pulse on that side, which the radial tracing proved to be a stenosis of the radial artery due to an embolus.

The pains in the right foot and left knee, being unaccompanied by swelling of the joints proper, may be interpreted as embolic, and were probably caused by dorsalis pedis and popliteal artery obstruction, respectively.

The next condition brought to our attention is a hemiplegia affecting the left arm and left leg and the right side of the face. This constitutes the so-called Millard-Gubler syndrome of crossed facial hemiplegia. Since it occurred suddenly and without unconsciousness, we may safely diagnose an embolus as the cause of the syndrome. The seat of disease in this condition is the pons, on the right side, that is, corresponding to the facial paralysis. The artery affected was probably one of the right branches of the basilar artery. We have still to explain the edema of the left hand, the clubbed fingers on that side and the rarefaction of the bones of the left hand producing a picture of osteoporosis. I think that these may be grouped under the heading of trophic disturbances, due to a hemiplegia, and those due to pontile lesions, according to Purves Stuart,¹ are not infrequently accompanied by severe vasomotor disturbances. Parenthetically, I would say that the trophic changes in bone may be even severe enough to cause spontaneous fractures in cases of hemiplegia.

Although the blood culture was negative, we regard this case as one of bacterial endocarditis in the bacteria-free stage. The organism is most likely of the

Fig. 3.—Pulse tracings: a, normal; b, right radial, pulsus tardus; c, left radial, anacrotic pulse.

Fig. 4.—Pulse tracings: a, right brachial, arrow pointing to extra-systole (premature contraction); b, left brachial, "bisferiens pulse," arrow pointing to notch.

Streptococcus viridans type. This brings our case in the class described by Schottmüller² as "endocarditis lenta" and by Libman³ as "subacute infective endocarditis."

660 Willoughby Avenue.

1. Stuart, Purves: *Diagnosis of Nervous Diseases*, 1916.
2. Schottmüller: *München. med. Wchnschr.* 57: 880, 1910.
3. Libman: *Am. J. M. Sc.* 140: 516, 1910.

Keeping Fit.—You can't go far if you don't keep fit.—*Bulletin*, Kansas State Board of Health.

HOOKWORM INFECTION AMONG TROOPS.

TREATMENT WITH OIL OF CHENOPODIUM *

R. H. KNOWLTON, M.D. (ST. PETERSBURG, FLA.)

First Lieutenant, M. C., U. S. Army

CAMP JACKSON, COLUMBIA, S. C.

Darling, Barber and Hacker¹ recently gave the results of their extensive study of the treatment of hookworm infection carried on in the Far East. The present investigation was largely patterned after their methods, but with two main objects in view: first, to get some idea of the severity of hookworm infection among Southern troops, and second, to check up the efficiency of the treatment used in this hospital. With the exception of thirteen negroes in Table 1, who came from their organizations, all the subjects used were chosen at random from the convalescents in the wards without reference to the degree of infection, although all were known to have positive stools. They were practically all from the Carolinas and Florida. A few had received treatment at their homes, but it does not seem to have been very effective, as one patient with 1,263 worms had received one treatment two months previously, one with 559 worms had received five, and one with 313 worms had received six.

The work was first undertaken in the hospital wards, but there was so much chance for error and the data were so incomplete that these results have largely been discarded, and none of them included in Tables 1, 2 and 3. A special building was then set aside for the work in which the patients lived and where all work was carried out. The object and methods of the investigation were explained to the patients, and they assisted greatly in the work. They were cautioned to avoid all fruits and fibrous vegetables while under treatment. Each patient had his own commode under his bed, with his name on it, and the stools were examined for forty-eight hours. The method of washing stools and removing worms was essentially that described by Darling, Barber and Hacker. The contents of a container were rinsed into a copper sieve (50 mesh) and then washed by a jet of water from a rubber tube attached to the tap. The residue containing the worms was rinsed into flat glass dishes and examined against suitable black and white backgrounds. Some of the patients became quite expert in picking out the worms, and there was a friendly rivalry as to who should have the most.

