

THE TREATMENT OF SYPHILIS OF THE CENTRAL NERVOUS SYSTEM

A COMPARISON OF MERCURIALIZED SERUM AND SALVARSANIZED SERUM *

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Cases of syphilis with positive findings in the spinal fluid treated during a period of three years following the opening of the Peter Bent Brigham Hospital may be divided into three groups. The patients of one group were treated with salvarsan, mercury and potassium iodid for a sufficiently long time to determine whether or not clinical and laboratory improvement would follow. If there was definite improvement, no change was made in the therapy. If improvement did not follow after a reasonable length of time, they were shifted into a second group the members of which received in addition to the above, salvarsanized serum intraspinally. In a third group were placed those patients having negative blood Wassermann reactions, and to them salvarsanized serum alone was given. Seventy-five patients were treated under this plan, and to them 450 intraspinal injections of salvarsanized serum were given in addition to the intravenous salvarsan and other medication. A detailed report of this work has appeared in a recent publication.¹

At the end of this time, having satisfied ourselves concerning the relative efficiency of these different modes of treatment and the results to be derived from each, we decided to discontinue the use of salvarsanized serum and to substitute for it mercurialized serum prepared by the method suggested by Byrnes.² The very obvious advantages of the mercurialized serum are, first, no previous treatment is necessary in its preparation, so where salvarsan is not needed, inconvenience and expense are avoided; second, the serum can be obtained at any time convenient for the patient and the physician rather than on the exact minute, as is the case with the salvarsanized serum; third, a large supply can be made up at one time and the individual

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1. Walker, I. C., and Haller, D. A.: The Treatment of Syphilis of the Central Nervous System with Intravenous Salvarsan Alone, with Intravenous Salvarsan and Intraspinal Salvarsanized Serum Together, and with Intraspinal Salvarsanized Serum Alone, *THE ARCHIVES INT. MED.*, 1916, **18**, 376.

2. Byrnes, C. M.: *Jour. Am. Med. Assn.*, 1914, **63**, 2182.

doses can be used as needed over a period of several weeks, thus saving an enormous amount of labor and time. We were further influenced in trying this method ourselves, as we believed that a comparison of cases treated by the same workers using different methods would be of more value than a comparison of results obtained by different men, because of the uniformity of technic used in the various tests, particularly the Wassermann reactions, and because of a constant personal equation in judging results obtained. It was possible also to use the mercurialized serum in the treatment of patients who had already received several doses of salvarsanized serum, and in this way form an opinion concerning the degree of reaction caused by the two serums in the same group of patients.

The present paper consists of a description of the preparation of mercurialized serum as used in the cases here reported, and of a tabulation of the results obtained from its use in forty-five patients to whom 150 doses were given, with a comparison of these results and those obtained in previous cases with salvarsanized serum. To facilitate comparison, the cases reported here will be numbered in sequence with those previously reported.

Technic.—In the preparation of mercurialized serum, blood is withdrawn from a vein and allowed to clot. The expressed serum is centrifuged in order to free it from cells. The serum is then pipetted into glass tubes in 8 c.c. amounts, and to each tube is added 0.001 gm. of mercuric chlorid in a 0.1 per cent. aqueous solution. The fluid is agitated for a few moments in order to insure a thorough mixing. The white ring of precipitated albuminate of mercury quickly redissolves in the excess of serum, giving a perfectly clear solution. The tubes are plugged and the serum inactivated for thirty minutes at 56 C. They are then stored away on ice until needed, when they are warmed to body temperature and the serum is administered.

The amount of serum used has seemed to be of relatively little importance, although excessive amounts probably add to the immediate reaction. From 6 to 8 c.c. has been the amount used in most of the doses given in this series, for the reason that about that amount of spinal fluid is usually withdrawn for cell count, globulin and Wassermann tests. The dose of mercuric chlorid has been varied from 0.0005 to 0.002 gm. The degree of immediate reaction is not perceptibly changed by increasing the amount to 0.001 gm., but an increase above this figure has seemed to add materially to the discomfort of the patient. The length of time during which the serum was heated to 56 C. has been varied from twenty minutes to two hours without apparently affecting the degree of reaction. The age of the serum does not perceptibly add to its irritating properties. Several doses kept on ice for eight weeks and more were followed by less disturbance than many which were administered within twenty-four hours after preparation.

The reactions in a given patient following the intraspinal administration of irritating drugs, whether salvarsanized serum or serum to which either mercury or salvarsan has been added, are of the same type and vary only in degree. Headache, slight fever, nausea and general malaise are to be expected, and these symptoms do occur in a moderate number of cases. Severe lightning pains follow treatment

in many cases. They are more apt to occur in patients who have previously been troubled with them; many patients who have had no pains for months or even years, often have them recur after treatment. This immediate reaction ordinarily passes off within twelve to twenty-four hours. In about 10 per cent. of individuals it will last longer, and occasionally, but not often, will necessitate two or three days' stay in the hospital after treatment, and several doses of morphin. In our series of cases severe reactions of this kind have been more than three times as frequent after mercurialized serum than after salvarsanized serum. Two patients have, on the day following treatment with mercurialized serum, developed a stiff neck and positive Kernig sign, with a temperature reaching 102 F. This condition did not persist in either case longer than twenty-four hours and there were no sequelae. Subsequent treatments given to these patients have caused no great disturbance. Occasionally intraspinal treatment with either salvarsanized serum or mercurialized serum will precipitate a gastric crisis in a tabetic patient subject to these attacks. In one instance an attack thus begun lasted for a week. Two patients, on the other hand, who were treated during attacks, have had the attack promptly terminate. This has been repeated on several subsequent occasions with one of these patients. The other has never had a recurrence. Temporary increase in tabetic symptoms, ataxia, difficulty in urination, incontinence and paresthesias may occur in the first two or three days following treatment with either serum, and rarely these symptoms last for a week or two. Only one patient has been greatly troubled, and this trouble was lessened by lengthening the interval between treatments. A patient whose case was diagnosed as general paresis, who had had a complete hemiplegia ten years before, with partial recovery, suffered a sudden and complete paralysis of the same side again following his fifth intraspinal treatment with salvarsanized serum. This confined him to bed for seven weeks. At the present time he walks better and uses his hand and arm as well, if not better, than he did before any treatment. This has been our most alarming experience in a total of 600 intraspinal treatments. It seems fair to say that the immediate reaction following either salvarsanized serum or mercurialized serum is one which can be regulated by dosage. We believe that the reaction following 0.001 of mercuric chlorid in 8 c.c. of normal serum is, as a rule, much more severe than that caused by 20 c.c. of undiluted salvarsanized serum. The unusual complications which occur may follow either, but it is reasonable to assume that they are more apt to occur where the irritation is greatest. In the administration of 150 doses of mercurialized serum we have had about as many of them occur as in 450 treatments with salvarsanized serum. Eleven patients have been treated with at least three doses of each kind of serum. In every case

the reaction has been noticeably more severe following the administration of mercurialized serum.

