disputed problems of the past fifty years—namely, the problem of so-called parasymphylis, since it was this very idea that prompted me to undertake to search for *Treponema pallidum* in one form or another in the brains of general paralytics and in the spinal cord from cases of tabes dorsalis." And again, "I was led by the observation that *Treponema pallidum* sometimes assumes a granular form in cultures to re-study sections of parietic brains stained for the *pallidum*."

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- Further references will be found at the ends of some of the papers cited.

ON THE RELATION BETWEEN THE TERMINAL-SPINED AND LATERAL-SPINED EGGS OF BILHARZIA.

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THE final chapters of my report on the investigation into the mode of spread of bilharziosis in Egypt may not be issued for some time yet owing to my continued absence abroad. I have the kind permission of the editor of the *Journal of the Royal Army Medical Corps* to publish now a short summary of the results obtained in so far as they bear upon the etiological relation of vesical and intestinal bilharziosis and the explanation of the position of the spine in the eggs which give rise to these two distinct clinical manifestations of bilharzia infection. This question has been for years the subject of widespread discussion, but hitherto no finality has been reached.

The controversialists have arranged their arguments and facts around two principal theories.

(a) Looss's theory maintains that the terminal-spined eggs are the normal product of impregnated females of *Schistosoma haematobium*, while the lateral-spined eggs are those produced parthenogenetically where males have not developed.

(b) Manson's theory, based upon the constant and peculiar shape of lateral-spined eggs, their peculiarly limited geographical incidence, and their special selection for the intestinal tract, hypothesizes a zoological distinction in the adult parasites.

An examination of the fresh-water molluscs at El Marg during the spring and summer of 1915 showed that three species, *Bullinus contortus*, *Bullinus dybowskii* (that is, the "*Physa alexandrina*" of Looss), and *Planorbis boissyi*, were infected with certain cercariae, which developed in mice under experimental conditions into bilharzia worms. These worms produced eggs of two kinds—namely, some with typical terminal spines and others with typical lateral spines.

By submitting individual mice, each on one occasion only, for a limited period to infection with the cercariae from single infected molluscs it has been possible to demonstrate that those developing in the *Bullinus* molluscs always produce bilharzia worms which give rise solely to terminal-spined eggs, while those which have developed in *Planorbis boissyi* always become worms which produce solely lateral-spined eggs. In all the experiments males developed and were more numerous than the females.

The cercariae found in *Bullinus*, although very similar to those found in *Planorbis*, showed differences in the suckers, in the relative length of tail, and in other minute points detailed in my final report. The adult worms experimentally reared also showed constant morphological differences. In the worms derived from *Bullinus* spp. the males have four or five large testes and the two lateral gut branches are late in uniting, so that even when mature the worms have a short intestinal caecum. In the female the ovary lies in the latter half of the body. The uterus is very long, voluminous, and contains many terminal-spined eggs, some of which lie in pairs. The yolk glands have a limited range in the posterior fourth of the body. These worms belong to the species *Schistosoma haematobium* (*sensu stricto*). In the worms derived from *Planorbis boissyi* the males are small, and have eight small round testes. The two lateral gut branches unite very early. In some of the smallest specimens found this union had already taken place. The intestinal caecum is correspondingly very long. The female has the ovary in the anterior half of the body. The uterus is very short, and almost invariably there is one egg only at a time in each specimen even when a number have already been laid. The yolk glands are extensive, ranging through the posterior two-thirds of the body along the whole length of the caecum. The eggs always have a lateral spine, the first laid is usually smaller than those succeeding, and the spine is then set almost at right angles to the long axis. Pending a consideration of the claims of other names to priority the specific name *Schistosoma mansoni* may be adopted rightly for these worms. They differ in their adult structure from *Schistosoma haematobium* (*sensu stricto*) more markedly than does *Schistosoma bovis*.

Vesical bilharziosis and Manson's intestinal bilharziosis are therefore etiologically properly regarded as entirely distinct diseases.

IODINE IN TETANUS.

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WHILE the value of iodine as an antiseptic has recently been the subject of discussion, no reference has been made to the well-established facts that iodine possesses the power of rendering tetanus toxin non-toxic, and that such a modification of this toxin can produce active immunity.

An example of this effect is shown in the first table.

TABLE I.—Results of Injecting Subcutaneously into Guinea-pigs a Mixture, consisting of Equal Parts of Gram's Solution of Iodine and of Tetanus Toxin, some of which had been kept at 36° C. and some at Room Temperature for Different Periods before Injection.