METHODS OF TREATMENT

According to the routine treatment used at this hospital, a light supper is ordered the night before and a full dose of magnesium sulphate is given about 8 p. m. No breakfast is taken in the morning, and 1.8 c.c. of oil of chenopodium is given in six gelatin capsules (supplied by a pharmaceutical house), two every hour for three doses. Two hours after the last capsules, another full dose of magnesium sulphate is given. This method was followed in the first series and the results are tabulated in Table 1. Table 2 shows a similar group of cases which were treated in the same way with the same oil expressed from the proprietary capsules. The oil was collected in a graduate and measured in a pipet, and exactly 0.3 c.c. put into hard gelatin

* From the laboratory of the base hospital, Camp Jackson, Marshall A. Barber, Major, S. C., U. S. Army, chief of laboratory.

1. Darling, S. T.; Barber, M. A., and Hacker, H. P.: *The Treatment of Hookworm Infection*, J. A. M. A. 70: 499 (Feb. 23) 1918.

capsules, which are very soluble in water. In every case, whatever the laboratory findings may have been, each patient received at the end of four days a second treatment with freshly expressed oil, and this was repeated at similar intervals until it was evident that all worms had been removed.

EFFICIENCY OF SOFT CAPSULES

In determining the efficiency of any method of treatment, the number of cures alone does not give a fair estimate, since the drug used may leave 2 or 3 per cent. of the worms and still be highly efficient, but the case does not count as a cure. By figuring the total percentage of worms removed from a group of patients, we obtained a much better index, but this has one objection—that one or two large carriers may dominate the result, while the man with a very few worms hardly influences it at all. If the percentages destroyed by one treatment in each individual of a group of patients are averaged, we again get a fairly good index; but here the man with one worm counts the same as the one with a thousand. Therefore it was decided to use both of the latter methods and average the results, obtaining a value which is spoken of as the efficiency index. The balance is similar to that of our Congress, on one side the representation based on population, and on the other, each state counting equally.

TABLE 1.—RESULTS OF ONE TREATMENT WITH OIL OF CHENOPODIUM

1.8 C.C. IN SOFT GELATIN PROPRIETARY CAPSULES

Case Number	Color	Hemo-globin	Total No. of Worms Found	No. Removed by First Treatment	Percentage Removed by One Treatment
1	O	..	177	175	98.9
2	C	..	27	7	25.9
3	C	..	18	18	100.0
4	C	..	3	3	100.0
5	C	..	27	16	59.3
6	C	..	6	6	100.0
7	C	..	17	17	100.0
8	C	..	1	1	100.0
9	C	..	11	11	100.0
10	C	..	59	59	100.0
11	C	..	81	81	100.0
12	C	..	11	11	100.0
13	C	..	13	13	100.0
14	W	80	369	346	93.8
15	W	85	66	43	65.1
16	W	85	21	21	100.0
17	W	80	18	9	50.0
18	W	80	28	18	64.3
19	W	90	57	54	94.7
20	W	78	15	11	73.3
21	W	90	99	12	12.1
22	W	85	131	131	100.0
23	W	85	16	16	100.0
24	W	85	8	7	87.5
25	W	..	12	4	33.3
26	W	90	245	239	97.5
27	W	80	6	0	0.0
28	W	..	288	119	41.3
29	W	85	115	102	88.7
30	W	90	38	38	100.0
31	W	85	10	8	80.0
32	W	95	71	56	78.9
33	W	80	32	27	84.4
34	W	75	313	247	78.6
35	W	60	1,704	495	29.0
Total.....			4,113	2,421	58.86
Average.....					78.18

Average of percentages..... 78.18
Percentage of grand total of worms removed by one treatment.. 58.86
Average or efficiency index..... 68.5

Table 1 gives the results obtained from the group treated in the routine manner with soft gelatin capsules. In this table it is seen that the first thirteen patients are negroes, and the results obtained were quite satisfactory. It is difficult to say whether this

is due to their superior power of digestion or to the fact that the capsules used were a new lot and very fresh; at any rate, the later results among the white patients were far less satisfactory.