The dosage and frequency of treatment with mercurialized serum depend altogether on the individual features of each case, just as they do with salvarsanized serum. Certain fairly definite rules can, however, be followed. The first dose with every case should be half strength. Later, when the spinal fluid Wassermann reaction is positive only with large amounts of fluid, treatments should be given at greater intervals. Cases of general paresis, active meningitis and cerebrospinal syphilis stand treatment much better than cases of tabes do. In this group of cases the dose each time can be a maximum one and a minimum interval of time between treatments can be safely

TABLE 1.—TO SHOW THE IMMEDIATE EFFECT OF AN IRRITANT ON THE SPINAL FLUID CELL COUNT

Case No.	Date of 1st Lumbar Puncture	Cells per C.mm.	Date of First Treatment	Cells per C.mm.	Date of Second Treatment	Cells per C.mm.	Date of Third Treatment	Cells per C.mm.
Mercurialized Serum								
94	4/14/16	142	5/22/16	140	5/26/16	300*	.....	...
91	6/17/16	34	6/21/16	30	6/27/16	62	.....	...
81	9/ 2/16	156	9/10/16	145	9/16/16	410*	.....	...
79	.....	...	9/ 5/16	291	9/ 9/16	187	9/11/16	300*
82	.....	...	9/ 4/16	175	9/ 8/16	100	9/12/16	180
100	9/15/16	8	9/18/16	8	10/ 2/16	74	.....	...
101	9/27/16	56	9/29/16	50	10/ 4/16	84	.....	...
Salvarsanized Serum								
27	10/28/14	100	11/ 4/14	37	11/11/14	165	.....	...
24	8/21/14	3	1/27/15	3	2/ 2/15	87	.....	...
64	10/11/15	37	10/17/15	35	10/28/15	64	.....	...
62	.....	...	1/ 7/15	11	1/12/15	123	1/19/15	216*

* Few red cells also present.

allowed. Several patients with meningitis and cerebrospinal syphilis have been given two treatments intraspinally each week for two or three weeks without severe reactions in any case. Two patients with tabes now under treatment cannot stand the administration of intraspinal serum more often than once in three months.

The immediate effect of either serum on the spinal fluid cell count often is to cause an increase in cells. The cell count then falls during the next few days to a point below the previous count. Occasionally, after a severe reaction, the count goes up considerably and red cells appear in the fluid. This is found much more commonly after the use of mercurialized serum than after salvarsanized serum (see Table 1).

A comparison of the efficacy of the two serums in relieving symptoms and in causing objective changes in signs and in the laboratory findings, offers more difficulties than are encountered in a comparison of the reactions from treatment, for while the individual susceptibility to reaction from intraspinal treatment varies, the amount of treatment needed to accomplish the same result in two different cases with the same diagnosis varies to a still greater degree. Evidently, then, the only fair comparison is a comparison of the general averages in fairly large groups of cases. We have attempted this in several ways which can be best understood by a study of the accompanying tables.

In Table 2 there are thirty patients who received a total of 104 doses of salvarsanized serum in addition to intravenous salvarsan. By subtracting the last cell count from the first listed in each case the total drop in cells for that case is found. The total fall for the 30 cases divided by the total number of doses given shows the fall in cells per dose. This fall in the group treated with salvarsanized serum averaged 14 per treatment. The 15 patients listed in Table 3 received a total of 55 doses of mercurialized serum, and here the average drop in cells per treatment calculated in the same way was 27, or twice that obtained in those patients treated with salvarsanized serum.

In the same way by subtracting the amount of spinal fluid necessary for complete fixation before any treatment, from that necessary after three or four doses of salvarsan and intraspinal serum, the change in the Wassermann reaction in cubic centimeters induced by treatment is found. In the cases of Table 2 this averaged 0.04 c.c. per treatment. The average in the second group treated with mercurialized serum was 0.08 c.c., or again twice as great an average change as that induced by salvarsanized serum. In the last column of this table remarks are found which bear on the clinical changes. The comparison here is somewhat in favor of the salvarsanized serum, as all the patients in Table 2 showed indications of improvement, or at least of remission of symptoms. Two patients treated with salvarsan and mercurialized serum showed no change. One of these was a case of general paralysis, the other was a case of *tabes dorsalis* with gastric crises.

Twenty-seven patients have been treated by the intraspinal route alone. Of these, seventeen were given salvarsanized serum and ten mercurialized serum. The findings in the spinal fluid with the changes resulting from the first three or four treatments are tabulated in Table 4.

The average drop in cell count per treatment in those patients given salvarsanized serum was twenty-one, while the average in those given mercurialized serum was twenty-six, or practically the same figure (Tables 4 and 5). The average change in the strength of the Wasser-

