In all, over 10,500 inoculations have been made. Many of the patients slept through the inoculation, and knew nothing of it until the next day.

The reactions were classed as follows:

Mild: An area of hyperemia from 5 to 7 cm. in diameter with or without edema and a feeling of soreness in the arm.

Moderate: Marked hyperemia and edema extending to the elbow; pains in the arm and general lassitude.

Severe: Marked hyperemia and edema, chills, pains in back and legs, patient confined to bed.

TABLE 2.—REACTIONS

Dose.	Mild.	Moderate.	Severe.
1	3,498	1	1
2	3,480	18	2
3	3,455	40	5

Table 2 includes the 898 cases previously reported under the headings "none" and "mild."

Agglutination tests were carried on in the manner described in the former paper.¹

Blood taken from 2,500 patients before inoculation failed in every case to cause agglutination at a dilution of 1:250.

Blood taken ten days after the last inoculation of 2,500 cases, including the 898 cases previously reported, gave the following results: positive at 1:250, 100 per cent.; positive at 1:500, 98.2 per cent.; positive at 1:1,000, 97.6 per cent.; positive at 1:10,000, 91 per cent. of the 1,500 cases tested.

The duration of the immunity is unknown. It is now three and one half years since the first inoculations were made. One case of typhoid fever developed three months after inoculation. It is not my intention to reinoculate any patients unless typhoid makes its appearance among the immunized.

SPINAL ANESTHESIA

ANALYSIS OF TWO HUNDRED AND EIGHTY CASES

L. L. STANLEY, M.D.

Resident Physician, California State Prison

SAN QUENTIN, CALIF.

In the 280 cases in which spinal anesthesia has been used on the inmates at the San Quentin prison, tropacocain has been the agent employed. In ordinary operations, excepting those in which the abdominal viscera are handled, no hypnotic is given the patient before the operation. The patient walks to the operating room, mounts on the table, and is ordered to lie on his left side. The back from the fourth dorsal vertebra to the coccyx is painted over with official tincture of iodine. This is allowed to remain on the skin for a few minutes and is then removed with alcohol. The patient is directed to bring his knees as near to the chin as possible, producing a curved outline to the back. A sterile sheet with an aperture 6 inches in diameter is now placed over the patient so that the hole is near the site of the spinal puncture. A platinum needle of 12 mm. diameter and about 10 cm. long is used for the spinal puncture. The needle is inserted between the second and third, or third and fourth lumbar vertebrae. As soon as the canal is entered, the obturator of the needle is withdrawn and the fluid flows out. Immediately a Luer syringe is attached to the needle, and 25 minims of the cerebrospinal fluid are withdrawn. The syringe is detached

from the spinal needle, and by means of a shorter needle the fluid thus collected is used as a solvent for the tropacocain, which is put up in sterile ampules of 1½ grains' dosage. While the attendant is dissolving the tropacocain in the cerebrospinal fluid, the operator collects from 15 to 25 minims of the fluid for purposes of Wassermann examination. This having been done, a manometer is attached to the spinal needle and the spinal pressure determined. The manometer used is merely a piece of fine bored glass tubing with an elbow arranged so that the tubing extends at right angles upward from the spinal needle. The manometer is graduated, and the pressure is determined by the height to which the fluid ascends in the glass tubing.

The tropacocain having been dissolved in the fluid, the syringe is again attached to the spinal needle. In order to prevent any air entering the spinal canal, it is our custom to pull the piston out slightly before finally injecting the medicated solution. Since excluding the air in this way, the number of headaches following operation have been greatly reduced. The solution is injected slowly and the needle is quickly removed. The patient is then ordered to lie on his back. He is then placed in a Trendelenburg position at about 10 to 12 degrees from the horizontal. The head, however, is raised above the shoulders so that although the medi-

Curve of relative amount of rise or fall in blood pressure at end of operation: readings to left of zero, lowered after operation; to right, raised.

cated fluid may gravitate toward the first dorsal vertebra, it will not well ascend toward the vicinity of the bulb.