Weight of Guinea-pig in Grams.	Quantity of Mixture Injected.	Time and Temperature.	Day after Inoculation.							
			1	2	3	4	6	10	14	
340	1 c.cm.	2 hrs. at 36° C.	—	—	—	—	—	—	—	
380	1 c.cm.	2 hrs. at R.T.	—	—	—	—	—	t	—	
340	1 c.cm.	1 hr. at 36° C.	—	—	—	—	—	—	—	
365	1 c.cm.	1 hr. at R.T.	—	—	—	—	t	tt	t	
340	1 c.cm.	½ hr. at 36° C.	—	—	—	—	t	—	—	
380	1 c.cm.	½ hr. at R.T.	—	—	—	—	tt	tt	t	
375	1 c.cm.	½ hr. at 36° C.	—	—	—	—	t	—	—	
350	1 c.cm.	½ hr. at R.T.	—	—	—	—	tt	t	—	
355	1 c.cm.	At once	—	—	tt	ttt	+	—	—	

R.T. = Room temperature.

Of this toxin, $\frac{1}{300}$ c.cm. killed a guinea-pig of about 350 grams weight in four to five days, and it is obvious that the iodine, when mixed with it, had an immediate effect, but not enough to prevent a fatal result. As the period of contact before injection increased, so did the effect of the iodine become more marked, until the mixture ceased to give rise to any symptoms of tetanus.

The immunizing effect of such a mixture is seen in Table II, which gives details of an experiment in which an iodine-toxin mixture was given in repeated doses.

TABLE II.—*Immunizing Effect of a Mixture of Equal Parts of Gram's Solution of Iodine and Tetanus Toxin. The Mixture was kept for Two Hours at 36° C. before Injection Subcutaneously.*

Date of 1st injection February 24th, 1913.

No.	Weight of Guinea-pig in Grams.	Quantity of Mixture Injected.	Date.			
			Mar. 1.	Mar. 6.	Mar. 11.	Mar. 17.
1	315	c.cm. 1	—	?	—	Each animal received 1 M.L.D. of toxin. All died within 8 days.
2	335	1	—	?	—	
3	360	1	?	?	—	
4	350	1	—	—	—	
5	320	1	—	—	—	
6	335	1	—	—	—	
7	375	1	—	—	—	
8	330	1	—	—	—	
9	325	1	?	?	—	
10	320	1	—	—	—	
11	315	1	—	?	—	Each animal received 2 c.cm. of iodine-toxin mixture.
12	335	1	?	?	—	
13	330	1	—	—	—	
14	340	1	—	—	—	
15	315	1	?	?	—	
16	330	1	?	?	—	
17	320	1	—	—	—	
18	330	1	—	?	—	
19	355	1	?	—	—	
20	360	1	—	—	—	
21	335	1	?	t	?	
22	315	1	?	?	—	

* No further injection; died April 16th. ** Died March 15th.

On March 27th guinea-pigs No. 6-10 each received 1 M.L.D. of toxin; the remaining animals, which were quite well (Nos. 11, 13-17, and 19-22), each received 3 c.cm. of iodine-toxin mixture. All the animals remained quite well.

On April 16th ten animals (Nos. 6-11 and 13-16) each received 2 minimal lethal doses of toxin; the remainder (Nos. 17 and 19-22) each received 5 c.cm. of iodine-toxin mixture. All the animals remained quite well.

On May 1st the animals received the following minimum lethal doses: Nos. 6 and 7, 4 doses; Nos. 8 and 9, 6 doses; Nos. 10 and 11, 8 doses; Nos. 13 and 14, 10 doses; Nos. 15 and 16, 12 doses; and Nos. 17 and 19-22, 4 doses. All the animals remained quite well.

On May 17th the animals Nos. 6-14 each received 100 minimal lethal doses, and Nos. 15-22 each received 50 doses. All the animals remained quite well.

NOTE.—The M.L.D. was 0.00006 gram of a dry standard toxin, and was given beneath the skin of the abdomen. The ? refers to animals which, on palpation, seemed somewhat stiff about the shoulders, but showed no definite signs of tetanus. t = Tetanus. + = Death.

A consideration of the table shows that a single dose of the mixture does not produce enough immunity to protect against one minimal lethal dose (1 M.L.D.) of tetanus toxin. Confirmation of this is afforded by other experiments in which 29 guinea-pigs received subcutaneously doses of iodine-toxin mixture varying from $\frac{1}{300}$ c.cm. to 6 c.cm., and every one of them succumbed to 1 M.L.D. of tetanus toxin given from eleven to twenty-six days later. We see further that two doses of iodine-toxin mixture produced active immunity to 1 M.L.D., while three and four doses

protected against two and four M.L.D.'s respectively. It is possible that the immunity produced was greater, but we cannot say so definitely, as four M.L.D.'s was the highest test dose used.