Case No.	Cell Count	Salvar., Gm.	Serum, C.c.	Cell Count	Salvar., Gm.	Serum, C.c.	Cell Count	Salvar., Gm.	Serum, C.c.	Cell Count	Change in Wassermann Reaction in C.c.	Remarks
39	128	0.3	20	38	0.4	18	25	0.4	20	19	0.5 + to 0.8+*	Pain and ataxia less
21	166	0.3	20	11	0.4	20	16	0.4	20	..	0.05+ to 0.1+	Headache and paresthesia relieved
11	145	0.3	14	90	0.4	22	30	0.5	18	10	0.05+ to 0.2+	Headache, aphasia and diplopia relieved
15	108	0.4	16	..	0.4	18	..	0.5	20	21	None	Incontinence and ataxia less
17	90	0.4	14	47	0.5	20	13	0.5	20	15	0.2 + to 0.3+	Pain relieved; ataxia less
18	84	0.4	20	40	0.4	20	16	0.4	23	10	0.2 + to 0.3+	Mentally improved
36	86	0.4	20	63	0.5.	20	40	0.6	20	30	0.2 + to 0.3+	Pain relieved
29	87	0.3	18	86	0.6	18	15	0.4	25	11	0.1 + to 0.2+	Ataxia and paresthesia relieved
1	35	0.4	18	7	0.5	20	2	0.6	16	1	None	Incontinence relieved
6	32	0.3	20	30	0.4	20	20	0.5	18	10	0.2 + to 0.3+	Pain relieved
45	14	0.6	16	5	0.6	18	4	0.5	25	..	1.0 + to 1.0—	Paresthesia relieved
48	37	0.2	18	16	0.4	20	25	0.6	18	8	0.2 + to 0.5+	All symptoms relieved
44	33	0.5	20	21	0.5	22	30	0.4	20	20	None	All symptoms except ataxia relieved
41	45	0.3	20	17	0.6	25	..	0.6	26	7	0.3 + to 0.6+	Tremor relieved; mentally improved
43	40	0.3	18	33	0.4	22	15	0.4	26	10	0.1 + to 0.2+	Gastric symptoms relieved
13	43	0.5	20	13	0.6	20	10	0.6	10	5	0.05+ to 0.2+	Pain, headache and dizziness relieved
20	57	0.6	18	16	0.5	20	16	0.5	22	7	0.3 + to 0.4+	Pain and vomiting relieved
10	47	0.6	16	55	0.6	18	28	0.5	20	16	0.2 + to 0.4+	Ataxia relieved
14	35	0.4	20	26	0.5	20	20	0.5	20	16	0.1 + to 0.2+	Pain and vomiting relieved
19	18	0.4	16	9	0.5	18	5	0.4	20	5	None	Pain and dizziness relieved
8	63	0.4	18	34	0.5	20	9	0.6	18	5	0.3 + to 0.4+	Headache and dizziness relieved
9	25	0.4	20	20	0.5	22	8	0.5	20	7	0.3 + to 0.4+	Pain relieved
5	26	0.4	20	9	0.6	20	10	0.6	18	9	0.2 + to 0.3+	Pain relieved
16	16	0.3	18	10	0.5	20	3	0.4	16	3	None	Pain and dizziness relieved
65	36	0.3	20	29	0.5	25	6	0.6	20	4	0.1 + to 0.8+	Diplopia relieved; mentally improved
47	21	0.3	20	7	0.4	25	3	0.4	26	1	0.2 + to 0.3+	Pain relieved
40	18	0.3	18	11	0.5	20	16	0.4	28	15	0.2 + to 0.5+	Ataxia lessened
64	64	0.4	23	30	0.4	20	9	..	20	..	0.5 + to 0.6+	Pain relieved
51	39	..	16	32	0.3	21	20	0.4	22	9	0.4 + to 0.6+	Pain relieved
74	16	0.6	18	5	0.6	15	2	..	..	..	0.2 + to 0.4+	Pain relieved

* Throughout this paper + means "complete fixation."

TABLE 3.—To Show the Effect of Three or Four Doses of Intravenous Salvarsan and Intraspinal Mercurialized Serum on the Cell Count, the Wassermann Reaction, and the Clinical Symptoms

Case No.	Cell Count	Salvar., Gm.	Mer- cury, Gm.	Cell Count	Salvar., Gm.	Mer- cury, Gm.	Cell Count	Salvar., Gm.	Mer- cury, Gm.	Cell Count	Salvar., Gm.	Mer- cury, Gm.	Cell Count	Change in Wassermann Reaction in C.c.	Remarks
75	15	0.3	0.001	27	0.4	0.001	7	0.4	0.001	4	None			None	All symptoms relieved
76	60	0.4	0.001	32	0.9 neo	0.001	10	0.9 neo	0.001	6	0.6	0.001	7	0.1+ to 0.2+	Pain relieved; ataxia lessened
77	60	0.3	0.001	25	0.4	0.001	6	0.4	0.001	23	0.4	0.001	16	0.2+ to 0.8+	Pain and dizziness relieved
78	520	0.3	0.001	201	0.6	0.001	107	0.6	0.001	94	0.6	0.001	15	0.6+ to 0.8+	All symptoms relieved
79	291	0.4	0.001	187	0.6	0.001	300	0.6	0.001	114	0.6	0.001	74	0.2+ to 1.0+	Aphasia gone; vomiting stopped
80	44	0.3	0.001	15	0.4	0.001	2	0.4	0.001	2	0.4	0.001	..	0.1+ to 0.2+	Less pain
81	156	0.4	0.001	410	0.4	0.001	142	0.4	0.001	73	0.4	0.001	42	None	Headaches relieved
82	175	0.6	0.001	100	0.6	0.001	118	0.6	0.001	56	0.6	0.001	45	None	Great mental improvement
83	52	0.4	0.001	30	0.6	0.001	11	0.6	0.001	5	0.6	.....	..	0.2+ to 0.6+	Less pain; no vomiting
84	66	0.4	0.001	40	0.4	0.001	41	0.4	0.001	20	0.4	0.001	20	0.1+ to 0.5+	Headache and vomiting gone
85	36	0.4	0.001	36	0.6	0.001	27	0.6	0.001	5	...	.....	..	0.2+ to 0.3+	No change
86	71	0.4	0.001	31	0.6	0.001	21	0.6	0.001	12	0.6	0.001	..	0.2+ to 0.4+	Pain relieved
87	11	0.6	0.0005	10	0.6	0.001	5	0.6	0.001	3	...	.....	..	0.4+ to 0.5+	Pain lessened
88	136	0.3	0.001	130	0.6	0.001	10	0.4	0.001	3	...	.....	..	0.3+ to 0.5+	Headache and gastric symptoms relieved
101	56	0.4	0.001	20	0.6	0.001	84	0.4	0.001	5	...	.....	..	0.2+ to 0.6+	No change

TABLE 4.—TO SHOW THE EFFECT OF THREE OR FOUR DOSES OF INTRASPINAL SALVARSANIZED SERUM ALONE ON THE CELL COUNT, THE WASSERMANN REACTION AND THE CLINICAL SYMPTOMS

