient groaned during the

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\* Translated from Bier, August: Versuche ueber Cocainisirung des Rueckenmarkes. Deutsche Zeitschrift fuer Chirurgie, 51: 361-368, 1899.

operation but remained motionless and explained later that he had not felt any pain but was aware that something was being done to his sick foot. His pulse speeded up but nothing else changed during the operation. Two hours after the operation his back and left leg became painful and the patient vomited and complained of severe headache. The pain and vomiting soon ceased, but headache was still present the next day.

2. A seventeen year-old baker suffered from osteomyelitis of the tibia. On August 20, 1898 at 10:11 a.m. 0.5 cc. of a 1 per cent solution of cocaine was injected as described, and at 10:13 a.m. a further 0.5 cc. (a total of 0.01 g of cocaine). Pain sensibility was lost in 5 minutes, but touch was still unimpaired. The operation began at 10:19 a.m. The tibia was laid open with a chisel throughout almost its entire length and several sequestra were removed. The patient felt nothing whatsoever of the procedure, which was over by 10:34 a.m. At 10:28 the patient vomited.

Sensibility was tested at 10:38 a.m. It was absent from the lower part of the body up to the following limits: anteriorly, in the nipple line, up to the level of the 8th rib on the right and the 5th rib on the left, posteriorly, in the scapular line, up to the 9th rib on the right and the 8th rib on the left. Neither pinprick nor touch was appreciated in the affected region.

At 10:52 a.m. sensation began to return. This delighted the patient, who laughed and chattered excitedly. When he was asked what made him so happy he explained it was because he had perceived nothing whatsoever of the operation. His excitement lasted 5 minutes. The pulse was full and strong, and the rate 120.

At 12 noon he developed a severe headache and vomited twice more during the afternoon.

The headache continued at intervals until August 22nd and tended to be most severe towards the end of the day. Headache recurred on August 26th and 28th, and vomiting on the 28th. Thereafter he remained well.

3. A fourteen-year old boy suffered from tuberculous ankylosis of the left knee joint, which was bent almost to a right angle. On August 20th, 1898 at 9:20 a.m. I injected an 0.5 per cent solution of cocaine and again at 9:22 a.m. (a total of 0.01 g cocaine) and then immediately performed a Helferich arched resection of the ankylosis. The ends of the bones were nailed together with three nails. The patient was extremely apprehensive and complained of pain during the operation but tolerated all the manipulations without resistance and probably did not actually feel pain. The next day he developed a backache and a pain in the left leg, which lasted until August 27. On August 26 he experienced a transient headache. There were no other problems. The boy complained unceasingly and was too backward and uncooperative for any tests of sensation.
4. On August 22, an eleven-year-old boy was operated on for tuberculous inflammation of the ischium. At 9:09 a.m. a half-syringeful of 1 per cent cocaine solution (0.005 g of cocaine) was injected in the usual manner. By 9:16 a.m. all sensation had ceased in the legs and buttocks. Stabs with a knife-point went unnoticed. The operation began at 9:18 a.m.; it consisted partly of curetting and partly of removing the tuberculous ischial tuberosity with bone cutting forceps. The lad was agitated by the operation, but explained that the cutting felt to him like scratching. Otherwise he felt nothing. A test of sensibility, performed at 9:36 a.m., showed that the entire body except the head was

insensitive. Pricking evoked lively evidence of pain over the head but none whatsoever over the neck and arms. Slight touch sensibility, however, was retained. The pulse remained strong and regular throughout the operation. There were correspondingly few after-effects. The patient complained of pain at the site of injection on the day of the operation, but this disappeared the next day. There were no other complications; in particular, there was no headache or vomiting.

5. A thirty-year-old brewery salesman sustained a compound fracture of the right femur on August 14, 1898, about a hand's breadth above the knee joint. The wound suppurated. On August 24th at 7:47 a.m. I injected one syringe of a 1 per cent solution of cocaine in the usual manner (0.01 g cocaine). At 7:59 a.m. I made a long lateral incision to expose the ends of the fractured bone. These lay partly comminuted and devoid of periosteum. I merely brought them to the surface, sawed them off, opened several pockets of pus, and packed the wound. The patient did not feel anything of the operation, which speaks volumes, because exteriorization of a fractured of the femur close to the knee is a very forcible procedure. However the patient had no complications either during or after the operation, except for a quite minor headache which began the next morning and quickly went away.
6. A servant girl aged seventeen suffered from osteomyelitis of the upper end of the left femur. On August 27 at 8:20 a.m., I injected in the described manner a half-syringe of 1 per cent cocaine solution (0.005 g of cocaine). I began the operation at 8:40 a.m. I made incisions along the medial and lateral sides of the thigh and exposed the bone which lay bare of periosteum in the depths of the abscessed area. The patient whimpered during the operation, but explained later that she had not felt any pain. She suffered no complications from the cocaine injection, either during or after the operation.

These cases demonstrate that a small volume of cocaine solution introduced into the dural sac renders a large part of the body insensitive, enabling major operations of that region to be performed without causing pain. However in most such cases important complications have occurred which equalled those that usually follow general anesthesia. To reach a well-informed opinion I decided to perform some investigations on my own body:

On August 24, 1898 I had Dr. Hildebrandt perform a lumbar puncture on me and inject a half-syringe of a 1 per cent solution of cocaine. The puncture was performed as described above without causing any pain except for a brief twinge in one leg when the needle pierced the dura. The Pravaz syringe failed to fit the needle used for puncture. During the efforts to achieve a fit a lot of cerebrospinal fluid escaped and most of the cocaine to be injected was lost. The result was that no insensibility was achieved; small incisions and needle punctures everywhere elicited pain.

Because of the considerable loss of cerebrospinal fluid I postponed repetition of the procedure on me until a later occasion, but Dr. Hildebrandt immediately offered to have the same study performed on himself without delay. I will describe the circumstances meticulously because the study was successful and its performance on a well-informed physician resulted in an excellent account of the action of cocaine on the spinal cord.

I introduced the lumbar puncture needle after the usual Schleich infiltration anesthesia. H. experienced this as pressure, not pain. At 7:38 p.m. I injected 0.5 cc. of a 1 per cent solution of cocaine (0.005 g). This resulted in H. experiencing a feeling of warmth in both legs. The pulse rate was 75 per minute.

**After 7 minutes:** Needle pricks in the thigh were perceived as pressure; tickling of the the sole of the foot was barely felt.

**After 8 minutes:** A small incision in the skin of the thigh was felt as pressure; introduction of a large, blunt, curved needle into the soft tissues of the thigh produced no pain at all.

**After 10 minutes:** A long needle was pushed down to the femur without evoking the least pain. Pinching the skin severely and seizing and crushing it in toothed forceps was experienced as pressure.

**After 11 minutes:** Pain sensibility was markedly diminished in the arm.

**After 13 minutes:** A burning cigar applied to the legs was felt as heat, but not as pain. Ether produced a feeling of cold.

**After 15 minutes:** Tickling the sole of the foot was no longer felt as such but only as movement. Pinching the leg was felt as light pressure but pinching the upper chest was very painful.

**After 18 minutes:** Strong pinching was hardly felt at all below the nipples.

**After 20 minutes:** Avulsion of pubic hairs was felt simply as elevation of a fold of skin, but avulsion of chest hair above the nipples on the contrary was very painful. Strong hyperextension of the toes was not unpleasant.

**After 23 minutes:** A strong blow to the shin with an iron hammer did not provoke pain.

**After 25 minutes:** Strong pressure and traction on the testicles was not painful.

**After 32 minutes:** Tickling the sole of the foot was perceived as faint touch. Needling down to the femur and strong pressure on the testicle were not painful.

**After 40 minutes:** Strong blows on the shin did not hurt. The entire body began to perspire gently.

**After 42 minutes:** Constriction by a rubber tube tourniquet around the thigh produced no pain, but around the upper arm was very painful.

**After 45 minutes:** Pain sensibility began to recover but was still considerably obtunded. It gradually recovered completely. The pulse rate, which had been 75 at the beginning of the study, was 72 to 75 beats per minute during the period of insensitivity. The sense of touch remained intact throughout the period of loss of pain; touches were perceived and correctly located. The patellar reflexes remained unimpaired throughout.

After performing these experiments on our own bodies we proceeded without feeling any symptoms to dine and drink wine and smoke cigars. I went to bed at 11 p.m., slept the whole night, awoke the next morning hale and hearty and went for an hour's walk. Towards the end of the walk I developed a slight headache which gradually got worse as I went about my daily business. By 3 p.m. I was looking pale and my pulse was fairly weak, though regular at about 70 beats per minute. In addition, I had a feeling of very strong pressure on my skull and became rather dizzy when I stood up rapidly from my chair. All these symptoms vanished at once when I lay down flat, but returned when I stood up. Towards the evening I was forced to take to bed and remained there for nine days, because all the manifestations recurred as soon as I got up. I felt perfectly well as long as I remained horizontal. Appetite and sleep rhythm were unaffected but any prolonged period of reading made me feel dizzy.

The symptoms finally resolved nine days after the lumbar puncture. Three days later I was able to make a fairly long journey by rail without difficulty and was able to thoroughly enjoy an 8-day hunting holiday in the mountains.

Dr. Hildebrand, for his part, went to bed at 11 p.m. feeling entirely well but was nevertheless unable to get to sleep because of restlessness. At midnight a violent headache set in that quickly became insupportable. At 1 a.m.

he began to vomit, and this recurred once later in the night. The next morning he felt very ill but was able with much effort to perform his service duties of operating and changing dressings. In the afternoon he was constrained to lie in bed but got up again the next morning and worked, although he continued to feel unwell for the next 3-4 days. During this period his appetite was poor and headache frequently recurred. Thereafter he felt entirely well except for a mild feeling of weakness that lasted another 2-3 weeks.

Dr. Hildebrandt's legs became painful and bruises developed in several places, especially over the tibia where sensibility had been tested by crushing and heavy blows.

These researches demonstrate that an extremely small amount of cocaine solution (0.005 g) injected into the subarachnoid space suffices to render almost two thirds of the body insensible enough for the painless performance of the most major operations. In the legs the insensibility sets in within 5-8 minutes. Presumably this is due the action of cocaine on the unmyelinated nerves or the nerve roots, as the case may be, and perhaps on the ganglion cells and not on the spinal cord itself. Generally, even with a small dose of cocaine, the upper border of insensibility in a large person gradually extends up to the nipples (cases 1, 2, 5, and Dr. Hildebrandt). With doses larger proportionately to body size insensibility extends to the entire body except the head (case 4; 0.005 g of cocaine in an 11-year old boy).

Complete insensibility lasts for about 45 minutes with a small dose of cocaine (0.005 g in adults), after which sensibility gradually returns (Dr. Hildebrandt).

So far, it appears that cocainization of the spinal cord can be employed with advantage for painful operations. It stands to reason that the method will only succeed if it leads to fewer hazards and disagreeable consequences than general anesthesia.

Although I have not yet encountered any real dangers there have been very unpleasant after-effects. These were more or less completely absent in three of our patients (cases 4, 5, 6) but in others unpleasant effects developed similar to those seen after chloroform or ether general anesthesia, and which in some cases were more pronounced and enduring than those following general anesthesia (cases 1, 2). The most severe symptoms occurred in us, the two physicians, perhaps because we treated our bodies too light-heartedly. Instead of lying down and resting following the lumbar puncture and injection of cocaine, we went about our avocations, drank and smoked more than was good for us, and performed our usual work the next day.

As regards the after-effects which cocaine evoked in these cases, it remains to be determined whether they were a specific toxic effect of cocaine or the result of irritating the central nervous system by injecting a foreign substance into the dural sac. Only once have I seen an effect that may be regarded as true cocaine poisoning, a very mild and brief one, the excitement that occurred in the seventeen-year-old brewery salesman (case 2). The long delay in the onset of the disturbances argues against a toxic effect, since they happened at a time when the cocaine had probably already been eliminated or metabolized. I think it is more likely that the headache and vomiting which were observed in cases 1, 2, and 3, and in Dr. Hildebrandt and myself are to be regarded as due to circulatory disturbances (hyperemia or anemia) of the central nervous system. The regional loss of cerebrospinal fluid can also provoke such complications. In my own case at most only traces of cocaine could have entered the subarachnoid space, yet no one else suffered the complications of lumbar puncture for as long a period as I did. That my symptoms were circulatory in origin is suggested by the fact that I felt perfectly well while lying down and that the disturbances set in only when I stood up.

It is remarkable how rapidly the action of cocaine on the nerve tissue can render a large area of the body insensitive, and how small a quantity of cocaine subdurally suffices for this purpose. One gains the impression that cocaine acts preferentially on the pain-conducting structures. Since the nerve roots are quite thick and one can hardly assume that cocaine penetrates them completely, it would seem that the nerves conveying pain lie in the outer layer.

The first function impaired by cocainization is pain sensibility, while the sense of touch is still intact. With larger doses and longer exposure touch also becomes impaired; it disappeared completely in only one case (case 2) where a fairly large amount of solution was used. Whereas warmth and cold sensibility are preserved, great heat does not cause pain (Dr. Hildebrandt).

The reflex response to tickling the sole of the foot disappears very early and after quite small doses. The patellar reflexes remain unaffected (Dr. Hildebrandt). Unfortunately I did not test the retention of other reflexes. Motor power also remains unaffected.

It may be possible to avoid the unpleasant side-effects of cocaine by means of substitutes or by supplementary medication. So far I have tested this only once, with tropacocaine, which is said to be less harmful than cocaine; in the event, it too produced a severe headache, as well as a quite inadequate decrease of sensibility.

I did not feel justified in investigating this further in man. Animal experiments may be necessary. The dog would be a suitable research animal because this species vomits readily and allows observation of one of the important signs of unpleasant side-effects.

However, I have not met a single instance of serious danger to the patient from the injection, and, in particular, no untoward effect on the heart or the respiratory system. One might be well advised to use the smallest dose that suffices for insensibility ( 0.005 - 0.01 g of cocaine for an adult) in patients for whom general anesthesia would be dangerous, as in case No. 1. According to his own declaration, although he did experience unpleasant after-effects, they did not last as long as after his previous general anesthetics. The experiences of Dr. Hildebrandt and myself demonstrate that it is mandatory to prescribe strict rest in bed. Of course, this is already always done following major operations, which is what we are here concerned with here. In addition, as I myself can vouch, any escape of cerebrospinal fluid must be avoided if possible.

## Extradural Injection of Medication by the Sacrococcygeal Route\*

MR. A. SICARD

In a communication made some time ago to this Society we stressed the potential experimental and clinical importance of injecting diverse substances into the cerebrospinal fluid by the lumbar route.

Subsequently, the results of subarachnoid injection of cocaine (Bier) became known and gave rise to much discussion. This method of analgesia has not only been used in surgery, particularly by Mr. Tuffier, but was tested by ourselves immediately after Mr. Bier's communication in the treatment of tabetic lightning pains. Numerous authors, most notably Marie Pitres and Achard Guillain, have used this method of medication to relieve neuralgic pain in the lumbar region and in the lower limbs (sciatica, lumbago), and, in the great majority of cases have obtained very satisfactory results.

Unfortunately the subarachnoid injection of cocaine presents incontrovertible disadvantages. We have ourselves on many occasions observed it to be followed by intractable headache lasting two or three days, sometimes accompanied by nausea and even by vomiting.\*\*

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\* Translated from Sicard, A.: Les injections médicamenteuses extra-durales par voie sacrococcygienne. Comptes rendus hebdomadaires des séances et mémoires de la Société de Biologie, 53:396-398 (Apr. 20) 1901.

\*\* We will not discuss here the use of this method in surgical operations, which has been reviewed at considerable length in communications by Messrs. Tuffier, Reclus and others (in February and March, 1901).

We have therefore sought a different and completely innocuous procedure that nonetheless enables injected liquid to reach the nerve trunks at their origin from the spinal cord. (See translator's note #1)

The extra-dural space, between the dura mater and the bony spinal canal, appeared inviting. We shall see that it is readily entered.

IN THE DOG, an injection of several cc. of colored liquid is easily made because the needle readily penetrates the sacrococcygeal or posterior sacrocaudal ligament. At autopsy the liquid is seen to have penetrated the space between the dura mater and the bony canal, without invading the subarachnoid plane or the cerebrospinal fluid. By varying the volume or speed of injection one can localize the injectate to the sacral or sacrolumbar region, or observe its spread higher to the dorsal or even cervical regions. An injection of cocaine, by the same route, in the dog produces some analgesia. With a dose of 0.04 to 0.06 centigrams dissolved in 5 or 6 cc. of water the analgesia spreads to the entire body of the animal and enables the performance of the most painful operations.

IN THE CADAVER, the finger readily palpates transcutaneously the two little tubercles at the apex of the sacrum. At the very center of the posterior sacrococcygeal ligament that closes the terminal orifice of the sacral canal, one introduces a needle from below up, in a plane almost parallel to the superficial plane of the sacrum in the midline, and pushes it in for a distance of 1 to 3 cm. Colored liquid introduced by this route will be found to have penetrated into the extradural space exactly as in the dog, and the dye will be seen to have diffused a varying distance up into the various spinal regions.

The extradural space is traversed by the neural trunks passing from the spinal cord to their respective intervertebral foramina. It was therefore of interest to attempt to act on the nerves directly by this new approach.

Injections were made by this route in nine patients suffering from lumbar or lower limb neuralgia (two cases of lightning pains, three cases of lumbago, four cases of

refractory sciatica). We injected cocaine in doses varying from 0.01 to 0.04 centigrams dissolved in 5 to 15 cc. of 0.7 per cent saline.

The injection, which was painless, did not require rest in bed and had no unpleasant sequelae: no elevation of temperature, no cephalalgia, no nausea. Occasionally there was delayed but temporary aching in the sacrolumbar region.

All our patients experienced immediate relief. It is true that the two tabetics' lightning pains disappeared for only 12 to 20 hours, but in the two patients with lumbago and in two of the sciatica cases relief has lasted two weeks. The remaining two cases of sciatica experienced relief for two to three days after each repetition of the injection.

We have never detected cutaneous analgesia during these tests. In a single case which we observed at the Salpêtrière Hospital with Mr. Cestan, on Mr. Raymond's service, the scrotal skin rapidly became analgesic and remained so for more than two hours.