TABLE 2.—RESULTS OF ONE TREATMENT WITH OIL OF CHENOPODIUM

1.8 C.C. IN HARD (SOLUBLE) CAPSULES

Case Number	Color	Hemo-globin	Total No. of Worms Found	No. Removed by First Treatment	Percentage Removed by One Treatment
1	W	75	139	115	82.7
2	W	85	104	163	99.4
3	W	85	212	198	93.4
4	W	80	121	121	100.0
5	W	75	137	137	100.0
6	W	70	14	14	100.0
7	W	65	1,263	1,160	91.8
8	W	80	81	81	100.0
9	W	85	1	1	100.0
10	W	75	55	55	100.0
11	W	90	9	9	100.0
12	W	75	41	35	85.4
13	W	85	16	3	18.7
14	W	75	8	8	100.0
15	W	75	26	23	88.5
16	W	80	10	7	70.0
17	W	85	53	53	100.0
18	W	80	107	106	99.1
19	W	75	127	122	96.1
20	W	85	57	57	100.0
21	W	80	191	190	99.5
22	W	75	4	4	100.0
23	W	85	170	170	100.0
24	W	..	1	1	100.0
25	W	75	29	28	96.6
26	W	85	559	551	98.6
27	W	80	225	222	98.7
28	W	80	35	34	97.1
29	W	85	17	17	100.0
30	W	85	55	52	94.5
31	W	75	22	16	72.7
32	W	85	261	259	99.2
33	W	80	391	389	99.5
Total.....			4,601	4,402	95.67
Average.....					93.40

Average of percentages..... 93.40
Percentage of grand total of worms removed by one treatment.. 95.67
Average or efficiency index..... 94.5

It will be seen that the efficiency of the soft capsules is fixed at 68.5 and that of the fresh oil at 94.5. The question now arises as to what this marked difference is due—whether to a lack of dosage in the soft capsule or to its lack of solubility. The chemistry department of the laboratory undertook to ascertain the contents by this method: Twenty-five capsules were placed in a graduate in water and the volume read off. They were then removed, dried quickly by blotting, and cut open. The empty shells were then put in water and the volume again taken. The difference represents the amount of oil in twenty-five capsules. By this method the contents were found to be about 73 per cent. of that stated, but there may be errors in this calculation, as, for instance, absorption of the oil into the gelatin.

Darling, Barber and Hacker, in their report, give a number of figures bearing on this point. Using as efficiency index the group percentage of worms removed by one treatment, they found that the result of divided doses of oil of chenopodium was: 2 c.c., 95.18 per cent.; 1.5 c.c., 88.7 per cent.; 0.75 c.c., 80 per cent., and 30 minim soft gelatin capsules, 66.4 per cent. This shows distinctly that the insolubility is the main factor, as even 0.75 c.c. of the fresh oil was superior to the soft gelatin supposed to contain 2 c.c. It is interesting to note the similarity of these figures to those shown in the foregoing tables, with particular reference to the low efficiency of the soft gelatin capsules. Those used by Darling, Barber and Hacker were old. Those used here were obtained fresh, but from another manufacturer.

INSOLUBILITY OF CAPSULES AS CAUSE OF
POOR RESULTS

Based on the idea that the insolubility was the main factor, a small group of patients was treated with three soft and three hard capsules. If the cause of the poor results of the routine treatment was the lack of dosage, the index would presumably be midway between that of Table 1 and Table 2. On the other hand, if the insolubility was the main factor, it was thought that perhaps the best results of all might be obtained. That is, the very soluble capsules would dissolve in the stomach and the oil be effectual on those worms high up in the intestinal tract, while the tougher, soft capsules would break up later on, and not losing any effectiveness by absorption, would care for the worms lower down. Table 3 shows this group of cases.