Case No.	Cell Count	Salvar. Serum, C.c.	Cell Count	Salvar. Serum, C.c.	Cell Count	Salvar. Serum, C.c.	Cell Count	Change in Wassermann Reaction in C.c.	Remarks
26	40	15	30	25	14	27	5	None	Pains relieved
27	210	14	100	27	37	20	165	0.4+ to 0.5+	Pains relieved; ataxia less
34	52	16	26	20	30	18	5	0.1+ to 0.2+	Pain and dizziness relieved
25	20	15	3	30	3	25	0	None	Pain and dizziness relieved
4	15	20	10	20	9	20	4	0.4+ to 0.5+	Pain and headache relieved
38	103	20	48	20	40	18	27	0.2+ to 0.3+	Pain relieved
22	7	20	6	15	6	20	6	0.5+ to 0.6+	Pain relieved; ataxia less
24	7	14	5	30	3	21	3	0.4+ to 0.6+	Temporary relief from gastric crises
33	5	15	3	20	3	20	1	0.6+ to 0.9+	Pain and numbness relieved
32	60	20	23	18	11	20	..	1.0 negative	Pain and headache relieved
31	27	15	13	20	7	25	..	1.0 negative	Pain relieved and ataxia lessened
12	43	15	20	20	9	20	..	0.3+ to 0.4+	Headache relieved
35	150	20	75	20	20	20	12	None	Headache and diplopia relieved
23	533	20	272	20	100	25	46	0.1+ to 0.2+	All symptoms relieved
64	30	16	9	20	15	25	3	0.5+ to 0.8+	Pain relieved
66	29	15	16	15	12	20	10	None	Pain relieved
50	16	16	11	20	11	20	5	0.6+ to 0.7+	Pain relieved

TABLE 5.—TO SHOW THE EFFECT OF THREE OR FOUR DOSES OF INTRASPINAL MERCURIALIZED SERUM ALONE ON THE CELL COUNT, THE WASSERMANN REACTION AND THE CLINICAL SYMPTOMS

Case No.	Cell Count	Mercury, Gm.	Cell Count	Mercury, Gm.	Cell Count	Mercury, Gm.	Cell Count	Change in Wassermann Reaction in C.c.	Remarks
90	107	0.001	58	0.001	26	0.001	16	0.2+ to 1.0 Neg.	Gain in weight; less ataxia
91	34	0.001	20	0.001	62	0.001	8	No change	No change
92	27	0.001	18	0.001	3	0.001	4	0.4+ to 0.8+	Relief of all pain
93	70	0.001	25	0.001	15	0.001	7	0.3+ to 0.6+	No change
94	142	0.001	300	0.001	36	0.001	20	0.2+ to 0.5+	Relief of pain and dizziness
95	100	0.001	30	0.001	12	0.001	7	0.5+ to 1.0+	Pain relieved
96	44	0.001	0	0.001	2	.....	..	No change	All symptoms relieved
97	6	0.001	6	0.001	2	0.001	3	0.3+ to 1.0 Neg.	All symptoms lessened
98	200	0.001	43	0.001	..	.....	..	No change	Pain lessened
99	20	0.001	6	0.001	..	.....	..	No change	Pain relieved

mann reaction per treatment interpreted as before in cubic centimeters of spinal fluid necessary for complete fixation was 0.03 in those treated with salvarsanized serum. In those treated with mercurialized serum the average was 0.13, or more than four times as great a change. From these figures it appears that mercurialized serum in this dose is a more efficient antisyphilitic than salvarsanized serum as measured by a drop in the strength of the Wassermann reaction. It appears, however, from the preceding comparison of the reactions produced by the two serums that mercurialized serum is so much more irritating that it cannot be used with the frequency with which salvarsanized serum can, and this is especially true of its use in *tabes dorsalis*. Consequently, the results at the end of a year of treatment, if each serum were used to the greatest extent consistent with safety, probably would not show such a discrepancy against salvarsanized serum because of the larger number of doses which could be given.

A comparison of the ultimate results obtained with the individual cases in the two groups is impracticable because of the differences in the total amount of treatment which has been given to the two groups, and also because of the small interval of time which has elapsed since treatment was discontinued, or because many of the group treated with mercurialized serum are still under treatment. The condition of the individual cases can best be described individually, and this is done in the case reports.

CONCLUSIONS

1. The irritating effect in the spinal canal of serum to which mercuric chlorid has been added in the dose of 0.001 gm. is greater than that of 20 c.c. of salvarsanized serum separated from blood drawn thirty minutes after a dose of 0.6 gm. of salvarsan.
2. The average effect on the laboratory findings in the spinal fluid from one dose of mercurialized serum is greater than from one dose of salvarsanized serum.
3. Unpleasant symptoms are more common following intraspinal mercurialized serum than following salvarsanized serum.
4. The greater irritation of the meninges from mercurialized serum prevents as rapid repetition of dosage as is possible with salvarsanized serum.
5. Cases of general paresis, meningitis and cerebrospinal syphilis stand intraspinal treatment with mercurialized serum better than do cases of *tabes dorsalis*. It is particularly in cases of active syphilis of the meninges that the mercurialized serum is useful.
6. Mercurialized serum has an advantage over salvarsanized serum in ease of preparation and in its keeping qualities. For these reasons

it can be used under clinical conditions in which the use of salvarsanized serum is impossible, or at least very much more difficult.

REPORT OF CASES

CASE 75.—A man, aged 48, entered the hospital March 27, 1916. A diagnosis of *tabes dorsalis* was made. Twenty-seven years before he had had gonorrhea. He had had no treatment for syphilis and did not know of his infection. For two years he had had attacks of nausea and vomiting lasting for from eight to ten days, coming on about every month. He had had a chronic deforming arthritis for several years.

Physical examination showed unequal, irregular pupils which did not react to light. His knee jerks were present and equal. There was no Romberg sign. Both elbows were partially flexed and almost completely fixed in that position.

The Wassermann reaction in the blood serum was positive. The spinal fluid gave a positive Wassermann reaction and showed a cell count of 15 per c.mm.

He was given five doses of salvarsan and five intraspinal treatments with mercurialized serum. Two months after his first treatment he became free from gastric symptoms and has remained so up to the present time. The Wassermann reaction was unchanged in his blood and spinal fluid. The cell count in the spinal fluid became normal.

CASE 76.—A man, aged 51, entered the hospital March 25, 1916. A diagnosis of *tabes dorsalis* was made. He had had a chancre twenty years before. He had had shooting pains in his legs for eight years. For two years he had been ataxic and for one year had had incontinence of urine. For six months he had had girdle sensation. He had lost 18 pounds in weight. His condition had not been influenced by repeated intravenous injections of salvarsan, mercury inunctions and potassium iodid by mouth.

Physical examination showed Argyll Robertson pupils, absent knee and ankle jerks and a positive Romberg sign.