Within one minute the patient feels that his feet are becoming warm, and he may even feel a tingling sensation in his toes. Within two minutes, sensation is lost about the anus, and as a rule within about four minutes there is such a loss of sensation that operations for hernia may be done without pain. For operations above the umbilicus it is our custom to allow the patient to stay in the Trendelenburg position for six or seven minutes, for apparently it takes this long for the tropacocain to gravitate cephalad to bathe the nerves which supply these segments. For operations about the anus, the average Trendelenburg position has been 1½ minutes, for operations on varicose veins 2½ minutes, for operations on the scrotum 2½ minutes, for hernia, 3½ minutes, and for gastroenterostomy, 4½ minutes.

Tropacocain hydrochlorid in doses of 1½ grains is carefully weighed and put in thoroughly cleaned and dried homeopathic vials, long size. By means of a Bunsen burner the top is then fused so that the drug is sealed in an air tight ampule. These ampules are then sterilized either by boiling or by live steam in an

autoclave. Tropicocain is not injured by heat in this manner, and will keep indefinitely without deterioration or loss of anesthetic properties.

During every operation one attendant is assigned to watch the patient, and keep a record of his actions during the proceedings. All phenomena are carefully recorded chronologically, and remarks regarding the attitude of the patient are set down. In this series of cases the same man has done the recording so that there has been no variation, as would be expected had several operators kept the records.

The following is an illustration of a written operation record:

P., No. 28977, man, age 31, weight 147, logger.

INGUINAL HERNIA, DOUBLE

Jan. 12, 12:15 p. m. Blood pressure: 110, systolic; 80, diastolic.
12:16 p. m. Pulse rate, 72.
1:39 p. m. Anesthetic administered, tropacocain 1½ grains, 2-3 lumbar.
1:39 p. m. Head lowered; Trendelenburg position.
1:42 p. m. Head raised; operation begun.
1:43 p. m. Pulse rate, 126; could not move feet.
1:48 p. m. Pulse rate, 96.
1:52 p. m. Blood pressure: 130, systolic; 76, diastolic.
1:54 p. m. Pulse rate, 90.
2:00 p. m. Pulse rate, 84.
2:05 p. m. Blood pressure: 112, systolic; 80, diastolic.
2:06 p. m. Pulse rate, 90.
2:11 p. m. Pulse rate, 90.
2:12 p. m. Blood pressure: 124, systolic; 80, diastolic.
2:16 p. m. Pulse rate, 90.
2:23 p. m. Pulse rate, 80; operation ended. Blood pressure: 124, systolic; 80, diastolic.
3:35 p. m. Felt first pain and could move feet.
7:15 p. m. Blood pressure: 108, systolic; 80, diastolic.
Jan. 20, 7:15 p. m. Blood pressure: 128, systolic; 84, diastolic.

Remarks: Pupils not changed; complexion unchanged; puncture made patient recumbent left side; cord transplanted; pressure (spinal) 15 cm. Left table in good condition. No pain.

This work was done with the assistance of two former assistant resident physicians, Dr. F. Stolle and Dr. S. H. Marks, and with the present assistant resident physician, Dr. J. P. Crawford.

The accompanying table is a summary of all the operations. It is self-explanatory.

In the plotted curve of the relative amount of rise or fall in blood pressure at the end of operation, the base line is the amount of blood pressure, and the abscissa the number of cases. The readings were taken each time with a Tycos sphygmomanometer. It is seen from the chart that the maximum fall in blood pressure was 88, whereas the maximum rise was 38 mm.

In none of these cases, however, was the blood pressure so low that it was necessary to take measures toward increasing it. Although the pressure was low, the patient did not show any signs of collapse.

As to pulse rate, it is found that the rate increases as soon as the spinal puncture is made, but after a few minutes returns to the normal beat. This increase is probably due to the fact that the patient is somewhat excited when brought to the operating room. The psychical effect of seeing the operating room attendants and feeling the prick of the spinal needle is sufficient to cause this quickening. From the data it seems that the spinal anesthesia itself has very little if any influence on the pulse.

