influence of overwork, fatigue, and the physical discomfort of life at the front.

Recent findings have led me to give some attention to the possible effects of bullet and shrapnel retained in the body. In the urine of a young corporal with a bullet in his right thigh we found lead; in that of a sergeant shot through the arm and chest, and with the metal retained in the chest, lead was also found; in the urine of a soldier with pieces of shrapnel in knee and shoulder a small quantity of lead was found; while in the urine of a young lieutenant, mortally wounded, with shrapnel in his pelvis, lead was found. It is only right to add that in the urine of other soldiers with shrapnel retained in the body no lead was found, and that in the urine of one patient similarly circumstanced lead was on one occasion absent, while a fortnight after it was present. Although in cases where lead was found in the urine albumin was not present in every instance, yet in other instances there seemed to be a distinct connexion between the albuminuria and the retained shrapnel, as the following indicates:

I was asked by one of my surgical colleagues to see a young soldier with a piece of shrapnel in the front of the uppermost part of the left thigh. The patient was extremely ill. He had albuminuria, with recurring haematuria; the wound in the thigh kept closing and opening every now and then, attended by rises of temperature. The surgeon took the view that the wound would not heal on account of the condition of the patient's kidneys, which he thought antedated the receipt of the wound. My opinion was that the presence of the shrapnel in the body was the cause of the kidney trouble, and that if the shrapnel was removed the kidney trouble would cease. The patient was transferred to my own ward, where, by external applications aided by natural processes, the shrapnel gradually came nearer the surface, and could be readily felt under the skin. As the patient was too ill to be given a general anaesthetic, local anaesthesia was employed and the shrapnel removed by the surgeon. From the date upon which the shrapnel was removed the temperature gradually fell to the normal, the wound closed, the albuminuria entirely and permanently disappeared, and the patient made a good recovery.

It has been the practice of surgeons during this war where pieces of projectile have become embedded in the tissues, are not readily accessible, are not pressing upon nerves or upon important organs, and where there is neither haemorrhage nor excessive suppuration, to leave the metal in the body undisturbed. There is always the possibility of the piece of shrapnel or bullet becoming encysted and remaining as an inoffensive foreign body. Yet, now and again, it has happened that some of these metal carriers whose wounds have healed have been observed to become anaemic, to be suffering from disorders of the intestinal and nervous system and to have become the subjects of albuminuria. Since in their urine lead is frequently found, it is clear that resorption of the metal must be taking place. It goes without saying that pieces of shrapnel are more likely to cause plumbism than portions of shell. All depends upon the type of metal, the organ or tissues in which it is embedded, and whether there is or is not suppuration. In all cases, therefore, where pieces of shrapnel are retained in the body it would be well to have the patient's urine examined for lead.

As lending support to this, Loeper and Verpy⁷ may be quoted. They found lead in the urine of six out of sixteen soldiers in whose body pieces of projectile had been retained. They found it only with shrapnel and not with the debris of shell, also never when the bullet was intact. They found lead to the extent of $\frac{1}{2}$ to 1 mg. per litre of urine; in other words, that more than 1 mg. of lead was being eliminated in twenty-four hours. This is a smaller quantity than is occasionally found in the urine of lead workers, but it is equal in quantity to, or slightly more than, that found in the urine of persons poisoned by food or by drinking water contaminated by lead. When a wounded soldier with shrapnel retained in his body is passing from $\frac{1}{2}$ to 1 mg. of lead daily the kidneys in course of time are almost sure to become affected, for secondary lead compounds are being formed; these are absorbed, and pass on into the circulation. The extent to which this takes place will depend upon the leucocytes and the chemical activity of the tissues. Absorption of shrapnel is slow; lead does not appear in the urine until three to four weeks after a soldier has been wounded. When resorption of the metal is taking place there is a tendency in some instances for the blood pressure to rise, for albumin to appear in the urine, for the red blood cells to decrease in number, and for colic and constipation to be complained of. Since

in one of my own patients albuminuria and suppuration gradually ceased after removal of the shrapnel it would seem as if there had been a causal relation between the condition of the kidneys and retention of the metal in the body. I am not in a position to say whether the presence of shrapnel in the lung is more provocative of plumbism than when the piece of projectile is retained in the body elsewhere.

With the object of testing the solubility of lead bullets generally, and of throwing light upon the fate of shrapnel retained in the body and exposed to the influence of the fluids of the tissues, also to the influence of fat upon metallic lead, I secured the co-operation of Messrs. T. M. Clague and A. J. Watson, analytical chemists of this city, to whose report I invite attention.

EXPERIMENTS ON THE SOLUBILITY OF PLAIN LEAD AND ANTIMONIAL LEAD.