The Wassermann reaction was positive in both blood serum and spinal fluid, with a spinal fluid cell count of 60 per c.mm. He was given six intravenous doses of salvarsan and five intraspinal treatments with mercurialized serum. His pains became less severe after two treatments; after five they were almost absent. His girdle sensation disappeared. The ataxia was somewhat lessened. The Wassermann reaction in his blood serum was unchanged, in his spinal fluid it had changed by only 0.1 c.c. The cell count had fallen to 7 per c.mm.

CASE 77.—A man, aged 42, entered the hospital April 5, 1916. A diagnosis of cerebrospinal syphilis was made. In 1904 he had had a chancre. Eight months before entrance he had had a sudden complete paralysis of his right side, with inability to speak for two weeks, and retention of urine. The paralysis had slowly cleared up until he was able to walk about his room, but could do very little more. He had had pain in his neck and both arms, which was gradually becoming more severe.

Physical examination showed small, irregular pupils, which did not react to light. There was some muscle atrophy of the right side, with decided weakness of his right arm and leg. All reflexes on that side were increased and there was a positive ankle clonus, Babinski, Gordon and Oppenheim.

The Wassermann reaction in both blood and spinal fluid was positive. The spinal fluid also gave a positive globulin test and showed a cell count of 60 per c.mm.

He was given four doses of salvarsan intravenously, large amounts of potassium iodid and some mercury. He was also given six doses of mercurialized serum intraspinally. At the end of six months all pain had gone from his neck and arms, he could walk better, but still dragged his leg. His right arm was gradually recovering some power and he was doing part time work with the fire department.

His blood serum continued to give a positive Wassermann test. His spinal fluid showed a cell count of 5 per c.mm., and gave a positive Wassermann test with 0.8 c.c. whereas at entrance only 0.2 c.c. was required for complete fixation.

CASE 78.—A man, aged 36, entered the hospital Aug. 28, 1916. A diagnosis of syphilitic meningitis was made. He had never had any previous syphilitic lesions. For two months he had had frequent headaches. Five days before entrance he had had extreme headache, failing vision, increasing mental confusion, vomiting and stiffness of his neck.

Physical examination showed a general hyperesthesia, stiff neck, with pain on motion, bilateral Kernig's sign and increased reflexes. There was some mental confusion.

The Wassermann reaction was positive in both blood and spinal fluid. The spinal fluid showed a cell count of 520 per c.mm. and gave a positive globulin test. His temperature was 103 F., pulse 100 per minute and respirations 30. The white blood count was 8,400 per c.mm.

After three weeks of treatment there were no signs of meningitis remaining, the patient was free from all symptoms and was out of bed all day. He was given eight doses of salvarsan intravenously in addition to potassium iodid and mercury. He was also given six doses of mercurialized serum intraspinally. His blood Wassermann reaction continued to be positive. His spinal fluid showed a normal cell count and gave a negative Wassermann reaction and globulin test. Six weeks after he entered the hospital he returned to work and had been working steadily ever since.

CASE 79.—A man, aged 22, entered the hospital Sept. 4, 1916. A diagnosis of cerebrospinal syphilis was made. He had had a chancre five years before and had been given three doses of salvarsan intravenously. He had had no further symptoms until six months before entrance to the hospital when he had begun to have some stomach trouble and headache. These symptoms had partially cleared up after further intravenous salvarsan. One day before entrance he had suddenly lost his faculty of speech and ability to swallow and the right side of his face had become paralyzed. He had had almost constant vomiting and hiccough since that time.

Physical examination showed unequal pupils, which reacted poorly to light, a right facial paralysis and a partial paralysis of his tongue and the muscles of deglutition. There was a double Kernig's sign but no stiffness of the neck. Fundus examination showed considerable edema of both disks. There was complete aphonia, frequent vomiting and continual hiccough.

The Wassermann reaction was positive in both blood and spinal fluid. The spinal fluid showed a cell count of 300 per c.mm. and gave a positive globulin test.

Treatment consisted of mercury intramuscularly, large doses of potassium iodid by mouth, seven doses of salvarsan intravenously and seven intraspinal treatments with mercurialized serum. Two months after the first treatment his blood serum gave a weakly positive test. His spinal fluid gave a positive Wassermann reaction with 1.5 c.c., whereas at first only 0.2 c.c. was required for complete fixation. The cell count had fallen from 300 per c.mm. to 20. He showed no signs of his trouble except a slight drooping of the right angle of his mouth.

CASE 80.—A woman, aged 36, entered the hospital June 12, 1916. A diagnosis of general paresis of the insane was made. She had been married nineteen years and had one child 18 years old. She had had four miscarriages. Her husband had had general paralysis of the insane for more than two years and had been recently committed to a home for the insane. She had had pains in her legs for three years, attacks of dizziness for one year and had had numbness and paresthesia of her legs for six months.

Physical examination showed unequal and irregular pupils, which did not react to light. The knee and ankle jerks were equal but exaggerated. She

showed very definite mental instability and cried or laughed on the slightest provocation. There was some memory defect.

The Wassermann reaction was positive in both blood serum and spinal fluid. The spinal fluid showed a cell count of 44 per c.mm. and gave a positive globulin test.

She was given four doses of mercurialized serum intraspinally and six doses of salvarsan intravenously without change in her symptoms other than relief of pain.

The Wassermann reaction remained unchanged in either blood or spinal fluid. The spinal fluid cell count fell from 44 to 2 per c.mm.

CASE 81.—A woman, aged 22, entered the hospital Sept. 2, 1916. A diagnosis of cerebrospinal syphilis was made. She had had poor health all of her life. At the age of 5 she had had a rash on her face diagnosed as syphilis. One year later she had had syphilitic periostitis of both tibiae and two years later she had had syphilitic iritis of the right eye. Six months before entrance she had had general malaise, drowsiness, apathy, anorexia, numbness of her hands, headache, vertigo, polyuria, polydipsia and had lost 15 pounds of weight.

Physical examination showed the scars of an old iritis on the right, with ability to count fingers at 1 foot. Vision in the left eye was normal and the right pupil was regular and reacted to light. The tibiae showed marked changes due to syphilitic osteitis and periostitis. The urine was always of light color, with specific gravity of 1.005 and lower. The twenty-four-hour amount was usually about 2,000 c.c. The Wassermann reaction was positive in both blood and spinal fluid. The spinal fluid gave a positive globulin test and showed a cell count of 148 per c.mm.