Such observations naturally suggest the thought that iodine might prove of value as a curative agent in tetanus. Auregan (1915¹) published a series of cases in which he had given a 20 per cent. "ultra finely granular oleaginous suspension of electro-chemical 'colloidal' iodine" with beneficial results. He gave it intramuscularly, but does not mention the size of the doses.

As the treatment of declared tetanus cannot be said to be as yet very successful, it seemed desirable to test experimentally the claim made by Auregan for the use of iodine in tetanus. We therefore carried out a number of experiments on guinea-pigs with this object in view.

In these experiments four guinea-pigs were used for each series. The toxin employed was the same standard test toxin as was used in the previous tests, and each animal received 1 M.L.D. subcutaneously. Twenty-four hours after the injection of the toxin only very slight symptoms of tetanus, or none, were to be observed, and therefore it may be said that the incubation period was about one day. The doses of iodine given in each series were 0.2 c.cm., 0.3 c.cm., 0.4 c.cm., and 0.5 c.cm., except in Series 8, when they ran from 0.1 c.cm. to 0.4 c.cm. Each dose of serum contained 500 U.S.A. units of antitoxin.

When the serum and iodine were inoculated at the same time, they were not mixed before injection, but were given simultaneously in separate places. When an animal received several doses of iodine or of serum, they were all of the same size.

TABLE III.—*Experiment to Ascertain the Curative Effect of a 2.5 per cent. "Colloidal" Iodine Preparation alone and in conjunction with Tetanus Antitoxin.*

Series.	Treatment.	No. of Recoveries, with Doses they Received.	Deaths.
1	Controls; no treatment	None	All within 4 days.
2	Iodine, 24, 43, and 48 hours after toxin	One. 0.4 c.cm. of iodine	3 within 3 days.
3	Iodine, 43 and 48 hours after toxin	One. 0.5 c.cm. of iodine	3 within 3 days.
4	One dose of iodine and of serum, 24 hours after toxin	One. 500 U.S.A. units of antitoxin and 0.5 c.cm. of iodine	3 within 5 days.
5	Serum and iodine, 24 hours, and iodine, 43, 48, 67, and 72 hours after toxin	None	3 within 4 days; 1 within 7 days.
6	Serum alone, 24, 43, 48, 67, and 72 hours after toxin	Three. 500 U.S.A. units of antitoxin	1 within 8 days.
7	Serum alone, 43 and 48 hours after toxin	None	4 within 4 days.
8	Serum and iodine, 24, 43, 48, 67, and 72 hours after toxin	Two. 0.2 c.cm. iodine and 500 U.S.A. units of antitoxin; 0.4 iodine and 500 U.S.A. units of antitoxin	2 within 4 days.
9	Serum and iodine, 43 and 48 hours after toxin	None	4 within 2 days.

A decidedly curative effect cannot be ascribed to this preparation of iodine, though some recoveries followed its administration, for the largest number (3) of animals that survived in any one series was in that which received repeated doses of serum alone; repeated doses of serum together with iodine gave two survivals, while iodine alone was followed by three deaths.

We then experimented with iodargol ("Iode colloïdal électro-chimique, pur et stable"), which is said to contain 25 cg. of iodine in 1 c.cm. All inoculations were made subcutaneously. The toxin was the same as before.

TABLE IV.—Effect of Iodargol. (Six Guinea-pigs, each weighing 340 grams.)

Toxin Injected.	Iodine Injection after 3 Hours.	Day 1 after Inoculation.		Day 2.	Day 3.	Day 4.
		9 a.m.	3 p.m.			
Oct. 27, 1915. 1 M.L.D. 2.15 p.m.	Control; no iodine	— No iodine		t	+	
" "	0.25 c.cm.	— 0.25 c.cm.	0.25 c.cm.	t	tt	+
" "	0.5 c.cm.	— 0.5 c.cm.	0.5 c.cm.	t	+	
" "	0.75 c.cm.	fill	+			
Nov. 5, 1915. 1 M.L.D. 11 a.m.	1.0 c.cm.	— 1.0 c.cm.	1.0 c.cm.	t	+	
	5.0 c.cm.	— No iodine			tt	+

There is little doubt that iodargol had no favourable influence upon the course of the disease.