These occurrences demonstrate that external to the space which contains cerebrospinal fluid there exists another space, the areolar tissue space situated between the dura mater and the bony surface and readily accessible by the sacrococcygeal approach. Liquids injected into this plane readily spread to the different spinal regions and come to bathe more or less closely the neural trunks that traverse the extradural space. The dural barrier effectively prevents the passage of these liquids into the subarachnoid space.

In our opinion this method of medication improves on and will take the place of subarachnoid injections. It is absolutely innocuous and does not require bed rest, yet produces the same therapeutic results. Surgeons will surely adopt the method if it can be improved to the point of producing analgesia of the lower limbs. We will discuss the problem of failure of analgesia on a later occasion. (See translator's note #2).

**Translator's note #1:** Sicard's statement of his rationale does not stand up to close anatomical scrutiny: Nerve trunks do not take origin from the spinal cord. If his "trunks" are taken to mean "rootlets" his reasoning is in error because drug that remains extradural does not reach the junction of the rootlets with the spinal cord.

**Translator's note #2:** One week later F. Cathelin (C.R. Soc. Biol. Paris 53:452-453,1901) described an independent investigation on dogs and patients in which cocaine was injected extradurally via the sacral canal and in which complete analgesia was obtained in dogs. The concentration of cocaine used was 1-2 per cent and the quantity injected 1 to 8 cg, or some 100 times greater than those of Sicard. Even so, only partial analgesia was obtained in man. In Sicard's studies the concentration of cocaine was almost homeopathic and the analgesia observed may have been due mainly to osmotic swelling of nerve fiber (cf. Anesthesiology, 51:418-423,1979).

**Concerning Some New Local Anesthetics  
(Stovaine, Aल्पine, Novocaine)\***

PROFESSOR DR. H. BRAUN

An accurate opinion on the future of a new local anesthetic can be formed with only a few hours of experimentation on oneself or interested healthy subjects. I have described the method in my handbook.\*\* It is simple and quite harmless when used with substances whose general pharmacological properties have received due prior investigation, and it enables one to decide at once on the practical possibilities of the preferred product.

Besides producing local anesthesia, any drug in this very numerous abundant class of agents must also have the following properties:

1. It must be less toxic relative to potency than cocaine. We can distinguish here between absolute and relative toxicity. Most proposed substitutes for cocaine have less absolute toxicity, it is true, but their anesthetic potency is even weaker, so that their relative toxicity is not less than that of cocaine. The ratio of their toxicity to that of cocaine is readily established by experiments on animals and may apparently be safely carried over to man. The significance of this preliminary is, however, often exaggerated. It should not be forgotten that dangers inhere in most of the appropriate methods of employing cocaine. It is really only in spinal anesthesia that cocaine is surpassed by other preparations, and there its bad effects are for the most part not due to toxicity as usually understood.
2. It must not cause the least irritation or damage to the tissues. Like cocaine, tropacocaine and eucaïne it must be absorbed without producing any sequel at the site of injection such as hyperemia, inflammation or infiltrates, let alone necrosis. This is necessary to assure that wound healing will not be affected adversely and at once excludes strongly alkaline or strongly acid substances, which invariably cause tissue damage at the site. Many new discoveries are nullified by this extremely important consideration.
3. The substance must be soluble in water and be stable in solution for a reasonable period. It should preferably be easy to store and sterilize. Cocaine does not fully meet these requirements.
4. Nowadays it is necessary to add yet another condition. The substance must be miscible with epinephrine without affecting the latter's vasoconstrictor activity. Each of the substitutes hitherto proposed for cocaine fails to meet this requirement: it either inhibits the activity or destroys it. Only cocaine leaves the vasoconstrictor power of the minutest doses of epinephrine intact.
5. Further considerations arise in relation to certain specific applications. To be effective at a mucous surface the anesthetic must be rapidly absorbed into the membrane. This is an essential precondition and in retrospect gives cocaine a hitherto unequalled advantage.

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\* Translated from Braun, H.: Ueber einige neue örtliche Anaesthetica (Stovain, Aल्पin, Novocain). Deutsche klinische Wochenschrift, 31:1667-1671, 1905.

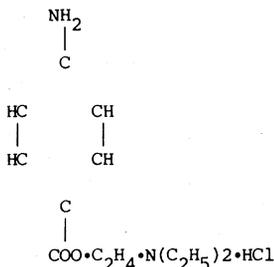
\*\* Die Lokalanaesthesie. Leipzig, 1905.

As regards spinal anesthesia, no specific reservation can be made. The mechanisms of the action and complications of agents injected into the human spinal canal are not yet sufficiently well understood.

.....  
(c) NOVOCAINE.

This compound was discovered by Einhorn and is described here for the first time. Its chemical characteristics have been communicated to me by the manufacturers, Hoechst Chemical Industries:

The preparation consists of p-aminobenzoyldethylaminoethanol hydrochloride, with the structural formula:



The salt crystallizes from alcohol in needles that melt at 156 C. It is soluble 1:1 in water, and the solution is neutral. The salt is about 30 times more soluble in cold alcohol. Carbonic acid salts and caustic alkalis precipitate the free base as an oil that quickly crystallizes; the aqueous solution, however, mixes with sodium carbonate solution without producing turbidity. The free base crystallized from dilute alcohol contains two molecules of water of crystallization, but crystallizes from ether or ligroin as anhydrous, shiny prisms. The melting point of the hydrated base is about 51 C and of that the hydrated base about 58-60 C. Reagents that react with alkaloids, such as potassium iodide, potassium mercuric chloride, and picric acid are able to precipitate it even from very dilute solutions.

The aqueous solution of novocaine can be boiled without decomposition and remains completely clear after standing for days in a stoppered glass flask.

The pharmacological investigation of novocaine was performed by Dr. Biberfeld at the Pharmacological Institute of Breslau, with the following results:

The preparation produces anesthesia rapidly in experimental animals: the 0.25 per cent solution anesthetizes an exposed nerve in about 10 minutes. It has no side effects locally, and even a very concentrated solution produces no sign of irritation whatsoever. Application of the powder to a fresh wound or to very sensitive tissue such as the cornea does not irritate. Moderate doses have minimal systemic effects. 0.15-0.2 g per kg subcutaneously in the rabbit causes practically no change in the kymographic records of blood pressure and respiration. Intravenous injection depresses the blood pressure and renders respiration slow and shallow. The decline in blood pressure is of central origin; the heart appears to be unaffected. No peripheral effect on the blood vessels was detected. The lethal subcutaneous dose in the rabbit is 0.35-0.4 g per kg, as compared with 0.05 for cocaine and 0.15 for stovaine. 0.25 g per kg fails to kill a dog, as opposed to 0.05 of cocaine and 0.15 of stovaine. Stovaine is also twice as toxic as novocaine in the rat and the frog.

My investigation of the new drug had the following results:

1. 0.1 per cent isotonic solution of novocaine. Injection as a wheal into the skin of the forearm is painless and produces immediate local anesthesia. The anesthesia is however only of brief duration, as in the case of tropacocaine; sensibility recovers within 3-5 minutes. Hyperemia does not occur and the wheal disappears without leaving any trace.
2. 0.5 and 1 per cent novocaine solutions. Skin wheal of forearm. The injection is painless. The wheal remains anesthetic for 10-15 minutes. The wheals absorb without leaving any trace. No hyperemia.
3. 5 and 10 per cent novocain solution. Skin wheals. Injection of 5 per cent is painless, 10 per cent causes a little irritation. The wheal remains anesthetic for 17-27 minutes. Very minor hyperemia at the injection site. The wheals disappear without trace, leave no infiltrate or local hypersensitivity.
4. 1 per cent novocaine solution. 1 cc. is injected subcutaneously in the forearm near the superficial radial nerve. Within a short time the skin over the site of injection becomes less sensitive but a clear-cut effect on the branches of the nerve is not detected.
5. 0.5 per cent novocaine solution. Constriction of the fifth finger with a rubber tube. Injection of 1 cc subcutaneously in a circle at the proximal phalanx. Eleven minutes later the finger is completely insensitive. Removal of the constricting tube. Sensibility has recovered within five minutes. The finger shows no residual swelling or tenderness.

It can be concluded that the anesthetic action is stronger but more transient than that of other compounds, in this resembling tropacocaine. But here for the first time since the discovery of eucaine we have an almost ideal non-irritating local anesthetic. Even the 10 per cent concentration is reabsorbed following intradermal injection without leaving any trace at the site of injection. As noted by Biberfeld, there is no effect on the peripheral blood vessels. 10 per cent solutions produce a slight irritation and hyperemia, as in the case of other concentrated, hypertonic salt solutions, owing to their physical properties. Nevertheless, the new drug by itself cannot substitute for cocaine. To obtain results similar to those with cocaine one would have to increase the concentration and dose so much that the lower toxicity would be rendered illusory. Fortunately, this drawback can be readily overcome by the addition of epinephrine.

6. 0.1 per cent isotonic solution of novocaine. To 100 cc. add five drops of 1;1,000 epinephrine solution. Raise a skin wheal on the forearm. The injection is painless. Strong local ischemia. Anesthesia of the wheal lasts more than one hour. No reaction.

.....

9. 0.5 per cent novocaine solution containing one drop Of 1;1,000 epinephrine per cc. 1 cc. of this solution is injected subcutaneously around the base of the fourth finger. Injection is painless. After 10 minutes the finger is anemic and completely without sensibility. After 65 minutes sensibility begins to return to the fingertip. Another hour elapses before recovery of sensibility is complete. No residual pain or swelling of finger.

Novocaine in combination with epinephrine is thus seen to be a very powerful local anesthetic. Not only is the action of epinephrine not

interfered with by novocaine, it appears to be enhanced. I gained this impression at the very beginning the experiments with wheals.

..... Our experience (with novocaine) now extends to 150 operations.

..... We have not encountered any case of toxic reaction, although repeatedly using a dose of as much as 0.25 g. The maximal safe dose for humans is probably considerably higher, since both the absolute and relative toxicity are incomparably smaller than for previously known local anesthetics. Local irritation with novocaine is as rare as with cocaine .....

## New Method for Producing Local Anesthesia in the Limbs<sup>\*</sup>

PROFESSOR DR. AUGUST BIER

So-called major operations on the limbs, such as excisions of joints, transpositions of nerves and extensive sequestrum removals, cannot be performed painlessly with infiltration or conduction anesthesia. I have therefore employed a new way of conveying the anesthetic both to the nerve endings and the nerve trunks, the route of the blood stream. In my experience, this route appears to be free of the above mentioned deficiencies. The procedure is really quite simple and I think I can make it most readily understandable by describing a case of resection of the elbow which I performed with its aid and demonstrating some of the required manipulations on a human subject's arm.

A teen-aged female patient suffered from a very severe tuberculous arthritis of the elbow, for which several operations had already been performed elsewhere. The limb was covered with scars and fistulae and was in a fully extended position. The fingers were extremely stiff. All attempts to move the elbow or finger joints caused a great deal of pain.

First, an Esmarch bandage was applied from the fingers to above the elbow in order to expel as much blood as possible from the part. Next, a pneumatic tourniquet was applied four fingerbreadths above the elbow joint, and a second tourniquet a similar distance below the joint.

Using Schleich's infiltration anesthesia the median vein was exposed at the elbow, a slit was made in the vein and an intravenous infusion cannula inserted in the peripheral direction and secured with a tie. The vein was ligated centrally to the slit. Next, 100 cc. of 0.25 per cent novocaine solution was injected into the vein with the usual syringe. The solution penetrated quite easily in both directions into the isolated part of the limb, without encountering appreciable resistance from the valves. Immediately after the end of the injection the joint, which previously had been stiff and extremely sensitive to any attempt at flexion, could be bent to a right angle without causing any pain at all.

I proceeded at once with the resection. The incisions through the skin, muscles, and periosteum, as well as all the cutting required by the resection, were completely painless. The patient at first noticed the forcible elevation of the periosteum, but after a few minutes this intervention too went unperceived, as did the extirpation of the capsule, the removal by sawing of the bone ends, and the curetting and excision of the fistulae. I emphasize that this was an extremely sensitive patient, who screamed loudly during the initial injection for the Schleich infiltration anesthesia.

At the end of the resection (15 minutes after the injection of the novocaine solution) the sensibility distal to the distal tourniquet was tested. Sensation, but not motor power, was found to be completely abolished in this part of the limb. The anesthesia enabled one to mobilize the finger joints, which were completely stiff, by forcible flexion and extension, apparently without causing any pain whatsoever.

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<sup>\*</sup> Translated from Bier, A.: Ueber einen neuen Weg Localanaesthesie an den Gliedmassen zu erzeugen. Archiv fuer klinische Chirurgie, 86:1007-1016, 1908. Unfortunately, the train of thought that led Bier to this daring innovation in technique is unknown.

The operation ended 20 minutes after the injection. The peripheral tourniquet was released and the central one loosened so as open the arteries but maintain closure of the veins and retain whatever novocain solution still remained in them. The bandages were then inspected for any sign of bleeding, before removing the tourniquets. The hand was still completely insensible; seven minutes later feeling returned to the flexor aspect and, after another two minutes, to the extensor aspect as well.

The following case illustrates the use of the method for the removal of a sequestrum:

A fourteen year-old girl with acute osteomyelitis had necrosis of the distal two thirds of the left radius. Several fistulae and ulcers were present. Before exsanguinating the blood from the arm an upper arm vein was freed by dissection, following which the blood was forced out of the arm with an elastic bandage. Next, a tourniquet was applied at the elbow and another at the wrist. Sixty cc. of a 0.25 per cent solution of novocaine was then injected toward the periphery through the exposed vein. Sequestrectomy of the distal two thirds of the radius brought to light several additional sequestra and was completed entirely without pain.

Here too the entire segment of limb down to the fingertips had become anesthetized. On loosening the tourniquets the anesthesia disappeared almost immediately.

In both of these cases we achieved exceedingly effective anesthesia. The operation could proceed in the region between the two tourniquets immediately after the injection had been made. A little later, anesthesia spread distal to the peripheral tourniquet, and one was then able to operate there without causing any pain.

In other instances, immediately after the injection we have been able to perform such operations as sequestrectomy of the tibia, resection of the knee joint, and amputation of the lower leg.

At times the anesthesia was not always complete or immediate; in some cases we had to wait for ten minutes or longer. The subjects, however, always explained later that they had watched the procedure, had not perceived any real pain, and were readily able to bear the operation.

I have encountered one partial failure, in a male drunkard in whom it was desired to perform an orthopaedic resection of the knee for flexion ankylosis of the joint. With the skin incision he became so agitated that administration of ether was resorted to, whereupon it became possible to complete the operation. The patient subsequently remarked that he had not felt any pain but had seen what was going on, and this had made him "nervous". Incidentally, in this powerful male we used too little of the 0.25 per cent novocaine solution: we injected only 90 cc.

Analgesia does not suffice for the performance of major operations in anxious persons, so I have more recently utilized the 0.5 per cent solution of novocaine in order achieve complete anesthesia. It usually produces immediate total anesthesia. I will describe later how to avoid systemic intoxication by the concentrated solution when the tourniquet is removed.

I believe the described procedure will only supplant other well tested methods in situations where infiltration and conduction anesthesia are not applicable to major operations. It will enable us to approach very closely to the ideal of performing under local anesthesia all operations on the extremities that require a bloodless field. I do not doubt that with further development of the technique this ideal will be safely attained in the near future. We are already able to perform knee and elbow joint resections and

extensive sequestrectomies of the lower leg and forearm painlessly with local anesthesia, something that had not been possible hitherto.

I feel sure this also applies to all amputations, especially as in such cases we do not have to worry about restricting the amount of solution used so as to prevent toxicity. The amputation incision can be made directly through a region that has been saturated with the solution; excess solution remaining in the tissues can conveniently be allowed to drain away.

I have had only one opportunity to perform an amputation of the lower leg with this method. I placed tourniquets at either end of the field of operation and injected 50 cc. of 0.5 per cent novocaine solution. The operation began immediately and proceeded painlessly except during the circular incision through the muscles and the section of the large nerves, at which time the patient complained of a light burning sensation but volunteered that it could not be described as pain.

In this instance the amputation was through the distal third of the lower leg, in a notably slender limb. Otherwise I would have had no hesitation in injecting larger volumes of the 0.5 per cent solution.

Large sequestrectomies in the lower two thirds of the thigh, however, may be difficult to perform in the present state of the technique.

In nervous or tense patients one can advantageously combine the described procedures with etherization or morphine-scopolamine twilight sleep.

To repeat, the technique is basically simple and proceeds as follows: a truly bloodless field is absolutely necessary and the tissues that are to be anesthetized must be as far as possible empty of blood. This is achieved by applying an Esmarch bandage as tightly and as thoroughly as possible, beginning at the peripheral end of the limb, and then unwrapping it; after the exsanguination maneuver one may expose the appropriate vein, incise it laterally, and allow the blood still remaining in the limb to drain out through the slit, assisted by pressure on the soft tissues.

The first tourniquet is placed a little above the operative site. The customary piece of rubber tubing is not suitable for this purpose because it is liable to cause disagreeable pressure or pain. In most situations a thin elastic bandage applied around a segment of the limb is preferable.

A tourniquet applied in this manner is well tolerated by the patient even for prolonged operations, provided that local anesthesia is administered at the same time as described. Use of such a tourniquet of course presupposes that one has first exsanguinated the part.

The second tourniquet is applied similarly, a little distal to the operative site. The elastic bandages should be kept in carbolic acid solution and always boiled after use in a septic operation. A subcutaneous vein is then looked for between the two tourniquets. In the leg the vena saphena magna is usually the best for this purpose; it is easy to find between the ankle and knee. In some cases the vena saphena parva is better. In the arm the cephalic, the basilic or the median basilic veins are preferred. If the vein can be seen or palpated it can be approached through a longitudinal incision; if not, one approaches it transversely, carefully keeping the anatomical course of the vein in mind. In the case of a transverse incision one must be careful not to injure the large veins. Often enough a vein is prominently visible in the operative region, especially if made to swell by hand pressure or with a phlebotomy ligature. It is inadvisable to select a very small blood vessel because this makes introduction of the cannula difficult.