Treatment consisted of five doses of mercurialized serum intraspinally and seven doses of salvarsan intravenously in addition to mercury intramuscularly and large doses of potassium iodid by mouth. After three weeks of treatment all headaches, dizziness, drowsiness and anorexia disappeared. She felt well and began to gain weight. Later the numbness of her hands disappeared. Treatment had no effect on her urinary symptoms.

The Wassermann reaction remained unchanged in both blood and spinal fluid. The spinal fluid cell count had fallen from 148 per c.mm. to 42 per c.mm.

CASE 82.—A man, aged 32, entered the hospital Jan. 13, 1916. Nine months before entrance he had had a chancre which was followed by a rash and sore throat, and at that time his blood Wassermann reaction had become positive. Two months after infection he had developed headache and dizziness. Three doses of neosalvarsan and fifty doses of intramuscular mercury had to some extent relieved his symptoms, but they had lately recurred and had progressed rapidly. At the time of admission he showed that he was below par mentally, with a marked memory defect. His replies to questions were vague and indefinite.

Physical examination showed unequal pupils which reacted to light. Fundus examination showed a one diopter choked disk on each side, with overfilled and tortuous veins. The deep reflexes were unchanged.

The Wassermann reaction in the blood serum was positive.

A right subtemporal decompression was performed and 10 c.c. of salvarsanized serum were injected into the lateral ventricle. The ventricular fluid removed gave a positive Wassermann reaction with 0.05 c.c., a positive globulin test, and showed a cell count of 230 per c.mm. Three days later the spinal fluid showed 240 cells per c.mm. and gave a positive Wassermann reaction with 0.05 c.c. He was given three doses of salvarsan at weekly intervals and sent home for further treatment there. Six months later he was again admitted to the hospital. At this time he was dull and stupid, disoriented for time and place, and could not answer questions in an intelligent manner. He showed also great fear when left alone. His blood Wassermann reaction was positive.

The spinal fluid cell count was 175 per c.mm., there was an excess of globulin and the Wassermann reaction was positive with 0.05 c.c.

He was given ten doses of mercurialized serum intraspinally and ten doses of salvarsan in addition to mercury inunctions and very large doses of potassium iodid by mouth. After five treatments a great change was noticeable in his condition. After his tenth treatment he was free from symptoms and seemed perfectly normal mentally.

There was no change in his blood Wassermann reaction. The Wassermann reaction in his spinal fluid changed from positive with 0.05 to positive with 0.2 c.c. The cell count fell from 175 per c.mm. to 9 per c.mm.

CASE 83.—A man, aged 38, was admitted to the hospital, Aug. 14, 1916. A diagnosis of tabes dorsalis was made. Eighteen years before he had had a chancre. For four years he had had infrequent attacks of nausea, with eructations of gas. For six weeks he had had constant pain in the epigastrium, which bore no relation to meals or time of day. He had become weak and tired and had lost 4 pounds in weight.

Physical examination showed unequal and irregular pupils, which did not react to light. The deep reflexes were unchanged. The Wassermann reaction in both blood and spinal fluid was positive. The spinal fluid gave a positive globulin test and showed a cell count of 52 per c.mm.

He was given three doses of mercurialized serum intraspinally and five intravenous doses of salvarsan. He has had no abdominal pain and no gastric symptoms since his second treatment.

The Wassermann reaction in the blood serum was not affected by treatment. The spinal fluid Wassermann reaction changed from positive with 0.2 c.c. to positive with 0.6 c.c. The spinal fluid cell count fell from 52 to 5 per c.mm.

CASE 84.—A woman, aged 47, entered the hospital Aug. 22, 1916. A diagnosis of general paralysis of the insane was made. She had had a syphilitic sore throat fifteen years before. For one year she had anorexia and vomiting after meals. For six months she had had headache; dizziness and increasing difficulty in walking. One week before entrance she had had a period of aphonia which lasted for nine hours. For several days she had had severe pains in the legs and a sense of constriction about her neck.

Physical examination showed tenderness to pressure over the whole skull. The pupils were unequal and did not react to light. The arm reflexes were very active. Knee and ankle jerks were diminished, but were present on both sides. There was marked swaying in the Romberg position. Gag reflex was absent.

The Wassermann reaction in both blood serum and spinal fluid was positive. The spinal fluid gave a positive globulin test and showed a cell count of 66 per c.mm.

Treatment consisted of five doses of mercurialized serum intraspinally, six doses of salvarsan intravenously, mercury and potassium iodid by mouth. After the second intraspinal treatment she claimed to be entirely free from symptoms.

The Wassermann reaction in the blood serum was unchanged. The spinal fluid Wassermann reaction changed from positive with 0.1 c.c. to positive with 0.5 c.c. The cell count fell from 66 to 20 per c.mm.

CASE 85.—A man, aged 48, entered the hospital Sept. 8, 1916. A diagnosis of general paralysis of the insane was made. He had had a chancre twenty years before. He had lost 30 pounds in the last five years. For one year he had had dizziness, nervousness and tremor of the muscles of his face.

Physical examination showed irregular pupils, which did not react to light. Knee jerks were present but unequal. He was dull mentally and had some memory defect.

Wassermann reaction in both blood serum and spinal fluid was positive. The spinal fluid gave positive globulin test and showed a cell count of 36 per c.mm.

He was given three doses of mercurialized serum intraspinally and four doses of salvarsan intravenously. There was no change in his condition from treatment. The Wassermann reaction in his spinal fluid changed from positive with 0.2 c.c. to positive with 0.3 c.c. The cell count fell from 36 to 5 per c.mm.

CASE 86.—A man, aged 35, entered the hospital Aug. 21, 1916. A diagnosis of tabes dorsalis was made. He had had gonorrhea twice, but denied having had syphilis. For nine years he had had paroxysmal attacks of pain in both shoulders, and for two years had had pain of the same kind in both legs, with parasthesias.

Physical examination showed irregular, unequal pupils, which did not react to light, and sluggish deep reflexes in both arms and legs.

The Wassermann reaction was positive in both blood and spinal fluid. The spinal fluid showed a cell count of 71 per c.mm. and gave a positive globulin test.

He was given four doses of mercurialized serum intraspinally and five doses of salvarsan intravenously. The Wassermann reaction was unchanged in his blood. The spinal fluid changed from positive with 0.2 c.c. to positive with 0.4 c.c. The cell count fell from 71 per c.mm. to 12 per c.mm. He was entirely relieved from pain and parasthesias after the third treatment.