TABLE 3.—RESULTS OF ONE TREATMENT WITH OIL OF
CHENOPODIUM
1.8 C.C.: 0.9 C.C. IN SOFT CAPSULES, 0.9 C.C. IN HARD (SOLUBLE) CAPSULES

Case Number	Hemo- globin	Total No. of Worms Found	No. Removed by First Treatment	Percentage Removed by One Treatment
1	..	52	50	96.2
2	65	919	892	97.1
3	75	130	130	100.0
4	80	81	76	93.8
5	75	40	40	100.0
6	85	10	9	90.0
7	75	364	361	99.2
8	80	45	45	100.0
9	85	26	25	96.2
10	80	169	153	90.5
Total.....		1,836	1,781	963.0
Average.....				96.3

Average of percentages..... 96.3
Percentage of grand total of worms removed by one treatment... 97.0
Average or efficiency index..... 96.7

These results indicate that the factor is not insufficient dosage, and apparently is the lack of solubility. It should be stated, however, that this series of cases was an afterthought, and in the second treatments in some of the cases the stools could be examined for only twenty-four hours. In previous cases, however, experience has shown that the early stools are the important ones, those of the second day showing little or nothing. The efficiency index of this group is determined at 96.7, slightly better even than the hard capsules alone (94.5), and very markedly superior to the soft capsules at 68.5.

OTHER OBSERVATIONS

In most of these cases the hemoglobin was taken by a Tallqvist scale in order to ascertain whether it gave

TABLE 4.—CORRELATION BETWEEN HEMOGLOBIN AND
NUMBER OF WORMS

Number of Worms	Hemoglobin			
	60 to 69	70 to 79	80 to 89	90 to 100
1 to 25	0	4	9	2
26 to 50	0	4	4	5
51 to 100	0	1	5	3
101 to 200	0	4	8	0
201 to 350	0	1	5	1
351 to 500	0	1	2	0
501 to 1,000	1	0	1	0
Over 1,000	2	1	0	0

any indication of the amount of harm the infection was doing to the patients. Table 4 shows the result in eight groups of patients classified according to the number of worms. It is not practical to figure very closely on a factor which is as uncertain as the hemoglobin estimation, but as it stands, it appears there is

no particular reduction in anything under 500 worms. In all other degrees of infection, most patients were found in the 80-89 group.

Table 5 shows the incidence of worms in the two races. Although the number of negroes is rather small,

TABLE 5.—INCIDENCE OF WORMS BY GROUPS

Number of Worms	Number of White Cases	Number of Colored Cases
1 to 25.....	19	11
26 to 50.....	10	4
51 to 100.....	11	1
101 to 200.....	14	2
201 to 350.....	7	0
351 to 500.....	3	0
501 to 1,000.....	2	0
Over 1,000.....	3	0
Total.....	69	18

it seems evident that they are less heavily infected than white persons.

The average number of worms in sixty-nine white patients not previously treated in this hospital was 155.3. In eighteen negroes the average was 38.3. Three white patients had 1,010, 1,263 and 1,704 worms, respectively. The last patient was a thin, pale boy very evidently weakened by his disease, and before he was discharged his appearance and weight had improved remarkably.

In all cases except a few of the heaviest infection, the number of worms of each sex was determined to see which was the more resistant to the oil. Table 6 shows that there is no difference at all and that the larger female has no more resistance than the smaller male.

During this work, the patients were under close observation following the treatment, and it was possible to observe any symptoms of poisoning if they

TABLE 6.—INCIDENCE OF WORMS BY SEX

Removed by first treatment:	Number	Per Cent.
Females.....	3,702	56.5
Males.....	2,854	43.5
Total.....	6,556	
Removed by later treatments: i. e., survivors of first treatment:		
Females.....	380	56.0
Males.....	299	44.0
Total.....	679	

were present. In taking the fresh oil, the patients usually felt like lying down after the second or third dose, and, as a rule, they remained quiet during the day; but they were always ready to eat when they were allowed to, and felt better afterward. There was no vomiting except occasionally after the purge, and there were no other toxic symptoms except a feeling of weakness, of which all complained. This passed off in a few hours, and in the morning they were about as usual. The patients of the first series agreed that the hard capsules made them sicker than the soft, but there were no objective signs of toxic action of the drug.

CONCLUSION

The results show that while in a considerable proportion of soldiers the infection is light, all grades are encountered and a few may be termed as severe. The negro appears to be less severely infected than the white race. The soft gelatin capsules stated to contain 5 minims are distinctly less efficient than a similar dose placed in soluble capsules.