Once the desired vein has been found one proceeds exactly as with an intravenous infusion. Using a Deschamps needle one places two threads around the exposed vessel, incises the side of the vessel obliquely, introduces the

intravenous metal cannula - I use metal ones exclusively - ties the vessel tightly to the cannula with one of the threads and uses the other to ligate the vessel. The solution of novocaine is injected under steady, gentle pressure through the usual 50 cm piece of double bore tubing, where one channel serves for aspiration and the other for injection. I generally tie in the cannula with the distal end pointing peripherally and inject against the venous valves, although sometimes in the opposite direction. Either way the solution will in the end always get past the valves. In most cases the valves do not offer much resistance, but sometimes one must exert appreciable pressure to overcome the resistance. For this reason it is necessary to tie the cannula securely into the vein and the tubing to the syringe, to prevent them separating during the injection.

Thereafter one notes how the segment of limb between the two tourniquets takes up the fluid and swells. Generally the skin becomes even paler than it was after being exsanguinated. If, however, it still contains blood it will take on a blueish coloration as blood in the deep veins is forced toward the surface.

With peripherad injection of the solution one should take care to fill the veins as closely as possible to the proximal tourniquet, as the anesthesia under the latter sometimes leaves a little to be desired or sets in only after a delay of several minutes. To insure even distribution of the anesthetic solution one may spread it by hand or by flexing the joint where applicable.

Whether in 0.25 or 0.5 per cent concentration, the novocaine should always be dissolved in physiological saline in order to avoid damage to the tissues.

For resection of the knee joint in adults one may require 60-80 cc. of the 0.5 per cent or 150 cc of the 0.25 per cent solution, for the elbow joint, 40-50 cc. or 100 cc. Although one may sometimes succeed with a small amount of weak solution (for example we have been able to perform an arthrodesis of the knee joint in a three year old child using only 25 cc. of the 0.25 per cent solution), it is generally preferable to produce immediate and complete anesthesia by using a somewhat larger volume of the much more reliable and effective 0.5 per cent solution.

In our experience solutions weaker than 0.25 per cent have been unsuccessful.

It is still unsettled whether the direct anesthesia produced in a limb segment between two tourniquets is more effective than the indirect (conduction) anesthesia that is produced distal to the peripheral tourniquet. I have operated only once under the latter circumstance. Several times I have used both together, for example beginning a sequestrectomy in the region of direct anesthesia and then removing the lower tourniquet and continuing in the region of indirect anesthesia. I cannot be more precise on this point until I have accumulated more experience.

For the foot one can obtain immediate direct anesthesia by using a sufficient volume of 0.5 per cent novocaine, and can then begin the operation immediately after the injection. If one is using a weaker solution it is better to wait a while because the anesthesia will often take 2-15 minutes to develop.

Indirect anesthesia distal to the peripheral tourniquet develops slowly but does become complete and produces satisfactory operating conditions.

Eventually, if the novocaine has acted for a lengthy period, motor paralysis of the entire limb segment nearly always sets in.

Sensory and motor paralysis usually disappear as soon as the blood is flow is restored. Occasionally the anesthesia persists for a further brief period, the longest time noted (7 minutes) occurred in the above-mentioned case of resection of the elbow-joint. This illustrates the familiar brevity of action of novocaine used without epinephrine. Because of the rapid dissipation of

anesthesia most of the skin sutures should be inserted before the tourniquet is released. The anesthesia of the deeper parts sets in just as quickly, or even more rapidly, than that of the skin. More than once we have been able to manipulate extremely painful limbs completely painlessly immediately after the injection or forcibly loosen stiff joints while the skin still remained sensitive to pinprick.

A small volume of 0.25 per cent novocaine solution often completely abolished pain sensibility although the patient still perceived the incision or the elevation of periosteum. Since such minimal analgesia does not suffice for anxious patients, we make it a rule to use the more reliable 0.5 per cent solution exclusively.

You will surely ask me whether it isn't extremely dangerous to introduce the high doses of novocaine mentioned above directly into the blood stream? After all, it is known that all anesthetic poisons act much more quickly and strongly by this route than when they are injected into the tissues. I believe I can set your minds at rest on this point. Several considerations conspire to greatly diminish the risk of toxicity.

1. The solution of novocaine which we inject is very dilute.
2. Aqueous solutions, in particular physiological salt solutions, as shown in my previous studies, cross the wall of the vein very rapidly. If this were not the case anesthesia simply would not develop at all.
3. We perform these operations under bloodless conditions and localize most of the poison, so that it only reaches the general circulation later, during the stage of resorption.
4. Much of the administered solution escapes out through the operative wound before the release of the tourniquet.

We have encountered only one instance of intoxication, and that one could be interpreted as a mild one.

The patient was a very debilitated and anemic woman aged 60. I obtained excellent anesthesia by injecting 150 cc. of the 0.25 per cent solution of novocaine and resected her tuberculous knee joint. Fifteen minutes after release of the tourniquet, by which time the plaster bandage had already been applied, the woman complained of nausea and began retching. The pulse was feeble and its rate 72 per minute. For safety's sake the tourniquet was re-applied over the plaster bandage and removed five minutes later. The symptoms rapidly disappeared.

This must have been a case of mild novocaine poisoning: it could not have been due to direct, rapid uptake of the drug because the delay was much too long. A remedy which has already been well tried for snakebite can also be recommended for protection against cocaine poisoning in operations performed with a tourniquet: One loosens the tourniquet for a brief period and then tightens it again, and so on, several times in succession. In my own cases I have proceeded as follows: at the end of the operation, but before suturing, I remove the peripheral tourniquet and loosen the central one slowly just enough to reopen the arteries but not the veins, which in practice means until the limb reddens and the wound begins to bleed. In effect, one uses blood to wash out some of the novocaine solution that remained in the blood vessels. If sewing is to be performed one then reapplies the tourniquet and occludes the arteries again to prevent premature termination of the anesthesia.

In order to reapply the bandage correctly the unwound portion must first be rolled up.

In cases where large volumes of the 0.5 per cent novocaine solution have been used I leave the injection cannula in the vein until the end of the operation

and then, before removing the tourniquet, I wash out the entire vascular system of the limb with physiological saline solution.

The above-described anesthetic procedure demonstrates that a very intimate communication exists between the veins and the other blood vessels in a part isolated by a tourniquet. The procedure may therefore also be useful for other purposes. In diffuse cellulitis this method may be the only way to bring the Mueller and Peiser enzyme inhibitor into contact with all the infected tissues.

# CARL KOLLER AND COCAINE

HORTENSE KOLLER BECKER (HIGHLAND PARK, ILLINOIS)

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# CARL KOLLER AND COCAINE

BY HORTENSE KOLLER BECKER (HIGHLAND PARK, ILLINOIS)

It was like a red-hot needle in yer eye whilst he was doing it. But he wasn't long about it. Oh no. If he had been long I couldn't ha' beared it. He wasn't a minute more than three quarters of an hour at the outside (*IX*).

Thus, an old man described his cataract operation to Thomas Hardy and his wife on their visit to Dorsetshire in 1882.

It takes little imagination to picture the situation before the advent of local anesthesia, particularly in ophthalmology. Operations upon the eye were especially difficult, and for them general anesthesia was unsatisfactory. It was not administered as skilfully as it is today; retching and vomiting often followed which might seriously damage the eye, and the patient's conscious coöperation was frequently necessary. A long, delicate operation upon the sensitive eye demanded the greatest fortitude on his part, but the doctor too was under heavy strain, for he had to work with utmost speed on a tiny surface, with sight itself frequently at stake, torn perhaps by irritation or pity according to the patient's behavior which he had to control at the same time.

Local anesthesia in surgery is now so commonplace that it is hard to realize the suffering we have been spared since September 15, 1884, when a young Viennese doctor read a brief paper, barely two sides of a sheet, at a medical meeting in Heidelberg, and thus inaugurated the era of local anesthesia. The young man was Dr. Carl Koller, my father, whose long life ended on this side of the Atlantic in 1944. Later, after my mother's death, I found myself confronted with his papers which she had saved, the accumulation of some seventy-five years.

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A number of busy people have been most helpful in connection with the preparation of this paper and I offer them my thanks for their time and interest. I am also indebted to Dr. Ernst L. Freud for his help in translating his father's letters and permission to print them.

As I plowed my way through papers and pamphlets, letters, photographs, and medals, I began to regret that I had not questioned him more about the background of his discovery and his colleagues. I wondered what his life had been like in that other world, during that great period of scientific flowering which was to grow so rapidly in every direction and to make inevitable the present immensely complex system of specialization. It was a period when it was possible for one man to possess almost fully the medical knowledge of his time.

The bare facts I knew, to be sure, for they came to my attention late in my father's life when he was repeatedly honored. An exceedingly modest man, he despised general publicity as unworthy and unscientific, as indeed did most of his colleagues. It was assumed that their work belonged only in the annals of medicine, forming a small part of that mighty foundation which safeguards our health, lessens pain and fear, and, above all, is part of the sum of pure knowledge. They had an almost holy respect for this search after knowledge, for which not even the most brilliant intuition sufficed, if it was not followed by most painstaking and accurate research. Many of these men were eccentric, arrogant, and self-willed, and might ride roughshod over our modern concepts of 'adjustment', 'integration', and 'social attitude', but in their work they were disciplined to lay down their pride and to see the destruction of their most cherished, long-held theories in the light of their own careful, objective research.

When I was young, being less high-minded than he and rather fond of glory, I well remember my disappointment when, with his usual contempt for publicity, my father refused to be 'profiled' in *The New Yorker* or have the history of his discovery broadcast on the air. Then why, when he can no longer forbid it, should I break that wished-for silence? That is a long story and the one I hope to tell here.

As I made my way through drawers and closets, reducing long-loved possessions to a list, I thought the questions which had begun to fill my mind had come too late, but by a strange

chance they were still to be answered, and one by one the pieces of the puzzle dropped into place. It came about in this way.

I pulled the lid off a large, dog-eared carton and saw it was heaped to the top with neatly tied, brown paper parcels, variously labeled in my father's small, well-formed handwriting, 'Vienna 1880-1884', 'January 6th, 1885', 'Göttingen 1885', 'Utrecht 1885-1887', etc. I ran for the scissors and cut the strings that had been tied over seventy-five years before by his skilful surgeon's fingers. There, fresh as the day they were written, on linen paper still strong and white, in cramped, highly individualistic script, appeared many famous names. There were the physiologists, Du Bois-Reymond and Brücke, also Billroth (a devoted friend of Brahms), all three pillars of the Helmholtz school which had such profound effect on the scientific work of that day. There were Kölliker, the noted embryologist, Sigmund Freud as well as his friend and associate, Josef Breuer, and the diminutive Professor Samuel Ritter von Basch, to whom the ill-fated Emperor Maximilian handed his ring minutes before his execution in a wild, foreign land. As young medical students, Gaertner, Freud, Wagner von Jauregg, and my father often watched that ring on the doctor's hand, while he fired their imagination with stories of his Mexican adventures. There were Oskar Hertwig and that kindest of men, the Nobel prize winner, Willem Einthoven, father of the cardiogram. Here were Professors Snellen and Donders, giants in the fields of optics and physiology, along with many others. Here, too, amid medical papers, slipped into the manuscript of my father's first communication at Heidelberg, was a tissue-thin envelope that had held those very grains of cocaine with which he had first experimented and demonstrated its usefulness in surgery.

As I leafed through those hundreds of papers and letters, the student days in old Vienna came alive again, with their *Kneipen* and *Singvereine*, student manifestoes, and expeditions into the lovely countryside. Pages and pages were filled with plans, hopes, disappointments, poetry, and even girls.

How articulate they all were, how much they had to say which, I suppose, would today have found its way over the telephone and vanished forever. My father was fond of the gloomy, romantic poetry of Lenau—*Zu viele Raben* (Too many ravens), complained Freud—and of inquiries into the riddle of life. *'Du sprichst immer so schwere Sachen'* ('With you everything has to be so deep'), Freud teased him. Of the fanciful humor that made *Alice in Wonderland* his favorite book and of his mordant sarcasm the letters, of course, tell nothing. After all, there were none of his among them.

My father was born in 1857 in Schüttenhofen which was then in Austria and is now in Czechoslovakia, and he died in New York in 1944. His lifetime encompassed most of the great discoveries of modern medicine: asepsis, anesthesia, vaccines, antibiotics, and, of course, local anesthesia. He used to say that he was born in the Middle Ages, for in Schüttenhofen water was then still drawn from the village well, and the enormous speed-up of communication and technology had not begun. And he lived well into the Atomic Age. I remember when Sir Ernest Rutherford first smashed the atom in 1919—or to put it more scientifically accomplished the first artificial transmutation—how awed I was as he tried to explain to me the significance of this inevitable step in the growth of human knowledge. Before he died the first atom bomb was being constructed at Los Alamos.

My grandfather, Leopold Koller, a business man in Teplitz, moved to Vienna with his family when his young wife died and his only son Carl was a small child. A man who revered knowledge, he was deeply interested in the education of his children, was very just and high-minded, but austere and distant. Having grown up in a period of revolution and social change, he was one of those Jews who made the difficult break from ritual and dietary laws, although he never ceased to regard himself entirely as a Jew. My father therefore had no formal religious education and was haunted as he grew older by the hopelessness of that loss which was expressed in poetry and prose by men like Matthew Arnold and John Stuart

Mill. The conflict of science and religion resolved itself for many into a terrible scepticism, and the verses I now found, by a contemporary poet, Carl Thomas, which my father had clipped from a Teplitz newspaper when he was nineteen, reflected this thinking. 'What of fame?' asked the poet, 'What of glory? What even of knowledge itself? The end and the answer must be nothingness.'

From private tutoring, instruction at some point by the Jesuit fathers, whom he ever after deeply admired, and after the *Akademisches Gymnasium*, he started with some uncertainty upon his career in 1875. For a year he studied jurisprudence and then in 1876 finally turned to the study of medicine at the University of Vienna.

The University and its adjunct, the *Allgemeine Krankenhaus*, or General Hospital, where my father later interned, were manned by such noted teachers as Professor Arlt, Brücke, Ludwig, Meinert, Billroth, Mauthner, and many others. Its teaching was profoundly influenced by the great deterministic Helmholtz school of thought (since Brücke as well as Billroth were two of its pillars), which had far-reaching effects on scientific thinking then as well as for a long time to come.

Continuing my search through the carton, I picked up a card covered with the tiny, disciplined writing of another founder of that school, Du Bois-Reymond, in whose laboratory my father worked for a while. And this recalled a letter he wrote in 1936, some fifty years later, in which he tried to explain determinism to me.

He [Du Bois-Reymond] was quite a celebrity of that age. He made famous studies of the electric eels and rays of South America and had been the Rector of Berlin University, and his oration on that occasion, *Ignorabimus*, drawing the limits of human knowledge quite in the line of Kant, was a classic. I believe it is today. He rode the horse of causality, stating among other things that, if it were possible to know the set-up of things and forces, one would be able to foretell the future with mathematical precision. Of late the atomic physicists and especially

the 'quantum boys' have been assailing causality, claiming that an atom could change its mind and go a way other than which it is headed. Whereas the strict causality law does away with free will, the 'quantum boys' have re-established free will, which is in harmony with our own feelings, but not necessarily correct by any means (37).

And again in 1941 at the age of eighty-four, in an even lighter vein:

You don't need to think that the difference of opinion which came to a head when discussing the causes which make a dog elevate one hind leg when making use of a hydrant or lamp post is something new, and invented by you and me. It represented two great schools of philosophy, that of the Empirics (which is dead and buried) and of the Nativists, which is very much alive, and which latter has as an extravagant outgrowth the race theories of the Nazis. These two schools of philosophy had it out on the grounds of physiological optics. The great Helmholtz led the Empirics and the much less known Hering, the Nativists. There are no Empirics left any more (except you).

Organisms work the way they are constructed without any benefit of experience. Dr. X, although I hate to quote him in this connection, said, 'A hospital works the way it is constructed'. With which he meant it would work smoothly if kitchens, pantry, and laundry are in the right place (37).

So much for the philosophy underlying the scientific work at the University, reduced, of course, to primerlike terms. That University and the associated General Hospital, despite brilliant teachers, in many ways afforded a frustrating experience for lofty-minded young men with any thought of an academic future. Competition was keen, the requirements difficult, and examiners at times merciless and sarcastic, but these might be considered just and proper obstacles. There were worse things than matching knowledge against knowledge: favoritism, corruption, and the necessity for pulling strings and playing politics utterly at odds with the idealism of most of these proud, aspiring young scientists. Beside these, for men like

Freud or my father there was anti-Semitism, an evil-smelling vine that twined about the whole social structure of Vienna, choking so many green hopes to death.

Within the University the strength of anti-Semitism was perhaps heightened by a kind of race consciousness and nationalism which was linked to the German learning of the time. Germany was considered the true source of intellectual life. The non-Germanic peoples of Austria were considered less educated, less cultivated, and inferior, and even some of the great professors preached that this learning, developed by German thought, should be disseminated by those of German blood. True, I had but to look at the letters before me to see that, though the obstacles to promotion for a Jew were aggravated and a professorship was almost out of the question, Jewish students might still, as individuals, have close friendships with and receive inspiration from these unusual teachers, as my father did from Billroth, Ludwig, Stricker, and the others. We must not interpret the situation entirely by its fearful but logical conclusion in the blood bath of the last war.

The letters, therefore, were filled with many problems, as was natural in the crucial years when young men must decide their future. Among them was a series from three students who appeared to see a great deal of one another and whose letters about each other and the same happenings formed a tantalizingly incomplete but continuous story. These were Rosanes, Freud, and the brilliant and charming Lustgarten, who was a particularly close friend of Freud as well as of my father, and served as my father's second in a duel with an anti-Semitic colleague of which I now read for the first time.

Two of the letters written by Freud, when he was twenty-four and my father twenty-three, were about an old bugbear that has not changed much in the last seventy-five years—examinations. One of its most trying forms at the University was the oral *rigorosum* which, while considered a preliminary medical examination, could be taken even after studies were completed. The letters were written to my father on successive

days and though the first of them sounds high-spirited and gay, it was not necessary to read the second to find out that its writer was ill and exhausted. This the handwriting showed plainly as it grew more and more erratic and difficult to decipher.