In other experiments injections of "colloidal" iodine were given before and three hours after the toxin without any beneficial results.

Further, we tested the effect of a preparation of iodine and soluble starch which neutralized tetanus toxin *in vitro*, but it proved quite ineffective as a curative agent. On one occasion the animals did survive, but this result seemed mostly accidental, for the injections were inadvertently made too close together, and the swelling caused by the injection of toxin joined to that due to the iodine, and thus the latter may have come into direct contact with the toxin before it was absorbed. When this experiment was repeated, care being taken to place the injections far enough apart to prevent direct mixing, the result was death of both the animals.

CONCLUSION.

We are forced to come to the disappointing conclusion that iodine injected subcutaneously has no effect upon tetanus toxin which has been also injected subcutaneously in a different place.

We cannot, therefore, hope to influence favourably the course of an attack of tetanus by injections of iodine alone, nor does iodine appear to have any effect in enhancing the power of serum.

It would seem, then, that iodine can only be of use when applied to the infected focus, so that it can come into direct contact with the toxin before absorption.

REFERENCE.

¹ *Lancet*, 1915, i, p. 430.

THREE CASES OF ABDOMINAL GROWTHS PRESENTING VERY UNUSUAL CHARACTERS.

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CASE I.—Tumour Composed of many Hydatid Cysts Growing within the Abdomen, and Protruding into an Umbilical Hernia so as to form a Large Pendulous Growth.

A WOMAN, S. H., aged 39, was admitted to the General Hospital in April, 1914, with a very hard, heavy, lobulated

FIG. 1.

mass protruding at the umbilicus (Fig. 1). There were some round elastic nodules on its surface. The umbilicus

was lying on it, and it was sent to the hospital as an umbilical hernia. It measured 7 in. by 6½ in. When the patient stood up it hung down (as shown in Fig. 2) so far that the upper surface came as low as the pubes. Because it was so heavy it dragged down the abdominal wall in a funnel-shaped form with it. She always had to support it when her bowels acted. A number of firm round nodules could be felt extending from it, up under the abdominal wall. It was clearly not a simple umbilical hernia, but some form of growth, perhaps extending into the sac of an umbilical hernia, but the nature of the growth was not suspected.

FIG. 2.

At the operation on April 14th I found there was an umbilical hernia, and that a very thick mass of omentum passed out of the abdomen into it. To the distal end of this, lying in the hernia, a large lobulated tumour was attached. The abdomen was full of cysts, some quite small and others the size of duck's eggs. They occupied every part from the pelvis to the diaphragm, some lying under the stomach. I was able to divide the omentum, connecting the colon and the cysts within the abdomen with the umbilical tumour, and then removed the tumour mass with the overlying skin, and brought the edges of the umbilical opening together by the overlapping method. The umbilical tumour weighed 3 lb. 8 oz., and was composed of a number of the same kind of cysts as those within the abdomen, fused together. I found they were typical hydatid cysts. The patient made a good recovery, and returned to South Wales. In answer to a letter of inquiry as to her present condition sent last July, the only information she supplied, with regard to her abdominal condition, is contained in these words: "I am getting on all right, and don't feel no ill effects in the stomach."

CASE II.—Sarcoma of the Small Intestine causing Recurrent Attacks of Obstruction.

A woman, R. S., aged 44, was sent to me at the General Hospital in October, 1914, by Dr. Graham, of Watchet, with recurrent attacks of abdominal pain. She had the first attack two years before I saw her, the second one year before. For sometime before I saw her she had been getting the attacks every few days. In April she had a very severe one, lasting several days, and requiring hypodermic injections of morphine. All the attacks, even the one two years before I saw her, were of the same character; the pain was either just at the umbilicus or close to it, and was usually most severe at the umbilicus. It was of a gripping character, and after lasting some hours she generally vomited, and then the pain either diminished or ceased. She said she was generally distended when in pain. She suffered from habitual constipation, but for some time she had had no action of the bowels without aperients or enemata. The vomit was bile, and there was no history of either haematemesis or melaena. For a month before I saw her she had been on liquid diet only, with the exception of a small quantity of bread, but had had severe attacks every few days. When she had been taking ordinary diet the attack used to come on two or three hours after dinner.

On admission there was nothing abnormal to be made out in the abdomen, but when seen in an attack of pain I found considerable distension in the lower abdomen, and once I could make out a distended coil. I thought the attacks were due to intestinal obstruction, probably from adhesions. I operated on October 20th, and found the obstruction due to a growth in the small intestine. The coil containing the growth was lying quite free in the pelvis. It must have been about the middle of the small