BY

T. MALTBY CLAGUE, Ph.C., and A. J. WATSON, Ph.C.

"CERTAIN clinical observations made by Sir Thomas Oliver suggested the desirability of an examination into the comparative solubilities in the fluids of the human body and in analogous liquids of the modern hardened bullet and the old bullet of pure lead.

"The uncoated shrapnel bullets used by the enemy and allied forces of to-day contain antimony in large amount (10 per cent. and upwards).

"Bullets were placed by us in the blood serum of sheep and macerated for seven days. After burning off, the residue was found to contain lead equivalent to 10 parts per million of the blood serum, but the analytical difficulties of dealing with the blood were great, and for convenience a solution was prepared containing 0.9 per cent. of NaCl and 0.13 per cent. NaHCO₃ to represent blood serum. Shrapnel bullets macerated for four days (heated each day to 35° C. (95° F.) for six hours) yielded in the case of pure lead 260 parts per million, and in the case of antimonial lead 300 parts per million.

"With a view to a more complete conformity to the conditions found in the human body an automatic circulating system was arranged in which an alkaline saline solution circulated through a U tube containing six bullets.

FIG. 1.—Water at 70° C. surrounded the limb of U tube containing the bullets; this caused the solution to circulate; the temperature did not rise above 25° C. to 30° C. After six hours' circulation, 20 c.cm. removed from Woolf bottle at position of least contact (x) contained 5 parts of lead per million of water; after fourteen hours' circulation it contained 7 parts per million. The liquid in the U tube was allowed to digest thirty-six hours in the cold and then removed. Pb content was found equal to 14 per million.

Antimonial Lead Bullet.

Oily Solvents.	Acidity.	Lead Yielded in Parts per Million of Solvent.
Lard	1.0	10
Neatsfoot oil	3.2	200
Suet	0.7	5
Olive oil	1.6	100
Liquid paraffin	0.0	Nil.

Bullets in solvent for six days heated to 35° C. (95° F.) each day for six hours.

Solubility of Bullets, Pure Lead, and Antimonial Lead.

Time.	Solvent.	Pure Lead.	Antimonial Lead.
6 days (heated) ...	Neatsfoot oil (acidity 3.2) Olive oil (acidity 1.6)	Per Million. 200 300	Per Million. 200 200
4 days (cold) ...	Neatsfoot oil (acidity 3.2)	30	15
1½ days (heated) ...	Olive oil (acidity 1.6)	300	100

A piece of a lead bullet was placed in pus removed from a case of empyema. It was allowed to remain therein for forty-eight hours at a temperature of 40° C. On examination the pus was found to contain 12 parts of lead per million.

"The result of our experimental work shows that present-day hardened lead is soluble in the proportion of approximately three parts as against two and a half of pure lead in aqueous liquid, and that in fatty liquids or semi-liquids the pure lead is much the more soluble."

In addition to lead, shrapnel contains antimony and arsenic, and this raises the interesting question whether antimony and arsenic may not be absorbed as well as lead. It was common practice years ago in Germany, when horses were taken to market to be sold, for horse dealers to give to broken-winded animals a few ounces of small shot. This was followed by good effects which lasted for several days. The improved condition of the animals was attributed to the arsenic in the shot. We cannot, of course, compare the presence of shot in the alimentary canal of a horse with the retention of pieces of shrapnel in the lungs, the muscles, connective and adipose tissues of a wounded soldier. Apart from animal differences the metal in one instance is first exposed to an acid medium in the stomach, while in the other it is exposed to the alkaline juices of the tissues of the body, even allowing for the slightly acid reaction developed in actively contracting muscle. Experiments have been made in regard to this subject in Germany. Professor L. Lewin of Berlin, in a paper¹ on the toxic effects of arsenic in bullets, states that 10 grams of shrapnel containing 8 per cent. of antimony and 14 mg. of arsenic were broken up into numerous small pieces, placed in the undermentioned solvents in an Erlenmeyer's flask and kept at a temperature of 38° C. The results were as follows:

Experiment.	Solvent.	Duration in Days.	Solution in Percentage.		
			Lead.	Antimony.	Arsenic.
1	HCl 0.25 %	6	0.033	trace	trace
2	HCl 0.25 %	14	1.1	0.02	trace
3	Olive oil	6	0.628	trace	trace
4	Olive oil	14	2.0	0.57	trace

From these experiments we learn that more antimony than arsenic was dissolved, and that the amount of antimony dissolved was proportional to the length of exposure; also that, high as a solvent dilute hydrochloric acid may be for lead, olive oil is even higher. Lewin submitted similar pieces of shrapnel to the action of weak alkaline solutions—for example, 0.05 per cent. to 0.2 per cent. of soda—but, even after fourteen days' exposure, the amounts of antimony varied from 0.007 to 0.013 mg., while the amount of arsenic remained at 0.0002. From these experiments we may take it that, so far as the retention of shrapnel in the body is concerned, no damage is to be apprehended from arsenic and antimony. The one danger is lead.