Vienna, 23 July, 1880<sup>1</sup>

Dear Friend:

I no longer believe in earthly justice, for I can now obediently announce to you that I did not fail; on the contrary, I managed to pass with considerable distinction (*per minora* [a]). I don't know the kind of debacle for which the gods are actually sparing me, but this time they visibly held their sheltering hands over me. Before we turn to more interesting matters, listen to me like a good fellow while I tell you how it all happened. I am very happy about it; what is there to delight in, except for what comes one's way undeservedly? Perhaps one might even say that all men are proud only of distinctions they do not deserve. (Addition to the philosophical aphorisms in Stricker's diaries on General Pathology, in instalments [b].)

So I sat in travail with the fateful eve of examination approaching (*eref* examination, as they said in olden times [c]) and noticed that I still had all the material in front of me. So I decided to forget about pharmacology, of which I had learned narcotics, and to repeat this worthy subject quietly after vacation. But on Wednesday afternoon, twenty-four hours before the decision, I thought it over again; the fiendish laughter of Hell yelled in my ears, the clamor in Israel was great, and my best friends sang the dirge, 'Tell it not in Askalon. Publish it not in the streets of Gath', which was sung at the death of Saul and Jonathan. So I decided to delve for 12 more hours into the depths of pharmacology; and as this thought oppressed me, I went for a walk for several hours. It took several hours be-

<sup>1</sup> Notes: a. *per minora*—for less important subjects.

b. Salomon Stricker (1834-1898), professor of general and experimental pathology at the University of Vienna. Joking reference to Stricker's lectures on General and Experimental Pathology which appeared at the time in instalments.

c. Reference to Jewish holidays which always start on the preceding evening (*eref*—eve).

cause I met young Zuckerkandl [d], one of the most intelligent and pleasant people whom one might meet. I have to be brief. I could, to be sure, run through the little Binz [e]. But in pathological anatomy I have studied only the 'general' [part] and of internal medicine only the lung and infectious diseases. This was now a very serious matter. This joke might cost me 17 fl 50 and six months, as well as alienating the regard of Lustgarten [f] and Schwarz (you notice I don't put you in the same category). After a short collapse I went forth to the battlefield determined to defend my life in every possible way and to keep unrestrainedly quiet in pharmacology. The nearness of battle exerted its usual stimulating effect on me. I was lively, bold, and confident. From Sigmund [g] I got an 'Excellent' in no time for a clinical presentation of measles. Now came the Schlemil historicus [h]. With his usual lack of skill he questioned me on one subject only, brain hemorrhages. We had a lively debate. I could hardly use the most commonplace abstractum without his saying, 'This is not correct, this is a phrase', etc. I replied, 'I did not speak without thinking'. 'Think it over again and you will understand it yourself', he said.

[No signature]

Vienna, 24 July, 1880<sup>2</sup>

Dear Friend:

I had intended to burden you with a detailed account, but

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- d. It probably was Otto Zuckerkandl (1861-1921), later professor of urology at the University of Vienna, whom Freud calls the young one, in contrast to his older brother, Emil Zuckerkandl (1849-1910), professor of anatomy.
  - e. Karl Binz (1832-1913), professor of pharmacology at the University of Bonn. Freud refers here to *Grundzüge der Arzneimittellehre* of Binz. First edition 1866, twelfth edition, 1894. Possibly Freud had the sixth edition (1879) in mind.
  - f. Dr. Sigmund Lustgarten (1857-1911), instructor (Assistant) at the Chemical Institute, later at the Department of Dermatology at the University of Vienna.
  - g. Dr. Karl Sigmund, Ritter von Ilanor (1810-1883), since 1869 professor of dermatology and syphilology at the University of Vienna.
  - h. Unlucky fellow, apparently Freud's nickname for one of the examiners.

<sup>2</sup> Notes: See p. 318.

fatigue and feeling sick have not let this develop further than the torso which I don't want to withhold from you.

I am very sad to omit everything interesting, but I can't do otherwise for early tomorrow morning I am going to the Semmering [a] with my sister Rosa for the last three days of vacation. But I don't want to leave you too long in doubt of my fate.

Total result: 'Excellent' in pathological anatomy, general pathology, gastroenterology.

'Satisfactory' in four others. In pharmacology it may be announced that I did not miss a single question, but I could not avoid giving the impression of having learned nothing, as it always took me a long time before I could compose the right answer. With Stricker I would have had another 'excellent' had I not described a *Dämpfung* [b] as 'triangular', when it should have been 'square'. I am as glad as I am tired. Of our friend Stricker I shall report later.

For the present I wish you the smallest number of encounters, the biggest possible number of rendezvous, sheer Solo Pagat, Ultimo Valat [c], and assure you that it will give me great pleasure to answer further letters of yours after I have recovered my strength.

With warm greetings  
Your friend  
Sigm. Freud

The pathological laboratory, with the inscription *Indagandis causis et sedibus morborum*, housed two buildings that were to be of the greatest importance in my father's work. One was the chemical laboratory presided over by Professor Ludwig, who had himself been assistant to the renowned Bunsen at Heidelberg, and who more than any other influenced my father's scientific development. The other was Stricker's pathological laboratory, devoted chiefly to animal experimentation. Here along with my father worked his friends, Gaertner, Freud, Spina, and

<sup>2</sup> Notes: a. Mountain resort near Vienna.

b. An area of dullness in percussion.

c. Winning hands in the old Austrian card game, tarok.

Wagner von Jauregg, who later received the Nobel prize for his treatment of general paresis, in which he induced a fever by inoculating his patient with malaria plasmodium. Here my father studied circulation, respiration, and glandular secretions, employing many different poisons, and it was this work that prepared him for the discovery which is the subject of this paper. Here, as he plunged into the search for pure knowledge, he was to have the most satisfying scientific experience of his life.

It was a time, as I have said, before the age of specialization, but in the field of embryology this had already taken place, though the number of embryologists was very small. My father became absorbed in a then much disputed question, the origin of the mesoderm, or middle germ layer, of the chicken embryo. At a certain stage in the development of the embryo, the mesoderm appeared as though out of nowhere and it was a mystery how this came about. At the age of twenty-two, my father did not stumble upon the solution but reasoned it out, and his papers on the subject, published in 1879 (18) and 1881 (25), created a stir in the small world of embryology. If one may judge by the letters, the young researcher found himself in the midst of an international correspondence. Not only the great histologist Kölliker, but other men prominent in the field, B. Benecke, Leo Gerlach, Edouard van Beneden of Belgium, and F. M. Balfour of England, to name a few, sent him their work and reviewed their scientific problems with him. He was honored by having his findings incorporated into the impressive *Festschrift* for Kölliker (28), and they then found a place in the textbook of the Embryology of Man and Mammals by Oskar Hertwig (12), one of the most highly regarded and authoritative books in the field at the time. Many of the letters were addressed to the '*Hochwohlgeborener Herr Professor*' in ignorance of the age and status of the young scientist. This discovery, although of no significance to the general public, seemed to my father a greater scientific achievement than his discovery of local anesthesia, which had such important effects

on the history of medicine and surgery. Perhaps this was the happiest time of his life. He had received recognition in his chosen scientific field, and above all he had been privileged to experience the pure and divine joy that comes when a man finds himself, as Einstein, I believe, somewhere describes it, after much thought upon a new plateau of human knowledge.

It was my father's teacher in ophthalmology at the University, Professor Arlt, who pointed out to his students the need for a local anesthetic in eye surgery. This idea inspired my father, who now wished to go into the field of ophthalmology and hoped, by some important contribution in that field, to win one of the two assistantships in ophthalmology at the University. So he set to work upon this problem.

'Up to 1884', he wrote Dr. Chauncey Leake in 1927, 'the only method of local anesthesia known and not very frequently practiced was the Richardson ether spray, which acts by freezing and was used for subcutaneous abscesses and for similar operations of short duration. The immediate cause of my approaching the question of local anesthesia was the unsuitability of general narcosis in eye operations—eye operations were formerly being done without any anesthetic whatever' (37).

And he added in a paper which resulted from Dr. Leake's suggestion: 'I therefore began to experiment in local anesthesia of the eye with a view to surgery—performing a great many experiments upon animals. Thus I tried chloral, bromide, and morphine and other substances, but without success and gave up these experiments for the time being. Although these experiments had been unsuccessful they had the good effect that my mind was prepared to grasp the opportunity whenever I should encounter a real anesthetic' (23).

A quantity of photographs slid about among the piles of letters as I probed, and one inscribed to my father, was of a young man with a noble forehead, great intelligent eyes, and an expressive face. This was von Fleischl-Marxow, one of the two assistants of the famed Brücke. This charming man with a fantastically brilliant mind suffered from a disease so

painful that it had driven him to morphine addiction. Ironically his terrible agony was a most important link in the chain of events that was later to relieve so much of the world's pain—the use of cocaine as a local anesthetic.

Cocaine is the alkaloid derivative of the coca leaf—which was not separated from the leaf until 1855. The story of coca is very long and old, and there is space to mention only a few of the men who contributed to the knowledge of it. They must be thought of as individual trees in a forest.

The coca plant had been known from early times to the Indians of Peru and, from the time of Pizarro, had found a place in the literature. It was considered by the Incas a living representation of the god, and the fields where it grew were thought to be holy. 'Travelers in South America', wrote my father, 'on the high plateaus of the Andes in Peru and Bolivia brought back many tales of its mysterious properties'. In 1700 the poet Cowley wrote of how the god Varicocha gave man the nourishing leaves which enabled him to endure long hunger and heavy labor.

In 1847 Prescott wrote: 'This is a shrub which grows to the height of a man. The leaves when gathered are dried in the sun and being mixed with a little lime, form a preparation for chewing much like the betel nut of the East. With a small supply of this cuca in his pouch and a handful of roasted maize, the Peruvian Indian of our time performs his wearisome journeys day after day without fatigue, or at least without complaint. Even food the most invigorating is less grateful to him than his loved narcotic. Under the Incas it is said to have been exclusively reserved for the noble orders. If so, the people gained one luxury by the conquest' (34).

Actually the conquistadors feared the power that lay in the control of the divine plant by one group, so that the second Council of Lima, October 18, 1569, three hundred and fifteen years before its present medical use was discovered, issued a decree against its exclusive use by one class. And after that period it was used so generally and extensively that it consti-

tuted a most important item of Spain's colonial trade. Indeed, the December 22, 1884 issue of the Medical Record remarks, 'At the present day the laborers of the whole of South America continue the use of coca'.

About the year 1863 in Paris, a young French chemist, Angelo Mariani, concocted a medicine from an infusion of imported coca leaves in wine, and *vin Mariani*, Mariani elixirs, Mariani lozenges, and Mariani teas soon became enormously popular, especially in America. Mariani became a standard and respected name, users were warned against imitators, and his products were endorsed by the most distinguished doctors such as W. Oliver Moore, de Wecker, and Charles Fauvel, who recommended them for a wide variety of uses. Mariani himself said of his wine, 'It nourishes, fortifies, refreshes, aids digestion, strengthens the system, it is unequalled as a tonic, it is a stimulant for the fatigued and overworked body and brain, it prevents malaria, influenza, and wasting diseases'. Dr. J. Leonard Corning wrote the following endorsement: 'Of *vin Mariani* I need hardly speak as the medical profession is already aware of its virtues. Of all the tonic preparations ever introduced to the notice of the profession, this is undoubtedly the most potent for good in the treatment of exhaustive and irritative conditions of the central nervous system' (29).

Though manufactured in France by a Frenchman, this remedy was used most widely in America. I noticed, however, that the Viennese pharmacist, Dr. August Vogl (35), under whom my father studied and whose library was used by Freud for reference (2, p. 584), highly recommended a cocaine tea which he himself brewed, and which he had been using for several years, adding sugar and cream, in preference to Russian tea! About the coca leaf infusions, one apparently could not say enough; but in regard to the chewing of leaves there were occasional warning notes. At the end of Prescott's passage on coca he says: 'Yet with the soothing charms of an opiate, this weed so much vaunted by the natives, when used to excess, is said to be attended with all the mischievous effects of habitual

intoxication' (34). A footnote adds: 'A traveler (Poepfig, noticed in the Foreign Quarterly Review [No. 33]) expatiates on the malignant effects of the habitual use of the coca as very similar to those produced on the chewer of opium. Strange that such baneful properties should not be the subject of more frequent comment with other writers! I do not remember to have seen them even adverted to' (34).

Although Gardeke first extracted the active principle of the coca leaf in 1855 and named the alkaloid erythroxyton (16, p. 439), its present name came a little later. 'In 1858', wrote my father, 'the Austrian government sent the frigate Novarra on an expedition encircling the globe. Dr. Scherzer, not a medical man, but a trade expert, who was sent on this expedition to study trade opportunities, took a quantity of the leaves and gave them to the great chemist Wöhler, at the University of Göttingen, Germany. Dr. Wöhler had his assistant, Dr. Albert Niemann, extract the active principle. He found this to be an alkaloid and named it cocaine' (21).

Now it had been known from earliest observation that the chewing of coca leaves made the lips and tongue numb (that is to say it numbed the mucous membrane of those parts), and this fact was also observed in the alkaloid cocaine almost as soon as it was separated from the leaf. In 1862 Professor Schroff, in a paper read before the Viennese Medical Society, pointed out that cocaine numbed the tongue, narrowed the peripheral arteries, and widened the pupils by its action via the bloodstream or when applied locally. Nor was he the only one to have experimented upon the eye. These facts were commented upon by Montegazza in 1859, De Marles in 1862, the Spaniard Moreno y Maiz in 1868, and by many others. In 1879 von Anrep, at the Pharmacological Institute at Würzburg, wrote a comprehensive experimental paper in which he also described the locally numbing effects of cocaine and even the dilation of the pupil upon local application, and he suggested that this drug might some day become of medical importance. 'Strangely enough', commented G. F. Schrady in an editorial in the Medical Record of Novem-

ber 8, 1884, 'Anrep did not note that the conjunctiva was insensible, or if so did not appreciate the significance of this fact'.

In the textbook on pharmacology which my father studied at the University, he had underlined the following passage which appears in the article dealing with the coca plant:

'Local effects: Injection under the skin as well as painting the mucous membrane, for example, the tongue—brings about the loss of feeling and pain. 15 minutes after painting it Anrep was incapable of distinguishing sugar, salt and sour at the treated spot. Even the needle pricks could no longer be felt there, whereas the other unpainted side reacted normally. The loss of sensibility lasted between 25 and 100 minutes.'

The article concludes with 'Therapeutic Uses: Up to now cocaine has not found any medical use. But on account of its powerfully stimulating effects on the psyche, respiration, and the heart, and also on account of its anesthetizing effect upon the mucous membrane, it might deserve experimental trial in quite a number of diseases.' Relative to the therapeutic use of the coca leaves: 'There have been some experiments but no trustworthy ones over an extended period. They are, however, sold commercially and highly recommended for all possible needs' (32).

Probably the general effects of cocaine were so striking that its numbing of the mucous membrane was disregarded, although this characteristic had been generally observed and was uniform. As a matter of fact, anyone with medical training who had studied the alkaloid and learned that it numbed the mucous membranes of the tongue and lips now had sufficient information to reason out this discovery. It was certainly very strange, with this fact repeatedly noted, with experimentation already performed upon the eye itself, with a result of such importance only a short step away, that this discovery should not have been made by any of the brilliant scientists who experimented with cocaine over a period of twenty-five years. Even my father, his mind prepared by his search for a local anesthetic in surgery several years earlier, was not immediately aware of

the significance of this attribute. And it was not until he had the drug in his own possession and had noted its effect upon himself, that the numbing of the mucous membrane of the lips had sufficient impact to distract him from the purpose for which he was directly experimenting. This, as we shall see, was to test its general physiological effects for his friend, Freud.

Yet such is often the course of scientific discovery. To translate Mephistopheles' warning to Faust, which Freud quotes in his Autobiography in another connection: 'It is vain that you seek scholarly knowledge all about you; for every man learns only what he can' (6).

It was not chance that the man who had been previously searching for a local anesthetic in surgery was the first to realize that the Peruvian herb was his answer. My father wrote: 'Just as the fact that sulphuric ether produced sleep and insensibility to pain had been known for a long time before Morton demonstrated successfully that this state could be utilized for the painless performance of operations, so the fact that cocaine locally applied paralyzed the terminations and probably the fibres of the sensitive nerves had been known for twenty-five years before it came into the hands of someone interested in and desirous of producing local anesthesia for the performance of operations' (23).

Although cocaine had been the subject of interested research from the time the crystal erythroxyton was separated from the leaf (Dr. Herman Knapp (16) stated in 1884, 'There is an extensive earlier literature on coca and its alkaloids'), it had many ups and downs and was repeatedly abandoned especially in England and continental Europe as of no practical value. Freud later wrote that its neglect there might have arisen from the lack of uniformity and unreliability of its manufacture, and that these might have been responsible for the contradictory and inconclusive experimental results, as well as its scarcity and high price. Whatever the reasons, it had fallen into disrepute and was little spoken of at this particular time. Freud was undoubtedly acquainted with cocaine in a general way,

since he probably studied the same textbook as my father, and it will be recalled that in his letter he mentioned that he had studied narcotics. But now his attention was redirected to it, and this time with the keenest interest, by at least two articles. In one, Aschenbrandt (1) described the remarkable effects of cocaine upon Bavarian soldiers during the fall maneuvers, how with its help they were able to endure hunger, strain, fatigue, and heavy burdens. The other, by W. H. Bentley in the *Detroit Therapeutic Gazette* (one of sixteen articles on the subject published there which Freud had read), described the use of cocaine in the treatment of morphinism by withdrawing morphine and substituting cocaine. There existed in the United States quite a literature on the use of cocaine in this way. Freud now began to harbor the hope that it might be possible to relieve the suffering of his friend, Fleischl, with this interesting drug. 'The circumstances under which Freud became interested in cocaine', my father recounted, 'were the following: It happened at that time that a young physiologist of great prominence and promise, an unusually brilliant and attractive man, was being treated for morphinism by Dr. Josef Breuer, assisted by one of my colleagues, Dr. Sigmund Freud, the neurologist, later founder of the school of psychoanalysis' (20).

'As assistant to the pathologist, von Rokitansky, he [Fleischl] had infected his thumb and in the amputated stump neuro-mata had developed, so that in consequence of the unbearable pain he had fallen a victim to the morphine habit. Dr. Breuer and Dr. Freud tried to break the morphine habit by substituting cocaine for morphine and in their plan they failed, so that their patient became a cocainist instead of a morphinist, probably the first of these unfortunates in Europe. And many a night have I spent with him watching him dig imaginary insects out of his skin in his sensory hallucinations' (21).