CASE 87.—A man, aged 29, entered the hospital June 8, 1916. A diagnosis of rheumatic fever and tabes dorsalis was made. He had had rheumatic fever at the age of 18 and again at 26. He had had a chancre three years before entrance. He had had shooting pains in the back of his neck and head for six months.

Physical examination showed an acute arthritis of both knees and one shoulder. These manifestations promptly disappeared after a few days in the hospital. In addition he showed absent knee and ankle jerks, unequal and irregular pupils, which reacted poorly to light.

The Wassermann reaction in both blood and spinal fluid was positive. The spinal fluid showed a cell count of 11 per c.mm. and gave a positive globulin test.

He was given five doses of salvarsan intravenously without any change in symptoms or change in his spinal fluid cell count. After his first dose of mercurialized serum the cell count fell to normal. He had two additional doses of mercurialized serum intraspinally and six additional doses of salvarsan intravenously. His blood Wassermann reaction became negative and he became free from symptoms. The Wassermann reaction in his spinal fluid was unchanged.

CASE 88.—A woman, aged 28, entered the hospital Aug. 23, 1916. A diagnosis of cerebrospinal syphilis was made. She had had syphilis for four years. For two years she had had severe headaches and failing vision in her right eye, and for one year she had had nausea and vomiting whenever she had undertaken any physical exertion. For six months she had been very irritable, and for one month had been almost continuously in bed.

Physical examination showed unequal pupils, which did not react to light.

The Wassermann reaction was positive in both blood and spinal fluid. The spinal fluid cell count was 136 per c.mm.

She was given three doses of mercurialized serum intraspinally and six doses of salvarsan intravenously. This relieved her of all symptoms.

Her blood Wassermann reaction had not changed. The spinal fluid Wassermann reaction changed from positive with 0.3 c.c. to positive with 1.5 c.c. The spinal fluid cell count fell from 136 to 3 per c.mm.

CASE 89.—A woman, aged 48, entered the hospital June 27, 1916. A diagnosis of cerebrospinal syphilis was made. For two years she had had weakness of the legs and ataxia. For one year she had had headaches and for six weeks she had had such extreme headaches, dizziness and vomiting that she had been confined to bed.

Physical examination showed normal pupils, increased and unequal knee jerks, an ankle clonus on the right, and a positive Babinski's sign.

The Wassermann reaction in both blood and spinal fluid was positive. The spinal fluid cell count was 15. She was given three doses of salvarsan intravenously and two doses of mercurialized serum intraspinally. The blood Wassermann reaction was unchanged. The spinal fluid cell count fell from 15 to 6 per c.mm., and the Wassermann reaction changed from positive with 0.1 c.c. to positive with 0.4 c.c. This amount of treatment entirely relieved her of headaches and vomiting, the dizziness was greatly lessened and she was able to walk around without difficulty.

CASE 90.—A man, aged 42, entered the hospital March 4, 1916. A diagnosis of *tabes dorsalis* was made. For two years he had had numbness and weakness in his legs and for three months he had had unsteadiness in his gait.

Physical examination showed unequal pupils, which did not react to light, absent knee and ankle jerks, ataxia of the legs and a positive Romberg's test.

The Wassermann reaction in the blood serum was negative. The spinal fluid showed 107 cells per c.mm. and gave a positive Wassermann reaction.

He was given six doses of mercurialized serum intraspinally. Eight months after the treatment the numbness had disappeared from his legs and they became much stronger. Ataxia was lessened and he had gained 8 pounds weight.

CASE 91.—A man, aged 47, entered the hospital June 22, 1916. A diagnosis of general paralysis of the insane was made. He had had syphilis twenty-five years before. Five years before he had had a nervous breakdown and had become unsteady on his feet. For nine weeks he had had tenderness and pain in his left hand and for three weeks incontinence of urine.

Physical examination showed unequal pupils, which reacted poorly to light, exaggerated deep reflexes, a positive Romberg and a Babinski on each side. There was weakness and atrophy of the left hand, arm and leg, with disturbed sensation over the hand and arm.

The Wassermann reaction in the blood serum was negative. The spinal fluid showed a cell count of 34 per c.mm. and gave a positive Wassermann test with 0.5 c.c. He was given two intravenous doses of salvarsan and five intraspinal injections of mercurialized serum. The Wassermann reaction in his spinal fluid became more strongly positive under treatment, so that only 0.3 c.c. were required for complete fixation. The cell count fell to 4 per c.mm. There was little improvement in his condition clinically. He regained control of his urine and the pain in his hand became less severe.

CASE 92.—A woman, aged 48, entered the hospital March 20, 1916. A diagnosis of *tabes dorsalis* was made. She had had syphilis for eighteen years. For nine years she had had frequent pains in her legs. For six years she had had transient attacks of diplopia. She had had one dose of salvarsan and a great deal of mercury and potassium iodid without any relief.

Physical examination showed normal pupils and hyperactive deep reflexes in legs and arms.

The Wassermann reaction was negative in the blood. The spinal fluid showed 27 cells and gave a positive Wassermann reaction with 0.4 c.c.

She was given five doses of mercurialized serum intraspinally. The Wassermann reaction in the spinal fluid became negative, the cell count fell to 2 per c.mm. and she became entirely symptom-free.

CASE 93.—A man, aged 42, entered the hospital Aug. 31, 1916. A diagnosis of *tabes dorsalis* was made. For one year he had had difficulty in walking at night, urinary disturbance, sharp pains in his legs, occasional attacks of diplopia and rapidly increasing deafness. Eight months before he had fallen and broken his leg. He had lost 21 pounds weight in the last year.

Physical examination showed unequal, irregular pupils, which did not react to light, absent knee and ankle jerks, marked ataxia of hands and feet, double vision and almost total deafness.

The Wassermann reaction in the blood serum was negative. The spinal fluid showed 70 cells per c.mm. and gave a positive Wassermann test with 0.3 c.c.

He was given five doses of mercurialized serum intraspinally. The Wassermann reaction in the spinal fluid changed from positive with 0.3 c.c. to positive with 0.6 c.c. The cells fell from 70 to 7 per c.mm. There was no change in any of the patient's symptoms.

CASE 94.—A man, aged 48, entered the hospital May 15, 1916. A diagnosis of *tabes dorsalis* was made. He had had urinary disturbances for eighteen months and had lost 18 pounds weight during the same time. He had had pains in his legs for six months.

Physical examination showed unequal and irregular pupils, which did not react to light; unequal knee jerks; swaying in the Romberg position; tremor of the hands and some ataxia.