It is extremely difficult to determine the length of anesthesia because the statements of the patients are not reliable, and it was impossible to determine by means other than their statements regarding this matter. For the purpose of creating sympathy, there is no doubt that some of the patients complained of pain really before it was felt. Only a few, however, complained while they were on the operating table, and it was only necessary in four or five cases of the series in which the operation was over an hour and a half to administer a few whiffs of chloroform or ether to quiet the patient. As near as could be determined, the average length of anesthesia was one hour and fifteen minutes.

Only 8 per cent. complained of headaches. To many surgeons, headache has been the deterring factor for using spinal anesthesia. Some assert that headache is so severe that they will not subject their patients to it. By excluding all air from the spinal canal, however, as shown before, there is very little danger of headache.

Only 18 per cent. had to be catheterized, of which over half were in operations about the anus, in which catheterization is usually expected.

In very few cases after operation has there been any vomiting. It is an extremely rare after-effect. In ordinary cases, such as hernias, varicose veins and other operations in which the intestinal tract is not

SUMMARY OF OPERATIONS

	Operations on Feet	Varicose Veins	Various Operations on Legs	Fistula in Ano	Hemorrhoids	Operation on Scrotum	Hernia	Appendectomy	Gastro-Enterotomy	Totals
Cases, number	15	23	18	29	59	30	61	32	13	280
Fall in blood pressure, number	7	22	11	19	31	19	56	25	9	199, 71.1%
Rise in blood pressure, number	5	0	4	3	14	3	2	1	2	34, 12.1%
No change in blood pressure, number	1	1	2	7	13	5	1	3	1	34, 12.1%
No data on blood pressure, number	2	0	1	0	1	3	2	3	1	13, 4.7%
Maximum fall in blood pressure, mm.	60	46	50	50	42	54	88	68	48	88
Minimum fall in blood pressure, mm.	2	8	2	4	4	6	6	2	16	2
Average fall in blood pressure, mm.	27	23	9	9	5	13	22	21	15	15
Maximum rise in blood pressure, mm.	19	0	8	36	38	16	20	20	10	38
Minimum rise in blood pressure, mm.	2	0	6	4	6	5	10	20	10	2
Average blood pressure	125	116	117	114	115	115	119	118	118	117
Average spinal pressure	14	11.5	14	17	12.5	18	14.5	16	14	14.2
Average length of operation, minutes	33	26	18	18	15	17	35	50	77	28
Average length of anesthesia, minutes	33	61	70	63	75	70	74	107	?	75
Average age, years	39	42	36	31	38	32	30	31	33	34
Average weight, pounds	159	146	159	161	176	162	170	155	159	160
Headaches	2	8	0	0	7	1	3	2	1	24, 8%
Catheterized	2	0	3	4	27	0	4	12	4	52, 18%
Average Trendelenburg position, minutes	3.5	2.5	2.8	1.7	1.7	2.4	3.1	3.2	4.2	2.5

involved, the patients are allowed to eat as soon as they return from the operating room. No ill results have followed. The food is usually relished. By the early taking of nourishment in this way, shock is reduced and the patient's convalescence is shortened.

The preparation is the same as that usually given for the inhalent anesthetics. No hypnotic is given except as previously noted above.

In only two cases out of a possible 400 has it been found impossible to produce spinal anesthesia. One patient was a woman, aged 90, suffering from hemorrhoids. She was deaf, and it was impossible to instruct her to the best position she should attain. Several attempts were made to enter the spinal canal, but the vertebrae were so ankylosed that it was impossible. In another case, a Mexican, aged 25, was stabbed through the abdominal wall into the stomach so that his recently ingested stomach contents were voided through the opening. He was brought to the hospital thirty minutes after the affray, but was in a condition of shock, and his blood pressure was very low. The puncture was made, and 10 minims of cerebrospinal fluid removed. No more could be withdrawn. On account of the small amount of fluid, it was thought well not to administer the anesthetic. In several other cases it has been found necessary after a delay of ten minutes to make another puncture and inject more of the tropacocain. The failure of the first injection was probably due to the fact that the needle may have been accidentally pulled from out the canal and the tropacocain infiltrated around the dura instead of in the canal. Invariably after the second injection the anesthesia has been satisfactorily produced.