Dr. Breuer was my grandfather's family physician and was deeply admired by my father, who described him as almost Christlike in character and charity, wise, restrained, lofty in

spirit, with that rare balance between the inquiring, intuitive mind and thorough, objective appraisal and research. 'Well-known among other things', said my father, 'for his work on the semicircular canals with the physiologist, Hering'. Of course he is better known to the general public for his early work with Freud, which is the first chapter in the story of psychoanalysis.

Freud and my father had known each other for four or more years. They belonged to at least one circle of friends: Paneth, Schnabel, Emil Wahler, Lustgarten, Rosanes, and many others, as the letters before me attest. They planned excursions together into the lovely countryside of Vienna and played tarok, an old-fashioned, four-handed card game, at the sidewalk cafés. I even came upon one card written by Freud to my father arranging such a game, but complaining about the unreliability of Lustgarten, who often defaulted at the last minute. The sentiment *En cas de doute, abstiens-toi* ('In case of doubt—don't!'), attributed to St. Augustine, which dashed so many of my impulsive childhood schemes, came from the plaque which hung over Freud's desk at the *Allgemeine Krankenhaus*. Occasionally they wandered down some scientific bypath together, as I see from a letter written to me by my father in 1933.

Good for you, that you have discovered Graetz's History of the Jews. It was a standard work already when I was a very young man. It was in 1883 when a (perhaps the first) electrical exhibition was held in Vienna. It was in the Rotunda on the Prater, the only building that was left standing from the great exhibition of 1873. To profit as much as possible from this electrical exhibition, we, Lustgarten, Freud, and I, studied a textbook on electricity and its appliances, very well and lucidly written by Professor Graetz, Professor of Physics at the University of Munich. This Professor Graetz was or is the son of the Graetz who wrote the history of our people. Since we are talking about electricity and the 1883 exhibition, one of the exhibits did not look like much but it was fraught with History, Science, and Fate. It was a surveyor's compass that looked to be

and was a galvanometer of the size of a very small alarm clock. And under it was the legend: 'With this *Bussole* Hans Christian Oersted discovered in 1820 that electric current deflects the magnetic needle'. In other words he had discovered electromagnetism 63 years before that exhibition, and there were already dynamos and all sorts of instruments and appliances to foreshadow the 'electric age' with all its developments from your electric door-buzzer to the telegraph, cable trolley, and electric R. R. which came from that discovery and that *Bussole*. . . . When I studied at Göttingen in 1885 and tried to follow the track which the mathematician Gauss had made, I happened to stroll into the P. O. and there was a small marble slab with the inscription: 'Here in 1830 the Professors Gauss and Weber plied the first electric telegraph between the physical laboratory and the astronomical observatory'. They evidently used Oersted's method, after they had agreed on the meaning of the deflections. Up until this day the cable uses the deflection of the needle when the current is closed for an alphabet. Morse, as you see, did not invent the telegraph, but by inventing the Morse alphabet made the telegraph possible and practical (37).

Freud, who hoped to marry in the near future and therefore needed more than ever to get on with his career and make a name for himself (little dreaming in those anxious and uncertain days how brilliantly he was to succeed), began to hope that cocaine might be the means toward this end. He became more and more interested in its general physiological effects, and the more he tested it the more he became convinced of its miraculous powers. It now seemed possible to him that with its apparent harmlessness, it might not only be used for therapy in morphine addiction but help to increase work output, relieve depressions, contribute to a sense of well-being, and in short become a drug of the greatest usefulness to mankind.

With his enthusiasm, strong personality, and vivid manner of expressing his ideas, Freud made his interest known to his fellow students, among them my father, who was of course, also interested in the treatment of their friend, Fleischl. As

Freud and my father lived on the same floor of the *Allgemeine Krankenhaus* as interns and saw each other almost daily, they were in the habit of discussing their hopes, disappointments, and work. On more than one occasion Freud asked his assistance in experimenting upon some project, just as he later asked him to undertake experiments with him on the general physiological effects of cocaine. One of these earlier requests, breezily dashed off, has remained among my father's papers.

Freud now set to work to assemble all the known facts about cocaine in a thorough and colorfully written paper (8), which had the effect of redirecting the attention of the Viennese doctors to this drug, creating immense general interest and excitement which went far beyond the circle of his friends and fellow students.

This study, twenty-five pages in length, discusses the coca plant, its history, the story of coca leaves in Europe, the action of cocaine on healthy human beings, and its therapeutic uses. The last heading, divided into seven parts, includes the following uses of cocaine: as a stimulant; for digestive disturbances; for the treatment of consumption; as a means of withdrawing alcohol and morphine in cases of addiction; for asthma; as an aphrodisiac; and lastly, its local uses. This may give some idea of the exciting but confusing range of possibilities that had been tried and discarded again and again since the scientific investigation of coca began.

In describing the history of the coca leaf in Europe, Freud wrote: 'Since the discovery of cocaine numerous observers have examined the effect of coca on animals and sick and healthy human beings, and some have employed the preparations designated as cocaine, some coca leaves in infusions, and some in the manner in which the Indians use them'. Under the heading, Therapeutic Uses, he noted: 'To many doctors cocaine seems fated to fill the gap in medical psychiatric treatment, which provides enough means of lowering the heightened excitement of the nerve centers, but knows no means of raising the lowered functioning of these. According to them coca is recommended

for the most varying kinds of psychic weaknesses.' The paper ends with the following paragraph describing the local uses of coca: 'The attribute of cocaine and its salt, the numbing of the skin and mucous membrane with which it comes in contact in concentrated solutions, may lead to other uses especially in *diseases*<sup>3</sup> of the mucous membrane. Following Collin, Charles Fauvel praises cocaine in the treatment of the pharynx, and describes it as *le tenseur par excellence des cordes vocales*. More uses that stem from the anesthetic effect of cocaine might very well develop.'

The local numbing seemed to suggest to Freud few uses beyond those already observed by von Anrep or mentioned in the textbook of Nothnagel and Rossbach. A possible usefulness in surgery did not occur to him any more than it had to Montegazza, Niemann, Wöhler, Schroff, Morena, or any of the other experimenters with cocaine since its separation from the leaf. What seems so obvious today probably escaped him because his goal was so very different; it was one which he was to achieve a long, long time later with tools which he himself would forge.

Immediately after the completion of his paper, Freud left Vienna on a long-anticipated trip to visit his fiancée in Hamburg. Before this, however, his interest in the general physiological effects of cocaine had led him into some experiments in which he had asked for my father's assistance. 'We would take the alkaloid internally by mouth and after the proper lapse of time for its getting into the circulation we would conduct experiments on our muscular strength, fatigue, and the like (measured by the dynamometer)', wrote my father (20).

This is the chain of events which actually placed cocaine in my father's hand and focused his attention on it: Freud's interest in the drug, awakened primarily by the American literature on substituting it for morphine, by which method he hoped to help his suffering friend, Fleischl; the actual purchase of the scarce, expensive product; and the request he made of my father to engage in experiments during the course of which my

<sup>3</sup> Italics added.

father was required to take it by mouth. These were the circumstances that prepared the way for his particular discovery, yet cocaine had been handled, taken by mouth, and its effect, even upon the eye, observed for twenty-five years without its usefulness in surgery occurring to anyone. 'Upon one occasion', my father said, 'another colleague of mine, Dr. Engel, partook of some [cocaine] with me from the point of his penknife and remarked, "How that numbs the tongue". I said, "Yes, that has been noticed by everyone that has eaten it". And in the moment it flashed upon me that I was carrying in my pocket the local anesthetic for which I had searched some years earlier. I went straight to the laboratory, asked the assistant for a guinea pig for the experiment, made a solution of cocaine from the powder which I carried in my pocketbook, and instilled this into the eye of the animal' (27). The young assistant in Stricker's laboratory, Dr. Gaertner, was the sole witness to my father's discovery and, troubled by the misstatements that in time came to be so often associated with the story, he retold it in a 1919 newspaper of which he was medical editor.

'For the thirty-fifth time the day is approaching on which the discovery was made which brought blessing to mankind and glory to the Viennese school of medicine. The fortunate discoverer, Dr. Carl Koller, is still as active as ever. If I feel obliged to sketch the history of his contribution today, my reason is that already legends have begun to form about the person of the discoverer and the events that took place at the time of the discovery and after, which their subject, living in America, is not able to correct.

'My right to be able to make these corrections in his place stems from the fact that, favored by a lucky chance, I had the good fortune to be the sole witness to the birth of local anesthesia.

'One summer day in 1884, Dr. Koller, at that time a very young man, was engaged in a piece of embryological research. He stepped into Professor Stricker's laboratory, drew a small flask in which there was a trace of white powder from his pocket,

and addressed me, Professor Stricker's assistant, in approximately the following words:

"I hope, indeed I expect, that this powder will anesthetize the eye." "We'll find out about that right away", I replied. A few grains of the substance were thereupon dissolved in a small quantity of distilled water, a large, lively frog was selected from the aquarium and held immobile in a cloth, and now a drop of the solution was trickled into one of the protruding eyes. At intervals of a few seconds the reflex of the cornea was tested by touching the eye with a needle. . . . After about a minute came the great historic moment, I do not hesitate to designate it as such. The frog permitted his cornea to be touched and even injured without a trace of reflex action or attempt to protect himself—whereas the other eye responded with the usual reflex action to the slightest touch. With the greatest, and surely considering its implications, most justifiable excitement the experiment continued. The same tests were performed on a rabbit and a dog with equally good results.

'Now it was necessary to go one step further and to repeat the experiment upon a human being. We trickled the solution under the upraised lids of each other's eyes. Then we put a mirror before us, took a pin in hand, and tried to touch the cornea with its head. Almost simultaneously we could joyously assure ourselves, "I can't feel a thing". We could make a dent in the cornea without the slightest awareness of the touch, let alone any unpleasant sensation or reaction. With that the discovery of local anesthesia was completed. I rejoice that I was the first to congratulate Dr. Koller as a benefactor of mankind' (10).

Although my grandparents lived in comfortable circumstances in Vienna, my father seems to have been estranged from his stepmother at this critical time and was forced to live very poorly indeed on what he was paid as an intern. A few months later there were many warm letters from her as well as from my grandfather, for whom he had the deepest respect and devotion, but at this all-important moment he was painfully

poor, indeed so poor that he could not afford to go to the next important scientific meeting which was to be held in Heidelberg. Thus, at his request, it was his friend, Dr. Josef Brettauer of Trieste, who read his paper for him and demonstrated his experiments at the meeting of the Heidelberg Ophthalmological Society on September 15, 1884 (26).

On the eve of the general meeting, Dr. Brettauer appeared before a small group of the staff and some distinguished visitors and gave them, as it were, a preview. With a sort of romantic justice, one of these men was the great Professor Arlt, whose teaching some years before had inspired my father's work. It happened that Dr. Henry D. Noyes of New York, who had been traveling in Europe, also was present. He immediately sent an account of what he had witnessed to the (New York) Medical Record in a letter which was published October 11, 1884. After describing the experiment, Dr. Noyes, who appeared to have been somewhat surprised at the youth of the doctor who had made such an important discovery, went on to say: 'The application of the muriate of cocaine is a discovery of a very young physician, or he is perhaps not yet a physician but is pursuing his studies in Vienna where he also lives. His name is Dr. Koller. The future which this discovery opens up in ophthalmological surgery and medication is obvious. The momentous value of the discovery seems likely to be in eye practice of more significance than has been the discovery of anesthesia by chloroform or ether in general surgery and medicine' (33).

On October 17, 1884, at the meeting of the *K. K. Gesellschaft der Ärzte* in Vienna, my father was finally able to read his own paper. By this time, however, the news had already spread like wildfire (so great had been the need for this remedy), and experiments were under way all over continental Europe, England, and across the Atlantic, wherever doctors were gathered.

The first paper read at Heidelberg started with the assumption of the general medical knowledge of the properties of cocaine. 'It is a well-known fact that the alkaloid cocaine (Erythroxyton coca) makes the mucous membranes of the

throat and mouth anesthetic when brought in contact with it—this led me to investigate the action of this agent upon the eye' (26).

In the second paper he mentioned this again and gave a brief history of the observation of this fact: 'From the foregoing it is evident that cocaine has been instilled in the eye in former years, but those phenomena which will be the subject of my present communication have been overlooked. The internal application of cocaine, tried repeatedly, has always been abandoned again. In 1880 Dr. von Anrep published an elaborate experimental paper on cocaine at the end of which he points out that its local anesthetic action may become of importance. . . . Cocaine was brought into the foreground of discussion for us Viennese physicians by the thorough compilation and interesting therapeutic paper of my colleague at the General Hospital, Dr. Sigmund Freud. Starting from the supposition that a substance paralyzing the sensitive terminations of the mucous membrane of the tongue could not greatly differ in its action on the cornea and conjunctiva, I have made a number of experiments in the laboratory of Professor Stricker' (24).

Since I had never known more than the general outline of this discovery nor inquired beyond this, and since my father was the last man to dwell upon his scientific achievements except when he felt an error must be corrected, I was totally unprepared for what I now found in the literature of that time. The enormous excitement leaped like an electric spark across the arc of more than seventy years. The speed with which the news spread seems incredible when we consider the relatively undeveloped stage of communication.

Articles appeared immediately not only in leading medical journals of Europe, England, and America, such as *The Lancet*, the *Medical Record*, *Semaine médicale*, etc., but also, day after day, in lay newspapers. Events moved so rapidly and so much experimentation had occurred in the few weeks before the second paper was published that the sale of cocaine was immediately affected. To cite but one instance, from the *Medical*

Record (November 22, 1884, p. 578): 'Dr. Squibb of Kings County said that he had received over 300 letters asking for cocaine immediately after the publication of Dr. Noyes' letter in the Medical Record—the price of the drug was formerly \$2.50 per gramme (15 gr.) but is now about \$.50 a grain'.

From all over the world letters poured in. Bundles of them lie about me as I write. They asked my father for fuller information, complained about the rise in price, added their own new-found observations, and congratulated him. Some were from the sick and nearly blind, filled with some last, poor ray of hope, some from lay people, some from doctors, and there was one from a cavalry officer, imploring further information so as to save the sight of his favorite horse.

My father was, of course, aware that local anesthesia had more general implications and was not by any means limited to operations on the eye. 'I had started from the fact that the drug made the *lips* and *tongue* numb,<sup>4</sup> but I limited myself to the eye, wishing to make a contribution to ophthalmology and also wishing to establish a claim to the much-coveted position of an assistant at one of the large eye clinics. I did, however, directly suggest to my friend, Jellinek [assistant to Schrötter in the laryngological clinic], that he make experiments on the nose, pharynx, and larynx. He reported the results at the same meeting of the *Gesellschaft der Ärzte* (October 17) at which I read my [second] paper' (24).

Jellinek speedily demonstrated the success of operations in these areas. He said: 'The experiments I am dealing with here were made after Dr. Koller had told me of his observations in regard to the cornea, and I must offer him my warmest thanks for his help and for leaving the corresponding medical situation (discovery of the usefulness of cocaine in operations on the nose and throat, etc.) to me' (14).

A letter from my father to Dr. W. Oliver Moore, dated November 11, 1884, was subsequently published in the New York Medical Journal in answer to a request for the history of his dis-

<sup>4</sup> Italics added.

covery. After mentioning the fact that the work of Freud had focused his attention on cocaine, it states: 'To convince myself of the wonderful effects of the drug upon the system generally, I took a quantity of the alkaloid, placing it on the tongue, and noticed the benumbing influence (this effect was already known to me through books); the idea occurred to me that the influence of cocaine on the terminal nerves of the conjunctiva and cornea should be the same as on the tongue and, if so, would be of the greatest importance, as we had not such a substance that would produce anesthesia without at the same time cauterizing the tissue'.

'To Dr. Koller, therefore', adds the Journal, 'is due the honor of the discovery and more credit is due him as he arrived at the facts by *reason* and not by accident. . . . Since his announcement of its wonderful anesthetic properties every journal in this and other countries has been filled with enthusiastic accounts of operations not only on the eye but on regions far removed from that organ' (31).

*Le Progrès médicale*, of November 29, 1884, states: 'All medical journals resound at the moment with news of this triumph of healing. It is scarcely two months since Dr. Koller of Vienna published for the first time the happy attribute [of cocaine] as a local anesthetic for the eye—and already publications on the subject are so numerous and the results so uniform that there exists a whole bibliography. . . . As always in such cases one has already taken as reality that which for so long had been only a hope, and one has the thought that cocaine is to be the means of banishing chloroform for operations on the eye'.

Dr. Herman Knapp, one of the foremost ophthalmologists in New York, who in his youth had been assistant to the famous, much-loved surgeon, von Graefe, was to become a lifelong friend of my father. He also followed the events of the discovery with intense interest. Already on October 25, 1884 he had published an article in the *Medical Record* in which he said: 'As soon as I read the remarkable communication by Dr. Henry Noyes [33] I procured specimens [of cocaine] from different

sources, Dr. E. R. Squibb, Bradley W. Foucar, N. Y., Messrs. Eimer & Amend, N. Y., and looked up many books'.

Matters had proceeded with such explosive rapidity—so fast that the sequence of events and even the facts of the discovery had become obscured—that by December Dr. Knapp thought the time had come to summarize them in an orderly account (16).

'No modern remedy', he wrote, 'has been received by the profession with such general enthusiasm, none has been so rapidly popular, and scarcely any one has shown so extensive a field of useful application as cocaine, the local anesthetic recently introduced by Dr. C. Koller of Vienna. Convinced that it will not only continue to prove as valuable as it has hitherto been found, but that its properties will be the subject of numerous scientific researches and clinical observations all over the globe for many years to come, I purpose as far as I am able to collect in the following pages what knowledge has thus far been acquired on this highly interesting and important drug. To help the reader in gathering information is, however, not the only object of this paper. I would like it also to act as a stimulus for new investigations. From this standpoint I consider a faithful, unabridged translation of the original paper which Dr. Koller read before the Medical Society of Vienna and published in the *Wiener Medizinischer Wochenschrift*, October 25, 1884, not only as an acknowledgment of a debt of gratitude we all owe to him, but also as an appropriate introduction to the present article.'