The Wassermann reaction in the blood serum was negative. The spinal fluid showed a cell count of 142 per c.mm. and gave a positive Wassermann reaction.

He was given seven doses of mercurialized serum intraspinally. The Wassermann reaction in his spinal fluid changed from positive with 0.2 c.c. to positive with 0.7 c.c. The spinal fluid cell count fell from 142 to 15 per c.mm. All his symptoms disappeared after the sixth treatment.

CASE 95.—A man, aged 42, entered the hospital May 6, 1916. A diagnosis of *tabes dorsalis* was made. For six years he had had lightning pains in his legs, which gradually became more severe and frequent. Mercury and potassium iodid by mouth had given no relief.

Physical examination showed irregular pinpoint pupils, which did not react to light; areas of hyperesthesia over the lower back; hyperactive reflexes in both arms and legs.

The Wassermann reaction in the blood was negative. The spinal fluid gave a positive Wassermann reaction with 0.5 c.c. and showed a cell count of 100 per c.mm.

He was given six doses of mercurialized serum intraspinally. The Wassermann reaction changed from positive with 0.5 c.c. to positive with 1.5 c.c. The cell count fell from 100 to 4 per c.mm. The pains were greatly lessened after only three treatments and after six treatments they almost entirely disappeared.

CASE 96.—A woman, aged 38, entered the hospital Aug. 4, 1916. A diagnosis of *tabes dorsalis* was made. One year before she had had both fallopian tubes removed because of gonococcus infection. For six months she had had attacks of sharp epigastric pain and vomiting coming on about once in three weeks. The attacks had been relieved only by morphin.

Physical examination showed irregular and unequal pupils, which reacted to light, a low, hypotonic stomach and a moderately dilated aorta. The Wassermann reaction in the blood was negative. The spinal fluid gave a cell count of 44 per c.mm.

She was given two doses of mercurialized serum intraspinally. The cell count in the spinal fluid was reduced from 44 to 0 per c.mm. by the first treatment. The Wassermann reaction was not changed. She had no pain or vomiting after treatment was begun.

CASE 97.—A man, aged 48, was admitted to the hospital Feb. 22, 1916. A diagnosis of *tabes dorsalis* was made. He had had a chancre twenty-six years before. He had been treated for five years for chronic nephritis. For two years before admission he had had difficulty in walking, especially at night, and dizziness. These symptoms had grown worse rapidly, so that for three months he had been almost continually in bed.

Physical examination showed a moderately advanced chronic nephritis with a systolic blood pressure of 210 mm. of mercury. The pupils were irregular and reacted poorly to light. The knee jerks were hyperactive.

The Wassermann reaction in his blood serum was negative. The spinal fluid showed a cell count of 6 per c.mm. and gave a positive Wassermann reaction with 0.3 c.c.

He was given four doses of mercurialized serum intraspinally. The Wassermann reaction in the spinal fluid became negative with 1 c.c. and the cell count fell to 2 per c.mm. After three treatments the dizziness entirely disappeared and he became able to resume his work, which he had not touched for more than two years.

CASE 98.—A man, aged 61, entered the hospital May 24, 1916. A diagnosis of *tabes dorsalis* was made. For ten years he had had paresthesias of his feet and for two years difficulty in walking, with pains in his legs and thighs.

Physical examination showed Argyll Robertson pupils and absent knee and ankle jerks.

The Wassermann reaction in the blood was negative. The spinal fluid gave a positive reaction with 0.4 c.c., and showed a cell count of 200 per c.mm.

He was given two doses of mercurialized serum intraspinally. The pains in his legs were lessened. The cell count in the spinal fluid fell from 200 to 10 per c.mm. The Wassermann reaction was unchanged.

CASE 99.—A woman, aged 41, entered the hospital Jan. 15, 1916. A diagnosis of general paralysis of the insane was made. She had had syphilis for fourteen years. For three years she had had sharp pains in her extremities and had lost 18 pounds weight during that time. She had had mercury continuously for six months without any benefit.

Physical examination showed irregular, fixed pupils and unequal knee jerks. She was very talkative and had some memory defect.

The Wassermann reaction in the blood serum was negative. The spinal fluid gave a positive reaction with 0.1 c.c. and showed a cell count of 20 per c.mm. She was given two doses of mercurialized serum intraspinally. The cell count fell to 6 per c.mm. and the Wassermann reaction changed from positive with 0.1 c.c. to positive with 0.5 c.c. All the pains disappeared after the first treatment and did not recur. There was no change in her mental condition.

CASE 100.—A man, aged 50, entered the hospital Sept. 12, 1916. A diagnosis of *tabes dorsalis* was made. For eight years he had had occasional attacks of epigastric pain, nausea and vomiting. He had had difficulty in walking in the dark for seven years. For six months he had had girdle sensation and pains in his legs.

Physical examination showed unequal irregular fixed pupils; absent knee and ankle jerks; positive Romberg's test and ataxia of both hands and feet.

The Wassermann reaction was negative in the blood and spinal fluid. The spinal fluid also gave a negative globulin test and showed only 8 cells per c.mm. He was given two doses of mercurialized serum intraspinally which caused no change in symptoms, but a rise in the spinal fluid cell count to 74 per c.mm. Two months later the cell count had fallen to 12 per c.mm. and he stated that his pains and girdle sensation had disappeared.

CASE 101.—A man, aged 53, entered the hospital Sept. 7, 1916. A diagnosis of *tabes dorsalis* was made. He had had attacks of severe abdominal pain with vomiting almost every week for three months.

Physical examination showed Argyll Robertson pupils.

The Wassermann reaction in the blood was positive. The spinal fluid showed a cell count of 56 per c.mm. and gave a positive Wassermann reaction with 0.2 c.c. He was given three doses of mercurialized serum intraspinally and four doses of salvarsan intravenously. The Wassermann reaction in the blood serum was unchanged. The spinal fluid Wassermann reaction was changed from positive with 0.2 c.c. to positive with 0.6 c.c. The cell count fell from 56 to 5 per c.mm. The attacks of vomiting still continue but are not of such duration or frequency as before treatment.

Eleven patients previously treated with salvarsanized serum were each given three or more intraspinal treatments with mercurialized serum, a total of thirty-eight doses. The effect on the Wassermann reaction, cell count and clinical symptoms was in every case equally as good as, if not better than, from the same amount of salvarsanized serum. The reactions in every case were more severe than with the salvarsanized serum.

Peter Bent Brigham Hospital.