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NOTES ON PAINLESS CHILDBIRTH.

(HYOSCINE (SCOPOLAMINE) AND MORPHINE.)

BY

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ALTHOUGH several papers have been published in this country on the satisfactory and safe use of scopolamine and morphine in labour, further records appear desirable. An account of those cases in a consecutive series which illustrate the chief points will be more useful than an abstract treatise. I will therefore state the facts and give illustrations from a first series of 60 consecutive cases, 30 conducted in hospital, and 30 in private practice, most of the latter being in a nursing home. If the series were extended and the first cases excluded, I could show better results, but my chief object is to point out the pitfalls and possible dangers. The technique was modelled on that of Gauss of Freiburg.

Illustrative Cases.

The two following cases indicate the possibilities and technique:

CASE I.

Primipara, with a small round pelvis. In consultation it was decided that a normal delivery at term was possible.

The patient was awakened at 2 a.m. the day before term by sharp pains; although unable to sleep she did not send till 9 a.m. as subsequent pains were slight and at long intervals; there was not much suffering during the day, but at 9 p.m. the pains became severe. At 10 p.m. morphine $\frac{1}{2}$ gr. and hyoscine $\frac{1}{16}$ gr. were injected, the os then being the size of a two-shilling piece. The ears were plugged with cotton-wool soaked in oil, the room darkened, and the patient put on her side in bed. In twenty minutes she was sleeping quietly, and continued to do so till 1.35 a.m.; the fetal heart being satisfactory, at 1.45 a.m. hyoscine $\frac{1}{16}$ gr. was given, and a drink of water. At 5.30 a.m. the patient was again rousing; the membranes ruptured and the os was found to be fully dilated, so a third dose of hyoscine $\frac{1}{16}$ gr. was injected. At 8 a.m. a little chloroform was given by a colleague and the child delivered with forceps at 8.20 a.m. The patient did not wake till 10 a.m., when she found by feeling her abdomen that the baby was born. She said she felt no pain after the first injection.

CASE II.

Multipara. The patient was brought by her husband; she was not enthusiastic, looking on the treatment as an unnecessary fuss and expense.

Labour began at 2.30 p.m., when the os admitted two fingers; at 2.40 p.m. morphine $\frac{1}{2}$ gr. and hyoscine $\frac{1}{16}$ gr. were given; accessory treatment as usual. The patient lay on her side and went to sleep almost immediately; at 5.30 p.m. she moved for the first time, sat up in bed, and asked for a drink of water; she at once went to sleep again; at 6.45 p.m. the second dose (hyoscine $\frac{1}{16}$ gr.) was given; she was soon asleep, and the nurse thought all pains stopped; she woke up once and had another drink of water. The third dose (hyoscine $\frac{1}{16}$ gr.) was given at 11 p.m. She again went to sleep; fifty minutes later the nurse noticed her moving; she looked and found the head crowning, the baby being born before any one else could be summoned, the nurse describing it as being born with only one pain.

This patient (Case II) was subsequently most enthusiastic about the treatment. The case shows that the effect is not due to any psychological impression on the patient.

It must not be assumed that all cases will be so simple and satisfactory; occasionally the patient is restless; slight degrees can be dealt with by a few whiffs of chloroform; when severe the condition is due to faulty technique, either not giving the patient water to drink or excessive doses of hyoscine, as the following record shows.

CASE III.

Primipara. Pelvis contracted, the external measurements being: Interspinous, 9 in.; intercrystal, 10 in.; external conjugate, 7 in.

Severe pains began at 4 a.m.; at 4.15 a.m. morphine $\frac{1}{2}$ gr. and hyoscine $\frac{1}{16}$ gr. were given. The patient was soon asleep. Doses of hyoscine $\frac{1}{16}$ gr. were given at 5.30 a.m., 9.30 a.m., and 12.15 p.m. At 4 p.m., as the patient was becoming conscious and there was no prospect of delivery for some hours, another dose of morphine $\frac{1}{2}$ gr. was given with hyoscine $\frac{1}{16}$ gr.; at 7.30, and again at 10.15 p.m., hyoscine $\frac{1}{16}$ gr. was given. I was then obliged to leave, so left a further dose of hyoscine $\frac{1}{16}$ gr. to be given if necessary. Shortly after the patient woke and became very restless. The nurse, thinking this was due to an insufficient dose, injected another hyoscine $\frac{1}{16}$ gr. at 11 p.m., the eighth dose, without applying the memory test. The restlessness increased, and in a short time the patient was so noisy and unmanageable that I was summoned. I found her delirious;