The translation of my father's paper then follows, and Dr. Knapp continues: "Two weeks before the original of Dr. Koller's paper was published in Vienna, physicians were informed of its substance. Merck's muriate of cocaine being in the N. Y. market, they without delay tried the new anesthetic in every direction, finding for themselves a number of important facts before Dr. Koller's other European publications reached them.

"This occurred in the following way: Dr. Henry D. Noyes of New York, traveling in Europe, sent to the Medical Record a

letter published in that journal on October 11, 1884. One of his notes attracted the greatest attention among the oculists of New York and, I dare say, the whole country. It was "The extraordinary anesthetic power which a two percent solution of muriate of cocaine has upon the cornea and conjunctiva when dropped into the eye". The cornea and conjunctiva can be touched and rubbed with a probe, a speculum inserted, the conjunctiva grasped with a pair of fixing forceps, and the eye pulled in different directions, without any unpleasant sensations. "The solution causes no irritation of any kind and its effect disappears in 15 to 30 minutes." Its remarkable anesthetic property was discovered by a young physician, Dr. Carl Koller, *Secundärarzt* (intern) at the General Hospital of Vienna, only a few weeks before its presentation at the Heidelberg Ophthalmological Congress through Dr. Brettauer. Dr. Koller made a few trials with it. These he had been led to make from his knowledge of the entirely similar effect which it has for some years or more been shown to have over the sensibility of the mucous membrane of the mouth, pharynx, and larynx. The substance makes a clear solution and is found in Merck's catalogue.'

The hopes which Freud harbored for cocaine were of such a different nature and so great that when he returned to Vienna to find its use as an anesthetic in surgery the center of medical conversation and excitement, he did not feel at all that he had missed a discovery, but rather that here was more evidence, although only in regard to a side issue, of the potentialities of the drug with which he had become so deeply enamored. Several papers followed his first one, *Über Coca*. Among my father's papers were two of them, inscribed to him by Freud. Across the top of the first one, giving an account of the experiments with the dynamometer in which my father had taken part, Freud had written facetiously, '*Seinem lieben Freunde Coca Koller* [To his dear friend Coca Koller] from Dr. Sigm. Freud'. This paper contains the following paragraph: 'Last July in Heitler's *Centralblatt für Therapie*, there appeared a

study by me of the coca plant and its alkaloid cocaine, which, basically an examination of the information in the literature and my own experiences with it, brought this long-neglected remedy to the attention of the doctors. I may say that the results of this stimulation were unexpectedly quick and complete. While Dr. Königstein undertook at my suggestion to test the pain-deadening and secretion-shrinking effect of cocaine on the *diseased* conditions of the eye, Dr. Carl Koller, my colleague at the hospital, *independently* of my personal suggestion conceived the happy idea of producing a complete anesthetic and analgesia of the cornea and conjunctiva by means of cocaine, *whose anesthetic effect on the sensibility of the mucous membrane had long been known*,<sup>5</sup> and further demonstrated the high practical value of this local anesthetic through animal experimentations and operations on human beings. As a result of Koller's communication in regard to this in this year's Congress of Ophthalmologists at Heidelberg, cocaine has been generally taken up as a local anesthetic' (7).

The other paper was a later reprint of Freud's original paper, *Über Coca*, with a few additional remarks. This paper also bears Freud's inscription across the top, *Seinem lieben Freunde Dr. Carl Koller von Dr. S. Freud*, and it is evident here that his hopes were still high that cocaine could yet achieve for mankind those other great services of which he had dreamed. 'For the local application of cocaine: This use of cocaine has received universal recognition through its application by Koller to the cornea, through the work of Königstein and numerous others, and assures cocaine a lasting value in medicine. It is to be expected that the internal uses of cocaine will lead to equally happy results, although the present high price is a hindrance to further experiment' (9).

Freud in his *Autobiography* in 1925, forty-one years later, gave the following account of his interest in cocaine: 'A side interest, though it was a deep one, had led me in 1884 to obtain from Merck some of what was then the little-known alkaloid

<sup>5</sup> Italics added.

cocaine and to study its physiological action. While I was in the middle of this work, an opportunity arose for making a journey to visit my fiancée, from whom I had been parted for two years. I hastily wound up my investigation of cocaine and contented myself in my book on the subject with prophesying that further uses for it would soon be found. I suggested, however, to my friend Königstein, the ophthalmologist, that he should investigate the question of how far the anesthetizing properties of cocaine were applicable in *diseases* of the eye. When I returned from my holiday I found that not he, but another of my friends, Carl Koller (now in New York), whom I had also spoken to about cocaine, had made the decisive experiments upon animals' eyes and had demonstrated them at the Ophthalmological Congress at Heidelberg. *Koller is therefore rightly regarded as the discoverer of local anesthesia by cocaine, which has become so important in minor surgery;*<sup>6</sup> but I bore my fiancée no grudge for her interruption of my work' (6).

Time plays strange tricks. In this statement, as always, Freud gives credit for this scientific piece of work where it is due, although, as we know, he had not only spoken to my father about cocaine but had also asked him to engage with him in experimentation with it. There is, however, something in the tone of this paragraph which can be accounted for, not by his feelings at the time of the discovery, when he still expected to reach other even greater results with cocaine, but only by his feelings a few years later, when these hopes were gone and only its value in surgery shone on undiminished. His biographer, Dr. Ernest Jones, relates that Freud did not 'hastily' leave for Hamburg, but that this journey to see his sweetheart, from whom he had been separated for one year, had been planned ever since they had parted. Jones, like Bernfeld, points out what I believe I have demonstrated by the literature of the time, that Freud's real interest, which later led to such brilliant achievements, had nothing to do with local anesthesia in surgery; he did not think of it and time would not have changed this fact.

<sup>6</sup> Italics added.

It is not known what 'diseases of the eye' Freud had in mind when he suggested that his friend, Dr. Leopold Königstein, experiment with cocaine. Königstein did so, but no more than the others who had gone before did he grasp the significance of its use as an anesthetic in surgery.

In an article (37) dated October 19, 1934, written to correct various errors in newspaper articles which had appeared in connection with the fiftieth anniversary of the introduction of cocaine as a local anesthetic, my father wrote: 'When Dr. Königstein heard that I declared cocaine a perfect anesthetic for eye operations, he said that I was mistaken, and no wonder. He had tried cocaine in various ways, mostly against inflammations, relying on its vasoconstrictor effects. For instance, he tried to cure trachoma and had used alcoholic solutions, so that it would have been impossible to detect any anesthetic effects because they would have been covered by alcoholic irritation. When Dr. Freud came back in the Fall, as he states in his Autobiography, he found that not Dr. Königstein, whom he had asked to make experiments on the diseased eye, had found anything of value, but another friend of his, Dr. Carl Koller, to whom he had also spoken about cocaine.

'Dr. Königstein regretted very much that he had allowed such an important fact to slip through his fingers, and when I read my paper about cocaine before the *Gesellschaft der Ärzte* October 17, 1884, Dr. Königstein also read a paper [17] from which it appeared that cocaine was an anesthetic, but in which it was not mentioned that I had made the experiments before him. To prevent an unseemly wrangle about priority, Doctors Freud and Julius Wagner von Jauregg made Dr. Königstein insert a letter (*Wiener Medizinische Presse*, Nos. 42 and 43, 1884) to the effect that he conceded the priority of the idea of utilizing the anesthetic properties of cocaine for practical purposes to me. Freud himself has never laid any claim to it. . . .'

Two of the letters remain to tell the story of a type of incident all too common in the history of scientific discovery. Deep as was the contempt for the seeking of publicity in the lay world, rightful priorities were something else and were

sometimes bitterly contested in the scientific world in which they were claimed. One of these letters was to my father from Freud, who was apparently shocked and astonished by the conduct of his friend:

Dear Friend:

I am aghast at the fact that in K's<sup>7</sup> published paper there is no mention of your name; and I don't know how to explain it in view of my knowledge of him in other respects; but I hope you will postpone taking any steps until I have talked to him, and that you will, after that, create a situation in which he can retract.

With kind regards  
Dr. Sigm. Freud

The other letter was from Königstein, very amicable in tone and assenting to the wording of the withdrawal of his claim to priority, a draft of which was enclosed in Freud's letter. His position was, to say the least, not very strong, since his paper was read at the time of my father's second paper, nearly a month after the first communication at Heidelberg. The relationship between Königstein and my father seems to have been perfectly friendly afterward, for I found later notes from Königstein, the first of which complimented him most warmly for his behavior on the occasion of the duel.

Dr. Rossbach, in whose pharmacological laboratory von Anrep had done thorough and original work which was respected and admired by my father, now raised his voice. He had read a review of my father's paper from which he gathered that von Anrep's work had been ignored. My father's answer is given here as a clear, contemporary statement of exactly what he considered his accomplishment to be.

Vienna, December 17, 1884

Honored Editor:

I wish to publish the following explanation, after which the

<sup>7</sup> Leopold Königstein (1850-1924), a friend of Freud, later professor of ophthalmology at the University of Vienna (25, pp. 86-89, ff.).

'Priority Protest' which appeared in the No. 50, 1884, of your estimable paper, will be found to be groundless.

1) Herr Professor Rossbach makes the reproach, on the evidence of a review he read about my report before the *Wiener Gesellschaft der Ärzte* on October 17, in which he missed the mention of v. Anrep, that I seem to be less concerned with the priority of v. Anrep than with my own.

I have, however, as can be seen from the accompanying reprint of the aforementioned communication, given due credit to the contribution of v. Anrep concerning the knowledge of the anesthetizing effect of cocaine, in the following words: 'In the year 1880 Dr. v. Anrep (*Pflügers Archiv. f.d. ges. Phys. 21 Bd.*) published a comprehensive experimental work about cocaine, at the conclusion of which he already pointed out that the local anesthetic effect of cocaine might become of importance'.

I must therefore regret very much that Herr Professor Rossbach did not look at the wording of my article (*Wiener Med. Wochenschrift*, 25 Oct. and 1 Nov.).

2) There can be no question of v. Anrep's priority in regard to the anesthetic effect of cocaine on the mucous membrane, since this was already known to the first researcher about cocaine in Europe, Professor Schroff (Cf. *Ztschr. d. K.K. Fes. der Ärzte in Wien*, 1862), as well as to all those that followed. Concerning this there can be no priority claim in favor of v. Anrep as against a later authority. V. Anrep, to be sure, has made this effect of cocaine the object of a close study.

3) I have never taken credit in regard to the discovery of this useful physiological characteristic of cocaine, although its effect on the cornea was never before attempted. I have only made that step, as Professor Rossbach rightly remarks, to turn well-known or easily deduced effects of cocaine to use in practical medicine, especially in the field of ophthalmology (19).

As time went on some warning murmurs began to be heard in connection with cocaine, which had been taken up with such enthusiasm since the publication of *Über Coca* and since its brilliant success in surgery as a local anesthetic. Already in the October 25, 1884 issue of the *Medical Record* an editorial had

stated: 'As yet we know little or nothing of its possible poisonous effect in large doses. It is to be hoped that no rashness in experimentation will demonstrate them.'

It so happened that in March 1885 in a lecture before the Psychiatric Society, according to Dr. Siegfried Bernfeld (2), Freud had said, referring to the treatment of morphinists: 'I would advise—without hesitation—giving cocaine in subcutaneous injections of 0.03 to 0.05 grms. per dose and not to shrink from an accumulation of doses'.

According to Jones and Bernfeld, his biographers, Freud was to reproach himself bitterly for this statement made in the days of hopeful enthusiasm. For as cocaine came more and more into general use, two or three years after the discovery of local anesthesia, it became apparent that cocaine had not been sufficiently tested in respect of some of its other therapeutic uses, and that addiction and even death had occasionally resulted. The praise and credit that had come to Freud for his fine paper and for having reawakened interest in the drug now turned to attack. He was accused of recommending subcutaneous injections without sufficient research and, in addition to the hue and cry about cocaine, was charged with charlatanism and quackery because of his enthusiasm for Charcot's work. It must have been a bitter experience for a sensitive and brilliant man, trained in the tenets of the Helmholtz school, who judged himself by its stern scientific standards, to find himself condemned as reckless and wanting in these very qualities, all the more since his keen desire to help and heal had led to his difficulties. Interestingly, Bernfeld suggests that this was the reason why Freud never again referred to his lecture on subcutaneous injections. He kept no reprint of its publication in his files, and in all the editions of *The Interpretation of Dreams*, as well as in the *Collected Papers* of 1925 and 1948, he gave 1885 (the date of the lecture) instead of 1884 as the date of his cocaine paper. Whatever his unconscious motivation (as suggested by Jones and Bernfeld), if indeed there was any, this was the only date available to anyone using the above works for reference (2, 15).

Like his friend Freud, who was to fall from the height of his hopes and dreams of establishing himself into years of disappointing struggle, my father was catapulted from the summit of early renown and success into terrible despair. In his case the change came with the utmost rapidity, whereas it was several years before Freud had to acknowledge the withering of his early hopes.

Although my father's name was now on the tongues of doctors all over Europe and America, and the medical publications were full of his discovery, he had in Vienna many enemies as well as friends. He was not only a Jew (in itself a drawback to promotion at the University) but a difficult, tempestuous young man, one who could never be compelled to speak diplomatically even for his own good. His chances of winning the longed-for assistantship in one of the great eye clinics receded further and further while, for all his glory, he stood looking anxiously into the bleak and uncertain future. Then came an incident which very nearly put an end to his young career.

He had served his year of compulsory military training in the Austrian Army in 1876, and I learned from his papers that his rank as a medical officer was First Lieutenant, or *Oberarzt* in the Army Reserve. His sword, rusted in its sheath, was accepted by me as a natural appurtenance to the attic of our brownstone house in New York, and even now the thought of it calls to mind the shelves laden with knickknacks and objects swathed in white covers and the strong odor of camphor. Now as I began to sort through the brown carton, my eye was caught by a bundle labeled '6 January, 1885'. This held letters of congratulation that referred to some event which obviously had nothing to do with the discovery of local anesthesia, but I was not yet familiar enough with German script to have anything but a foggy idea of their content. There were some documents of an imposing official appearance and, to my astonishment, a summons to appear before the Vienna police. Following the trail unsuccessfully through yellowed newspapers—here an

account of the disastrous Ringtheater fire with its terrible loss of life and lists of victims, there reports of the Dreyfus case, which fascinated my father as it did the Western world, and many, many articles on the discovery of cocaine and the experiments that followed it—I came at last upon the answer in a newspaper article of January 7, 1885 in the *Neues Wiener Abendblatt*.

‘(Duel) A few days ago in the General Hospital there occurred an altercation that yesterday led to a duel. The following circumstances led to the happening. The sick brought to the institution come to the Admitting Room on stretchers before they are turned over to the doctors who will take care of them, and it is there decided which will be taken at once and which will be examined later. On this particular day there was in charge of the Admitting Room a young doctor, recently much discussed for his scientific achievement, to whom a man with a very seriously injured finger was brought. The young doctor looked at the injured finger and saw that it was constricted too tightly by a rubber bandage so that the circulation was cut off and that there was immediate danger of gangrene. Among the other interns present in the room was a student of Billroth who asked that the patient be designated for Billroth’s clinic (some of the patients are immediately assigned to the various clinics from the Admitting Room). The doctor in charge of the Admitting Room made a note of this request and then wanted to loosen the dangerous bandage but the other began to object. Without paying any attention to these objections, the first doctor quickly cut the ring bandage from the finger of the patient. At the same time the second doctor hurled an insult at him that sounded like “Impudent Jew”. A resounding box on the ear was the answer to this insult. As a result of this retaliation the second one, insulted by the box on the ear, naturally found himself obligated to send his seconds to his colleague, and the matter finally ended in a sabre duel which took place yesterday. The young doctor who properly did his duty in saving the sick man entrusted to him from imminent danger remained entirely unwounded while the other after a few passes was led away.’

The cold official complaint covered several long pages:

'The intern in the General Hospital and Lieutenant in the Army Reserve, Dr. Carl Koller, became involved in an altercation on January 4 of the current year with Friedrich Zinner, a doctor and also a Lieutenant in the Army Reserve, during the performance of their duties as Admitting Physicians at the General Hospital. In the course of this altercation there occurred an act of insult first by word and eventually by action.

'For this reason Dr. Zinner sent, as his seconds, two doctors, officers of the active Army, to Dr. Koller to notify him of the challenge. The challenge was accepted.

'It was agreed to use "Spadones", i.e., honed foils with very thin and light blades. It was further agreed that the fight would go on until one or the other party should be unable to defend himself. There were going to be no bandages and the seconds were not to interfere, i.e., the seconds should not participate in the duel and not fence off certain thrusts as is sometimes customary.

'The duel took place on January 6 at the Cavalry Barracks at Josefstadt.

'The two defendants had, for the duration of the fight, taken off their coats and were dressed only in their shirts as far as the upper parts of their bodies were concerned. All in all there were three thrusts (or rounds); during the third, Dr. Zinner was wounded on his head and the right upper arm. He was immediately bandaged and taken to the General Hospital.'

Then follows a description of the wounds, the head wound being severe.

'According to the expert testimony of the medical examiners, the foils used during the duel are able to produce the wounds described if the foils should be used with a considerable expenditure of strength to strike somebody's head and might well result in a deadly wound.

'Considering this expert testimony and also considering that Dr. Zinner actually received a severe wound on his head, the foils used during the duel must be considered deadly weapons.

'While the defendant Carl Koller refused to answer the ques-

tions of the District Attorney, Dr. Friedrich Zinner has described the beginning and the events of the duel as mentioned above. He declares that he felt constrained to make this challenge because otherwise he would have forfeited his officer's rank as *Oberarzt* (Lieutenant) of the Army Reserve.'

Behind this duel, which was not the customary affair in which upper-class German students were wont to indulge, lay a long history of anti-Semitism, of small and large humiliations, and age-old hate. The box on the ear delivered by a hotheaded young man seemed to express for his Jewish colleagues their long-suppressed bitterness and resentment. Like a cry of relief, like the release of a long-held breath, letters poured in congratulating my father and rejoicing that one of their number had at last held up his head and answered his attackers like a man. Freud's letter<sup>8</sup> to his fiancée Martha Bernays, while the duel was in progress, expresses some of these feelings.

Vienna, Thursday, 6 January, 1885<sup>9</sup>

My precious Darling:

In the confusion of the past few days I haven't found a moment's peace to write you. The hospital is in an uproar. You will hear at once what it is all about.