CONCLUSIONS

1. In this series of 280 cases there has been no fatality.
2. There has been comparatively little shock.
3. There has been only 8 per cent. headaches.
4. There has been no pneumonia following operation.
5. There have been very few postoperative complications.
6. There have been no permanent paralyses following the anesthetic.
7. The period of convalescence has been shortened.
8. With the relaxed muscles, closing of the abdomen is greatly facilitated.
9. The blood pressure has fallen in most cases, but in the average case not to a dangerous degree.
10. The height to which the anesthetic is effective is influenced by the length of time the patient is in the Trendelenburg position.
11. The pulse rate is not influenced to any marked degree by tropacocain intraspinally.

Quicksilver.—According to *Commerce Reports*, the domestic output of quicksilver in 1915 was estimated to be 20,681 flasks of 75 pounds each, valued at \$1,700,000. The figures for 1914 were 16,548 flasks valued at about \$800,000. There was an increase of 4,133 flasks and in value more than double. The estimated output of California in 1915 was 13,916 flasks. The European war directly affected the industry by greatly increasing the demand for the metal in the manufacture of fulminate for explosives and also by reducing the customary imports from foreign countries. The exports from the United States for the calendar year 1915 were about 3,300 flasks.

TWO CASES OF INFECTION WITH STRONGYLOIDES STERCORALIS

F. L. WACHENHEIM, M.D.

AND

E. P. BERNSTEIN, M.D.

NEW YORK

Strongyloides stercoralis (*Anguillula stercoralis*) is an exceedingly common intestinal parasite in the tropics of both hemispheres, and not rare in certain subtropical regions. Its great rarity north of Mason and Dixon's line justifies the reporting of the following two cases:

CASE 1.—Rosé Z., aged 6 years, native of the United States, of Italian parentage, gave a history of restlessness at night, grating of the teeth, and vague abdominal pains for a considerable period. The abdominal discomfort could not be accounted for by errors of diet or any physical finding. Moreover, the child seemed listless and anemic. Hookworm was suspected and the feces were examined, with the resultant finding of strongyloides in enormous numbers. A differential blood count showed 11 per cent. eosinophils.

CASE 2.—Mary Z., sister of Case 1, aged 9 years, native of the United States, had been suffering for some time from similar abdominal pains with some diarrhea. Because of the above mentioned findings, a similar examination was made, which showed the same parasite and 17 per cent. eosinophils.

After thorough treatment with thymol, the worms disappeared in both cases, and after three weeks the eosinophilia had fallen to 5 and 6 per cent., respectively. Another sister and the mother were likewise examined for parasites, with negative results. The source of infection in our two cases remains obscure, as the children have always lived in the city of New York, where this parasite is not native. There remains the possibility of paternal infection or derivation from some infected native of Italy. As in the case of hookworm, the invasion usually takes place through the skin.

The life cycle of this parasite is of considerable interest, and bears a close relationship to the various names which have been given it by a number of writers who have described its sexually different forms as distinct species. Thus the embryos (rhabditic form) were called *Rhabditis stercoralis*, *Rhabdonema strongyloides* and *Rhabdonema intestinale*, while the mature parasite was classified as *Anguillula stercoralis*.

The mother worm, the *Anguillula intestinalis*, deposits its eggs in the intestinal tract, where the rhabditic forms develop. The eggs themselves are seldom found in the feces, while the embryo is usually present in great numbers. In the foregoing cases we were unable to find a single egg after prolonged search. The embryo is not to be seen macroscopically, being but 0.2 mm. in length; microscopically it is seen to be actively motile, with a cylindric body tapering at both ends.

On keeping the stool at room temperature, the embryos increase considerably in size, reaching adult form (1 mm.) and sexual differentiation. They have remained alive in the stools in both cases for over two weeks.

These parasites are the etiologic factors in the disease known as "Cochin-China diarrhea," and while common in China, the West Indies and Italy, and not very uncommon in Germany, they are comparatively rare in the United States. Very few cases have been reported here, and most of these could be traced to a foreign country as the source of importation.

111 West Eighty-Fifth Street—64 West Eighty-Third Street.