On Sunday Koller was on duty at the Journal, the man who made cocaine so famous and with whom I have recently become more intimate. He had a difference of opinion about some minor technical matter with the man who acts as surgeon for Billroth's clinic, and the latter suddenly called Koller a 'Jewish Swine'. Now you must try to imagine the kind of atmosphere we live in here, the general bitterness—in short, we would all have reacted just as Koller did: by hitting the man in the face. The man rushed off, denounced Koller to the director, who, however, called him down thoroughly and categorically took Koller's side. This was a great relief to us all. But since they

<sup>8</sup> In: *Letters of Sigmund Freud*. Selected and edited by Ernst L. Freud. Trans. by Tania and James Stern. New York: Basic Books, Inc., 1960. Letter No. 55, pp. 131-132. Reprinted by permission of Ernst L. Freud and Basic Books, Inc.

<sup>9</sup> Notes: See p. 349.

are both reserve officers, he is obliged to challenge Koller to a duel and at this very moment they are fighting with sabres under rather severe conditions. Lustgarten and Bettelheim (the regimental surgeon) are Koller's seconds.

I am too upset to write any more now, but I won't send this letter off until I can tell you the result of the duel. So much could be said about all this.

Your pleasure over the little presents made me very happy; surely Minna wouldn't think that I would confine her to a calendar! The Eliot [a] is for her, I have reminded them again. As for the money, my little woman, you keep it; Minna has a claim to part of the previous sum; it will be a long time before either of you get more.

Paneth has given me six bottles of very good wine, some of which will go to my family, but some will be drunk by myself and others here in my room. One bottle has gone off today to Koller to fortify him for the fight. I am considering a reckless purchase. For the forty-two florins' interest from Paneth I am going to buy myself a decent silver watch with a chronograph in the back; it has the value of a scientific instrument, and my old wreck of a thing never keeps proper time. Without a watch I am really not a civilized person. These watches cost forty florins.—I am too impatient to go on writing.

So far my neuralgia injections are working very well; the trouble is I have very few cases. Yesterday I went to see Prof. Weinlechner [b] and Standhartner [c], who gave me permission to use the treatment on all cases of this kind in their department. I hope to learn more soon about the value of the procedure.

I must go now and see if they are back.

All is well, my little woman. Our friend is quite unharmed and his opponent got two deep gashes. We are all delighted, a proud day for us. We are going to give Koller a present as a lasting reminder of his victory.

Farewell, my sweetheart, and write again soon to

Your Sigmund

<sup>9</sup> Notes: a. Book by George Eliot.

b. Dr. Joseph Weinlechner, professor of surgery at the University.

c. Dr. Josef Standhartner, professor at the University of Vienna.

In the packet of congratulatory letters was one from Freud to my father, written later on the same day.

Vienna, 6 January, 1885

Dear Friend:

I have missed spending the evening with you. After the vehement excitement of the last days I felt the need to unburden my heart to two of the dearest people, Breuer and his wife. You may guess what we were talking about, and what Breuer's comment was. It would give me great pleasure if you would accept my offer to use the intimate term *du* as an external sign of my sincere friendship, sympathy, and willingness to help. I hope that the shadows which seem to threaten your life at present will soon vanish and that you will always be what you have been in these last weeks and days, a benefactor to mankind and the pride of your friends.

Your Sigm. Freud.

Only from then on did the letters use this intimate *du*—those were indeed formal times. The only other facts I have since been able to unearth are that my father was pardoned (the pardon was among his papers), that he had never had the slightest experience in dueling, and had managed to take just one hasty lesson, and that his seconds were his friends, Dr. Lustgarten and Dr. Bettelheim, the regimental surgeon. No doubt he never wished to recall the anguish of those days. A box on the ear may very well be a reflex action, but a duel in which the object is to injure or be injured is quite another thing. What thoughts must have filled his mind for those forty-eight hours before the duel? How terrible it must have been not only to dread his own maiming or death but the almost equally horrible alternative, to injure another. What a conflict there must have been in the soul of a physician who, if he is worth his salt, dedicates his whole soul to cherish and fight for life, not to destroy it.

The events of the next few months are unknown to me. Perhaps this duel crystallized the difficulties which, because he

was a Jew, hampered his career. One thing is certain; during this time it became apparent that any hopes of promotion in the University, of which the hospital was a part, were quite vain. An article written in 1899 gives one a sense of how unfavorable the situation was. It appeared in a small Viennese periodical in answer to an inquiry as to the whereabouts of Dr. Carl Koller and was entitled University Negligence!

'Dr. Koller is at the moment one of the busiest ophthalmologists of New York. After completing his studies he was for some time intern at the clinic of Professor Weinlechner and settled an affair in which he was involved in the course of his service in a manner as praiseworthy as it was gallant—so that Professor Weinlechner commended Dr. Koller in his reference when he left, most warmly, not only as a doctor but as a man. Dr. Koller, whose first love had always been optics and its science, discovered in his private research, as you correctly brought out, the beneficial effects of cocaine, which was of inestimable value in eye surgery. Cocaine made a triumphal tour through the entire world—Koller, however, was not even able to get so much as an assistant's position in Vienna. Along with the lack of protection that you mention, there was a characteristic of Dr. Koller's that also played a part; namely, Dr. Koller was stiff-necked (stubborn), and a stiff neck paired with real strength of character amidst conditions as you described them hardly served as an impetus to the furthering of a career.' The article continued to describe how my father's good friend, Dr. Lustgarten, also was forced to leave Vienna because of some difficulties with the director of the General Hospital. 'Both Dr. Koller and Dr. Lustgarten rank in New York as the finest examples of the Viennese school. Creditable as it may be for the latter to be so worthily represented abroad, it must nevertheless be deeply deplored that matters at home should be so ordered that two outstanding doctors in succession must be numbered amongst those who do not count in their own fatherland' (5).

There is a feeling in some of the letters that the period of

scientific awakening in Vienna is over and that the orange has been squeezed dry. This disenchantment was reflected not only in Freud's letters, but also in those of Lustgarten, Widder, and others.

So the story went—much fine linen paper covered with helpful suggestions, but the alternatives were hard. It was a bitter experience for my father to find that even with a notable achievement to his credit all doors at home were shut in his face and, even in foreign lands, the outlook was none too hopeful. His good friend Le Plat, assistant to another lifelong friend, Professor Ernst Fuchs, wrote warning him away from Paris—for the competition was also keen there and feeling was growing against foreign students coming in to usurp the scarce positions which the French considered rightfully theirs.

Ill and in a pitiable state of hopelessness, my father existed through the days until he was pardoned. It was at some time during this period that he literally saw the handwriting on the wall and finally resolved to leave Vienna forever. As he was walking moodily through its streets one day he saw scrawled upon the side of a house these jeering words: *'Die Religion ist uns einerlei / In der Rasse liegt die Schweinerei'*.<sup>10</sup> Up to that moment, he later said, he had felt that anti-Semitism was largely a matter of religious belief, and this was something he considered at least within the scope of comprehension and might still be endured. But these words, written by an unknown hand, illuminated like a flash of lightning the nature of the enemy and a hate with which it was impossible to come to terms. It is because of this revelation that I am sitting here in my garden in the sunshine of this blessed land, and that he was privileged to show his gratitude like so many, by stretching out a saving hand to others when the bestial unreason had come to full growth under Hitler some fifty years later. From Teplitz my father went to study at Göttingen and other seats of learning in Germany and France. Meanwhile, from time to time he corresponded with his friend Freud who, if we judge by his let-

<sup>10</sup> 'It is not the religious belief that matters to us/ the swinishness lies in the race itself.'

ters, tried in every way to encourage and guide him through his illness and uncertainty.

Vienna, 7 July, 1885<sup>11</sup>

Dear Friend:

I am writing to you in the midst of the vexation and misery of a morning in the Admitting Office, and I am full of the disgust which one acquires in this house [a]. I spoke with Königstein yesterday who told me about a conversation with Mauthner [b] that was very funny. He asked M whether he might lecture in his department, because M's appointment can be taken for certain. Upon that M: 'I don't dream of turning my clinic into a *Judenschul* [c]. No assistant of mine should be a Jew. I won't have any Jewish second assistants either. The Jews don't know anything, they don't understand anything, they should leave this altogether alone. If I take a Jewish assistant and say something to him some day when I am in a bad mood, he will up and leave, whereas a Gentile would have seen to it that everything is smoothed out again', etc., etc.

This was naturally said without any reference to you. You may also deduce from this what can be booked as M's tendency to bluster and to his mischievousness—without malice—but you will retain sufficient reasons to form an unfavorable judgment of your own prospects.

That you should come home now does not seem very sensible to me. You get into bad situations too easily in Vienna and you have not anything to come back for. Stay away as long as you can. Even if you don't accomplish much there, it is still more than you would do here. And when you are ready, go confidently to America. You will be pleased with this advice.

I did not write you because I did not know what to write. I had run out of ideas and there was nothing better to do than to let the world take its course. Now I still don't know why you never gave me news of yourself for, of course, I am here at your service.

<sup>11</sup> Notes: a. General Hospital.

b. Ludwig Mauthner (1840-1894), first, professor at Innsbruck and then chief of ophthalmology at the *Wiener allgemeine Poliklinik*. He was of Jewish descent.

c. Derogatory expression for synagogue.

My traveling plans are to go from here to Hamburg on September 1st and to Paris on October 1st. Couldn't we meet? There is a slight chance that I might accompany Fleischl [d] to St. Gilgen [e].

I send you my warmest greetings and wait to hear from you.

Your

Dr. Sigm. Freud

Vienna, 14 August, 1885<sup>12</sup>

Dear Friend:

What could you possibly wish to do during these months other than to recuperate like everyone else in beautiful country, good air, and to ride, to climb mountains, and to do anything that will help you to get well?

By the middle of September you could really go to the *Naturforscher Versammlung* [a] in Strassburg. In the first place you are sufficiently human to enjoy the attention you will attract, and secondly there may be a market in which someone would buy you. If you cannot find a post quickly you may have to return to Berlin. I don't know of any better place if you don't want to go to America straight away. You know very well that as long as you have not transformed yourself thoroughly you dare not hope to get on better than before in Vienna. They will forgive you your bluntness but not your irritability.

If you stay in Teplitz I hope to meet you on September 1st (details to follow) at the station of Aussig. But you will have to ride with me for several stops if we hope to get anything out of it.

You will be glad to hear that Rosanes [b] almost certainly has been appointed Surgical Director of a new hospital in Neulerchenfeld [c]. We are so surprised that we can scarcely grasp the good news and only fear that in the 8 days before the final decision something may interfere.

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d. Ernst von Fleischl-Marxow, teacher and friend of Freud, ill at the time.

e. On the lake of St. Wolfgang in the Austrian Alps.

<sup>12</sup> Notes: a. International Meeting of Natural Scientists.

b. I. Rosanes, Chief Physician of the Erzherzogin Stefanspital, intimate friend of Freud and Koller.

c. Wilhelminen Spital in an outer district of Vienna.

Time is heavy on my hands, another 16 days, and what miserable times; my thoughts are somewhere else, I feel physically unwell, even pains, and intellectual bankruptcy, this I hope only temporarily. You will have to put up with someone complaining to you. It is too depressing if only you do the complaining. I send you my heartiest greetings and look forward to hearing from you soon.

Your Dr. Sigm. Freud

My father went to that medical meeting in Strassburg, and I believe it was there that he was 'bought in the market', as Freud put it, and became assistant at the *Nederlandsche Gasthuis voor Ooglijder* in Utrecht, presided over by the renowned physiologist, Donders, and his equally famous son-in-law, Snellen, the ophthalmologist. There he worked from 1885 until 1887, busy, fruitful years in the field he loved with associates and superiors whom he could respect and admire. Among his close friends was Professor Willem Einthoven, a man whose genius was combined with the most noble, loving spirit. Years later, when my father introduced his old friend from Utrecht to a meeting in this country, he described how Professor Donders had selected young Einthoven for the chair of Physiology in Leyden when he was only twenty-one or twenty-two and not yet through with his medical examinations, and how Einthoven accepted this immense honor, his heart heavy with conscientious doubts.

A few more letters from Freud help to outline the little I know of the years until my father left the Old World for the New.

Paris, 1 January, 1886<sup>13</sup>

Dear Friend:

I was sitting lonely in my room and translated Charcot, and then pondered over the problems of nerve pathology, but now in spite of the late hour I shall drink to your health and to the success of your work. It is now about a year since I first knew

<sup>13</sup> Notes: See p. 356.

that you were somebody worth while. For the great discoveries are always made by great discoverers. But after our last meeting, I had, as you rightly guessed, given you up, such a pitiful impression did you make upon me. Well, I don't understand it and am not giving out that I understand it, but I rejoice wholeheartedly that matters are going well with you. It cannot all be the result of your improved circumstances, there must also be something spontaneous besides, isn't that so? You will have to give me some credit, little use as I was to you (if I could have been of use, you would have heard from me). Wasn't it my advice that you should look around for a position and, with this in mind, of course, visit the *Naturforscher Versammlung*? Concede this small merit to me, just as with cocaine. I can be all the more happy about it then.

Of your discoveries I understand little, but what I do impresses me immensely. Now that Snellen [a] and Donders [b] confirm your opinions, my own point of view can be a matter of indifference to you, but I have always given you credit for the ability to 'take lots of pains' and being able to start a subject all over again.

The '*travailler sans raisonner*' belongs to me and not Lustgarten. I found it in Voltaire and had my Martha embroider it for me as a wall plaque. This priority I will not concede. As we are in the midst of complaints and reproaches, let me express my irritation that you wanted to take revenge upon Reuss [c] without including me. Haven't I always shared everything with you loyally? This frivolous tone is best suited to our present situation. I really should prefer not to predict in earnest, since I do not understand anything about your illness. If you are in a traveling mood, why not undertake a short visit to Paris? If anyone at all, Charcot will be able to give you advice. He is an extraordinary man of unbiased ingenuity and rich experience.

You shall only hear from me when you write. I shall be here

<sup>13</sup> Notes: a. Herman Snellen (1834-1908). Dutch ophthalmologist. Koller was his assistant in Utrecht, 1885-1887.

b. Frans Cornelis Donders (1818-1889). Dutch ophthalmologist and physiologist. Introduced use of prismatic and cylindrical lenses for glasses. Associated with his son-in-law, Professor Snellen.

c. Professor M. von Reuss, Director of the eye clinic of the General Hospital, who permitted Koller to test cocaine upon the diseased eye in the first weeks of the discovery.

for another two months: Rue le Goff, Hôtel Brésil. Keep on writing to me without expecting too much. In my soul there slumbers a project—to look up Dr. Metzger in Amsterdam—if he is worth it and will accept me. Do you know anything about him?

If you should sink into low spirits again—I really think you are cyclic—I do believe that your improved mental efficiency as well as your improved situation will protect you from the low miseries of the last two months. But perhaps you have conquered it for a long period. With warmest greetings I thank you for the pleasure you have thought to give me with your letters.

Happy New Year  
Your faithful friend  
Sigm. Freud

Vienna, 13 October, 1886<sup>14</sup>

Dear Friend:

With the greatest pleasure I see from your letter what a warm interest you take in me, and I conclude further that a gratifying change has taken place in you since I saw you last at the peak of your illness which, now that I am riper in experience, I can with certainty diagnose as neurasthenia.

I hope to hear more of you immediately, not about sufferings overcome but about present efforts and achievements, and for this reason I yield to the temptation of giving you news exclusively about myself. As a bridegroom one is spoiled for a while into assuming that one is interesting and lovable to others. You are right in thinking that Paris meant the beginning of a new existence for me. I found Charcot there, a teacher such as I had always imagined. I learned to observe clinically as much as I am able to and I brought back with me a lot of information. I only committed the folly of not having enough money to last for more than five months.

On the way back from Paris (to pass over a four-week stay in Berlin which I really spent translating Charcot's new lectures) I settled here rather desperately in rented rooms with service while my small fortune dwindled away rapidly. However, it went better with me than I expected. I shall not analyze

<sup>14</sup> Notes: See p. 358.

whether this was due to Breuer's help, or to Charcot's name, or because I was a novelty. In three and a half months I earned 1100 fl. and said to myself that I could marry if matters continued to improve. A set of circumstances then hastened my marriage; the fact that I could not keep my rooms any longer, my call up to Olmütz for a tour of military duty from August 10th to September 10th, certain family matters, etc.—in short I went from my discharge to Wandsbek [a] and on September 14th was at last granted my long-cherished wish. Then after a short stay on the Baltic I traveled with interruptions to Vienna; arrived here on September 29th and by October 4th we were already able to announce the start of the practice. My little wife, helped by her dowry and wedding presents, has created a charming home which, however, looks too modest for the noble and splendid rooms of Master Schmidt [b].

Only one thing is not going at all in accordance with our wishes; namely, my practice. It is a new beginning and a much more difficult one than the first. But perhaps we shall experience something better soon.

You will see from the reprints mailed at the same time that I have remained loyal to brain anatomy and have entered into close relations with the Russian [c] whom you brought to my attention. I don't work at home, however, and thank you therefore very much for the microtome you mean to send me. If you want to give me something I need urgently, let it be a perimeter [d], since as a clinician I depend more than anything else on the study of hysteria and one cannot publish anything nowadays without a perimeter.

Now in our next letter we shall leave the person of the undersigned to one side and hear what Dr. Koller is doing.

My wife sends her warmest greetings.

Your Sigm. Freud

<sup>14</sup> Notes: a. Wandsbek near Hamburg, where Freud's fiancée lived.

b. Stadtbaumeister F. V. Schmidt, the architect of the Sühnhaus, built on the site of the burned-down Ringtheater, in which Freud's first flat was located.

c. Liverii Osipovich Darkshevich (1858-1925), Russian neurologist with whom Freud was acquainted and whom he met again in Paris. They published a neurohistological paper (15, p. 205).

d. An instrument for measuring the field of vision.

Vienna, 1 January, 1887<sup>15</sup>

Dear Friend:

After a long wait to see whether your beautiful but silent present would be followed by a letter, I am using New Year's Day to thank you very much and to tell you how much pleasure the perimeter (just the thing I wanted) [a] gave me, as well as the charming picture you gave to my little wife. I shall tell you further in short what there is to say about us; namely, very little. Quiet happiness, as far as social life allows, unsatisfactory wretched practice, continued research in brain anatomy and in the clinical study of hysteria, without a trace of help from the higher-ups. Let's hope that I shall come through in both respects, practice and research, without the aid of these higher-ups. You know how matters stand in Vienna. There is nothing but good news to report of our friends. Lustgarten increases in scientific quality and social status—but that he should put on great airs and become more and more blasé is not what I would wish for him; Rosanes is just as distinguished but shows more sense of humor; Schnabel ridicules them both. Breuer's children are growing up charmingly; he himself is as always much harassed, open to every new idea, kind, and high-minded.

Soon you will get a trifle [b] from me, a lecture I gave to the *Gesellschaft der Ärzte* [c]. I thank you for your last paper which I naturally did not understand when I tried to read it. However, I am happy to think what clinical schooling and association with men of good will must have made of you. Otherwise, all I know about you is that you are planning to change Utrecht for Paris for the sake of cuisine (?), and I do not think you would overstep your duty if you would follow up your last amiable but altruistic letter with a more subjective one.

*Prosit* New Year and best wishes from my wife.

Your Dr. Sigm. Freud

<sup>15</sup> Notes: a. Parenthetic phrase written in English in the original.

b. *Beobachtungen einer hochgradigen Hemianästhesie bei einem hysterischen Manne*. (Observations of a Pronounced Hemianesthesia in an Hysterical Male.) *Wiener Mediz. Wochenschrift*, XXXVI, 1886.

c. Medical Association.

In March 1887 there was a fleeting visit to Vienna, and from his friends Lustgarten, Rosanes, Widder, and Freud came notes arranging for a reunion at the latter's house. The next letter in the series was dated six months later and seems to be an answer, and a decided one, to my father's request for advice on a future plan.

Vienna, 13 September, 1887

Dear Friend:

You were so kind as to ask for my opinion in regard to a new project for your future. I am flattered but I am giving this to you filled with the sense of the difficulty of offering advice on the question where you should set up practice. Brünn seems an unfortunate idea—a sow's nest, snobbish Jews, the leaders of whom troop to Mauthner and will continue to troop there for a long time to come; and an anti-Semitic gentile population; no intellectual life and all the gossip of a proper provincial town; an ophthalmologist, Plenk, who I believe is in charge of a ward at the hospital, and beside him a colleague in your own specialty, R. A. Schmeichler; conditions as unfavorable as possible to be associated with; just as Widder's predecessor Ignatz Kohn told me. Kohn to be sure is no honeytongue to get along with, but you are not either.

The whole idea does not appeal to me at all and does not seem to be worthy of further investigation. In order to succeed you need the many facets of a big city and its opportunities. If you are in a provincial town and could not get on with a handful of people, you might just as well pack up and leave. Better not go there at all. Your name and your capabilities entitle you to live in a big place. Go to Paris or London and don't get discouraged if at the start there is a slack period in your career. You would also succeed in Holland if you stayed there. Believe me, the choice of place is not important unless you chose one like Brünn where every chance of a future is cut off. I don't know if you have any other reason for being dissatisfied. If you want to stay in Holland, marry a Dutch girl. By the way, tomorrow is my wedding anniversary. I have never regretted it. Matters will never be right with you until you have your own wife and home.

My wife is awaiting her accouchement in 3-5 weeks. I send you my warmest greeting and hope to hear from you soon.

Your faithful

Sigm. Freud

Still undecided about his future, my father nevertheless left Holland and spent several months in London. It was not easy to make the final decision to leave the Old World, and the compass needle wavered before it set the course. For a brief moment he toyed with the idea of sailing as a ship's doctor to Borneo, since distant lands, the wilderness, and its animal life had always attracted him. A letter written to me in 1940, when he was eighty-two, shows that even shortly before he sailed he was still uncertain.

It was 1904. We were at Geneva and M and I went swimming every morning at the Île de Rousseau, where the Rhone issues from Lake Geneva. That place was the most beautiful blue-green water in the whole world. Afterward we went to the Riffelhorn above Zermatt where you have the Matterhorn before you so that you can grasp it. Amongst the guests was also Professor Michel, one of the major lights of ophthalmology, one of those not very numerous, upper-class, affected Germans. He walked with an affected hysterical limp.

This was my second meeting with Michel. My first was in 1888 when I was about to go to America. It was in Würzburg, where there was before Hitler one of the best German universities. I called on Kölliker, who was the first anatomist and embryologist of Germany and all over. He was 70 then and just packing up to go *auf die Gamsen Jagd*. He asked me what I was doing and I answered that I was going to America to practice ophthalmology. He was very much astonished and said, '*Ich habe geglaubt, dass Sie Professor der Embryologie in Wien sind* [I thought you were Professor of Embryology in Vienna]'. Then hearing of my perplexities, he said, '*Gehen Sie nicht nach Amerika, ich werde Ihnen eine Assistent-Stelle beim Michel verschaffen, dann ist Ihre Laufbahn gesichert* [Don't go to America, I will get you an assistantship to Michel, and then your career is assured]'. He sent me to Michel's clinic to get ac-

quainted with him. I went and stayed two days and then returned to Kölliker and told him that I did not like Michel. In retrospect I am touched by the kindness and gentleness of that great man. And so I went to London, stayed three or four months, mostly in the company of Eric Nordenson, and then into the wilderness out of which America was just emerging.

In the end, however, it was a friend in England, Dr. Arthur Ewing, who finally persuaded him to choose America, and in May 1888 he set sail for New York on the S. S. Saale, a ship still equipped with sails.

Separated by an ocean that in those days was very wide, and by time and divergent careers, the correspondence between Freud and my father dwindled. Some time in 1895 a sharp exchange of letters took place over a ridiculous, imagined slight to a female relative of Freud to whom my parents had offered help and hospitality. I think the correspondence stopped at this point. In 1926, however, on one of his trips to Europe my father called upon Freud in Vienna but, alas, he was away at the time and those two old colleagues were never to see each other again.

The next years in the new land were very busy ones: marriage, a family, and establishing the practice which became very large and consumed all his energies.

My father learned to love dearly this new land to which he came—the city of New York, that Baghdad-on-the-Subway with its small O. Henryish, daily adventures; the trout streams of Montana and Colorado (he was an expert dry-fly fisherman); the Western mountain ranges with their aquamarine glacial lakes into which, to my astonishment, he loved to plunge; the virgin forests of Maine where we used to summer. ‘Mt. Katahdin is without exception the most beautiful mountain that I have ever seen’, he wrote, ‘violet in color, sharply defined in the clear Maine air. Did you ever read the description of it by Thoreau?’

Back of the little inn in the wilderness which we reached by buckboard over bumpy corduroy roads flowed a swift, clear stream over sand and yellow pebbles. I can still see my father instructing my brother in mathematics, a shotgun leaning

against the window lest some ducks come winging up that Lazy Tom River.

Of course when he came to this country his work was very well known, but after 1884 he wrote little more on the subject of cocaine. Experimentation had proceeded, as I have already shown, with such speed and in so many directions that the sequence of events was lost sight of. My father was not aware of this until about thirty-five years had elapsed, when more and more frequently misstatements began to appear, almost entirely in the lay press and often coupled with the work of his old friend, Sigmund Freud. Though he had no wish to see his name before the public, my father was surprised on such occasions to see it omitted from the mention of his work, or to have that work so often incorrectly described. It was bewildering to him, I think, to have the facts which had been so widely known and documented in a veritable deluge of print when they occurred, misrepresented so often as the years went by. It is for this reason that I am trying to offer the small slice of truth which it is my privilege to possess. Small as that slice is, it is borne in upon me how difficult it is to know the truth and, when it is known, to impart the knowledge of it, so that one must be amazed that so much in the world is correctly known rather than that there are so many mistakes. I hope my father is right in what he taught us, that what is false is out of harmony with things as they are and must at last be discovered. *'Die Sonne kommt doch an den Tag.'*<sup>16</sup>

In 1934 in a letter (to which I have previously referred) to his old friend, Dr. Chauncey Leake, who had requested some further information for a meeting in which my father's work was to be honored, my father wrote: 'At the time of my first publication there was no doubt, nor could there be any, that this was the first step in local anesthesia, and a flood of publications in the medical and public press of the world at that time shows it clearly and is accessible of proof. Not only had I asked my friend Jellinek to use the anesthetic in the larynx and nose but,

<sup>16</sup> Nothing can keep the sun from rising.

in consequence of the first publication, it was quickly taken up by many others in different fields. In surgery it was first successfully tried by Professor Anton Woelfler, at that time assistant to the famous surgeon Billroth, and only subsequently taken up and developed as Infiltration Anesthesia by Schleich. The historical sequence which was quite clear in the beginning was lost sight of and blurred in the great flood of publications that followed; and so it was said in some of them that I had adapted the use of the new anesthetic to its use in ophthalmology, and in others no mention of my name was made at all, etc.'

This state of affairs was further underlined by a letter which my father received in 1939 from his old friend and colleague, Dr. Carl Hamburger, in which he speaks with admiration of Dr. August Bier, one of the foremost surgeons of Berlin, who himself had done important work with anesthesia and, undaunted by the Nazi anti-Semitic philosophy, had dared to speak out about the scientific contributions of Jewish doctors.

'Bier', said Dr. Hamburger, 'occupied himself with medical history and with philosophy and in the beginning of 1938 published a book (3) wherein, speaking of historical errors in general and anesthesia in particular, he remarked:

"Let us see how reliable this particular history is. I select as an instructive example the different opinions which exist about it [anesthesia]. To whom does credit belong for the so valuable practical use of local anesthesia in surgery? Listen as follows to the naked truth that anyone can easily verify. A workable local anesthesia has been known only since 1884 (Koller, Heidelberg, 1884). Only after Koller was this discovery used on all other mucous membranes. It was understandable that general surgery also made use of this glorious remedy." Then follows a detailed account of the discovery as already related elsewhere in this paper. "These are the historic facts. What, however, does the contemporary history of medicine or even general opinion make of these obvious facts? Let them show me one book of the history of medicine in which the service to medicine of Dr. Koller is worthily pointed out in accordance with its im-

portance. In vain one searches for him under his name in *Der Grosse Brockhaus*.

“Who of the general public knows anything of the discoverer of local anesthesia, Koller, and his follower (in general surgery), the modest Braun? The former has even among doctors been completely forgotten.”

‘It is very important to be able to point out’, Dr. Hamburger commented, ‘that even in the seventh year of the Nazi regime, the foremost surgeon of Germany wrote: “None other than the (Jewish) Doctor Koller has contributed the immense service of local anesthesia. What followed were only modifications.”’

Silence had settled down over my father’s name in Europe, it is true, and for long years he did not notice or pay any attention to the fact. Every now and then, however, it came to men’s minds that there was still living in their midst a man who had made an enormous impact on medicine.

He had been voted an honorary member of the American Physiological and Pharmacological Society, the *Gesellschaft der Ärzte* in Vienna, the *Accademia Reale Medica di Roma*, Italy, and the Society of Physicians, Budapest, Hungary. At a Congress in Oxford before he sailed to America, my father had met the ophthalmologist, Dr. Lucien Howe, who, among other important accomplishments, founded a research laboratory for ophthalmological work at Harvard in 1926. He had been present at what Mrs. Howe had called ‘that historic meeting in Vienna’. It was due to the efforts of Dr. Howe that the gold medal of the American Ophthalmological Society was created and the first one presented to my father in 1922.

In 1927 a scroll of recognition was presented to him by the International Anesthesia Society. In 1928 the University of Heidelberg, as a result of agitation by doctors and professors such as Ludwig Cohn, Axenfeld, and others who were disturbed by the lack of recognition, and upon the initiative of his old friend, Professor Fabritius, presented to him the Kussmaul medal in commemoration of the discovery which was first announced in that city.

In January 1930 a gold medal of honor, the first of its kind to be given by the New York Academy of Medicine, was presented to him. In 1934 the American Academy of Ophthalmology and Otolaryngology presented him with another gold medal of honor on the occasion of the fiftieth anniversary of his discovery.

Thus, fifty years after his discovery, unsought recognition came in a sort of awakening from all over the world. Letters and telegrams poured in from all sides, and it seemed as though this would finally reestablish the facts in men's minds. A long article which was a tribute to this discovery (13) revealed to me some hitherto unknown facts. It described how my father was allowed to depart from Vienna, having tangled, I gather, with some to me unknown professor or professors at the University. 'Shamefacedly one must admit that Koller has been shown the greatest ingratitude. *Er wurde totgeschwiegen.*'<sup>17</sup>

In November 1934 there appeared a long article, the reprint of a paper by Professor J. Meller (assistant to my father's lifelong friend, Ernst Fuchs), in honor of my father's discovery (30). It was in the shadow of the approaching storm, with his old enemies no doubt enfeebled or dead, that Vienna at last honored his work.

In 1934, also, my father wrote to me:

If you look back of the scenes you see more than from in front. I got a letter from Nordenson (Sweden), who Mother says is the best-looking man she ever met, in which he tells me that he asked Wagenmann, the President of The Heidelberg Ophthalmological Society, to publish a *Festschrift* with my *Vorläufige Mitteilung* [preliminary communication]. But Wagenmann, who is a good friend of mine, had to say it was too late now. Nordenson is naïve or he would have known that the Nazis would not like it. But Wagenmann promised and kept his promise to mention the anniversary in his *Eröffnungsrede* [opening speech]. The next best thing Nordenson could do was to ask Arnold Knapp [the son of Herman Knapp, who first translated my father's paper] to reprint the communication in

<sup>17</sup> He was done to death by a conspiracy of silence.

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the issue of the Archives of Ophthalmology, which he did as he had no need to fear the Nazis (37).

Before me lie the letters of Nordenson and Wagenmann and the proceedings of the meeting at Heidelberg—an amazing document. Dr. Wagenmann, who had begun his career at Göttingen under the ophthalmologist, Thomas Leber (another old friend whose letters, too, were here), had indeed mentioned the discovery in an extraordinary paper at an extraordinary time. From a historical point of view I think it is interesting.

The chairman, Professor Wagenmann, opened the fiftieth meeting of the German Ophthalmological Society with a ringing endorsement of Hitler. But under a bower of flowery prose it became apparent that he had had to bow to government pressure and promise that the constitution of the Society would be changed so that any chairman or delegate must be confirmed by the Ministry of the Interior. And he added that the government's recent emphasis on the study of race hygiene and hereditary diseases must give a new direction to the society's scientific research, which in its particular field must concern itself with hereditary blindness and malformations. Then proceeding to recount the history of the Ophthalmological Society studded with glorious scientific names—Helmholtz, Arlt, Leber, von Graefe, Donders, Axenfeld, and many others—he abandoned his political double talk, described the true ideals of the Society, and dedicated the remainder of his paper to honoring the Jewish doctor.

'Our society was the first scientific society dedicated to the therapy of the eye, and the first one in Germany dedicated to one branch of medicine. . . . Today we must think gratefully of one other scientific feat that took place fifty years ago at the sixteenth meeting of our society here in Heidelberg. At the first session on September 15, 1884, there was announced for the first time Koller's Preliminary Communication on local anesthesia of the eye. The fact, already known, that the alkaloid rendered the mucous membrane of the mouth and throat numb,

suggested to Koller, at that time in Vienna, that he should test its effect on the eye. . . . Koller, through the introduction of cocaine in the field of ophthalmology, became the discoverer of local anesthesia. We can be proud that the very important fact of local anesthesia grew out of ophthalmology, and that it was here in Heidelberg that the first communication, which was to be of the greatest significance to ophthalmology, took place. The ophthalmologists today no longer can conceive what a blessed effect the introduction of cocaine had for doctors as well as patients. Through this, Koller became the benefactor of mankind, and we all have reason to think of him with gratitude and to give expression to our sincere appreciation. Koller became a member of this society in 1888 and has always been true to it' (36).

My father had indeed been privileged to live in an age of medical awakening almost like a renaissance, to be a discoverer, and to build a life in a new land, highly respected and honored. His long life was spent in the busy and demanding practice of ophthalmology; but he never allowed himself to be closed in by the narrow walls of surgery or of specialization, for he still practiced in the old tradition of the whole man.

But I have always felt that in his heart there was a certain sadness, a feeling that in a way he had missed his calling. His was the mind of a research scientist, and his daring intuitive knowledge and thorough education equipped him for such a career. But pure research is well-nigh impossible for a devoted practicing physician; each way of life is a completely absorbing and jealous mistress. I have always thought that he regretted not having used to best advantage those special gifts with which he was endowed.

My father's mind was unusually clear and incisive until the day he died. I cannot think of any subject within the realm of human knowledge that did not interest him: physics, geography, mountain climbing, astronomy (he once went to Europe primarily to see the first planetarium at Jena), polar expeditions, history, and travel. He dreamed of Tibet, Spitzbergen,

Tanganyika, and Alaska until the very end of his life, 'but where do I get the time from, and eighty in seven weeks?', and so on and on.

His taste in literature was discriminating and elastic. He read constantly on every imaginable subject, poetry and prose, much of it in French, for that language had always attracted him. His humor could be delightful, whimsical, ironic, or sarcastic with a terrible bite as it fastened on its mark. His choice of words was colorful and had the poet's descriptive precision. The work of which he was proudest and which gave him his most undiluted pleasure was not the discovery of local anesthesia in surgery, but his fundamental research, when he was twenty-two, upon the mesoderm of the chick. I think that his outstanding characteristic, the one which is most often spoken of by those who knew him, was his integrity. Sham and pretense were intolerable to him.

In his obituary in the Archives of Ophthalmology, Dr. S. Bloom wrote: 'He was not a calm person, nor had he ever any hesitation about expressing criticism of himself or others if he discovered error. Like all scientifically minded people he despised insincerity in medical practice and often jibed at it. To all with whom he came in contact he was a stimulating personality, always speculating about the unknown and unsolved problems in all lines of endeavor. Friends, colleagues, and patients sensed in him a real person, true, reliable, fearless . . .' (4).

Over my desk hangs his favorite quotation from Ecclesiastes (IX, 11-12) which my father had typed. I think its broad sweep solaced him—for individual sadness is lost here in the common fate of mankind. It is the old man's submission to that fate which the young man had found so terrible.

'I returned and saw under the sun, that the race is not to the swift nor the battle to the strong, neither yet bread to the wise nor yet riches to men of understanding, nor yet favor to men of skill; but time and chance happeneth to them all.'

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