Conclusion.

So far as the evidence in these cases goes, the conclusion may be drawn that, in cases of chronic constipation, the variations between the rates of passage of the bismuth along the intestine were but small, whether the bowel had been emptied by a preliminary aperient or not; at the most the differences were not greater than can be said to be within the normal limits.

Further, where differences were noted in the two series, they were not constant, being in one case in the direction of greater rapidity after an aperient, in another of less, and in a third varying at different times in the same patient.

It is, however, undoubtedly wise in most cases to give a purge before making an x-ray examination, on account, first, of the greater clearness of the skiagrams obtained when the intestine is empty; and secondly, of the discomfort which the patient, deprived of his usual aids to defaecation, may experience in the two or three days occupied by the x-ray observations, during which, of course, no aperient must be given.

The result of these trials appears to show, nevertheless, that in cases in which time does not permit of a preliminary purge, or in which it is undesirable for any other reason to give it, the conclusions reached may be accepted without the fear that they have been materially vitiated by the omission.

INSECTS AND WAR:

III.—FLEAS.

By A. E. SHIPLEY, Sc.D., F.R.S.,
MASTER OF CHRIST'S COLLEGE, CAMBRIDGE.

Marke but this flea, and marke in this,
How little that which deny'st me is;
It sucked me first, and now sucks thee,
And in this flea our two bloods mingled bee.

Dr. DONNE.

THE fact, now fully established, that the bubonic plague is conveyed to man from infected rats or from infected men by fleas has taken that wingless insect out of the category of those animals which it is indelicate to discuss.

No doubt, as Mr. Dombey says, "Nature is on the whole a very respectable institution"; but there were times when she presented herself in a form not to be talked about, and until a few years ago the flea was such a form. Hence few but specialists have any clear idea either of the structure or of the life-history or of the habits—save one—of the flea.

Fleas are temporarily parasitic on many mammals and birds, but some mammals and some birds are much freer

Fig. 1.—*Pulex irritans*, female. The legs of the left side only are shown. (After a drawing by A. Dampf.) Enlarged.

from fleas than others. As the flea is only on its host for part of the time, it has to put in the rest of its existence in some other place, and this in the case of the human flea is usually the floor, and in the case of bird-fleas the nest; from these habitats they can easily regain their hosts when they retire to rest. But large numbers of ruminants—deer, cattle, antelopes, goats, wild boars—sleep in different places each night, and to this is probably due the fact that, with the exception of two rare species, one taken in Northern China and the other in Transcaucasia, the ruminants have furnished descriptive science with no fleas. Both of

these ruminant fleas are allied to the burrowing fleas or "chigoes."

I know I shall not be believed when I say that the same is true of monkeys, but I do this on the undoubted authority of Mr. Harold Russell, who has recently published a charming little monograph on these lively little creatures. Monkeys in nature are cleanly in their habits, and although in confinement occasionally a human flea attacks them, and although occasionally a chigo bores into the toes of a gorilla or chimpanzee, "speaking generally, it may be said that no fleas have been found truly parasitic on monkeys." Whatever the monkeys are looking for, it is not fleas. What they seek and find is in effect little scabs of scurf, which are made palatable to their taste by a certain sour sweat.

As a rule, each host has its own species; but though for the most part *Pulex irritans* is confined to man, it is occasionally found on cats and dogs, whilst conversely the cat and dog fleas (*Ctenocephalus felis* and *Ct. canis*) may attack man. The bite of the flea is accompanied by the injection of the secretions of the so-called salivary glands of the insect, and this secretion retards the coagulation of the victim's blood and stimulates irritation.

It is only a few years ago that the spread of plague was associated first with rats, and then with rat-fleas; and it became at once of enormous importance to know which of the very numerous species of rat-flea would attack human beings. The Hon. Charles Rothschild, who has accumulated a most splendid collection of preserved fleas in the museum at Tring, had some years ago differentiated from an undifferentiated assemblage of fleas a species first collected in Egypt, but now known to be the commonest rat-flea in all tropical and subtropical countries. This species (*Xenopsylla cheopis*)—and to a lesser extent *Ceratophyllus fasciatus*—unfortunately readily bites man, and if they should last have fed upon a plague-infected rat, their bites will communicate bubonic plague to human beings. Plague—the old English "Black Death"—is a very real peril in armies operating in Asia and in certain parts of Africa.

Just as some fleas attack one species of mammal or bird and avoid closely allied species, so the human flea has its favourites and its aversions. There is a Turkish proverb which says "An Englishman will burn a bed to catch a flea," and those who suffer severely from flea-bites would certainly do so; but there are persons even a flea will not bite. Mr. Russell has reminded us in his Preface of the distinguished French lady who remarked, "Quant à moi ce n'est pas la morsure, c'est la promenade!"

There are one or two structural features in a flea which are peculiar, the most remarkable being that, unlike other insects, it is much taller than it is broad. As a rule insects, such as a cockroach, the bed-bug, or a stag-beetle, are like skates—broader than they are thick; but the flea has a laterally compressed shape, like a mackerel or herring. Then the three segments or rings which come after the head are not fused into a solid cuirass as they are in the fly or the bee, but are movable one on the other. It is usual in insects for the first joint of the leg to be pressed up against and fused with the segments of the body that bear them, but in the flea not only is this joint quite free, but the body-segment gives off a projection which stretches out to bear the leg. Thus the legs seem, unless carefully studied, to have an extra joint and to be of unusual length. They certainly possess unusual powers of jumping. As Gascoigne, a sixteenth century poet (1540-78), writes, "The hungry fleas which frisk so fresh." The male, as is so often the case amongst the invertebrata, is much smaller than the female. The latter lays at a time from one to five minute, sticky, white eggs, one-fortieth of an inch long by one-sixtieth broad. They are not laid on the host, but in crevices

Fig. 2.—Larva of *Pulex irritans*. Cf. frontal horn; d, antenna. Enlarged.

between boards on the floor, or at the bottom of a dog kennel or bird's nest. Mr. Butler recalls the case of a gentleman who collected on four successive mornings 62, 78, 67, and 77 cat-fleas' eggs from the cloth his cat had slept upon. Altogether 280 eggs in four nights! The date of hatching varies very much with the temperature. *Pulex irritans* takes half as long again—six weeks instead of four—to become an adult imago in winter as in summer, but in India the dog-flea will complete its cycle in a fortnight.

When it emerges the larva is seen to be a whitish segmented little grub without any limbs, but with plenty of bristles which help it to move about; this it does very actively. There are two small antennae and a pair of powerful jaws, for the larva does not take liquid food, but eats any scraps of solid organic matter which it comes across; dead flies and gnats are readily devoured. The larva casts its skin several times, though exactly how often it moults seems still uncertain.

After about twelve days of larval existence it spins itself a little cocoon in some sheltered crevice, and turns into a whitish inert chrysalis or pupa. During its pupal existence it takes, of course, no food, but it grows gradually darker, and after undergoing a tremendous internal change, breaking down its tissues and building up new ones, the chrysalis case cracks and the adult flea jumps out into the world.

There are many superstitions about fleas. March 1st is in some way connected with them, and in the south of England the house doors are in some places closed on that day under the belief that this will render the building immune for the following twelve months. The most successful insecticide is said to be prepared from *Pyrethrum*, which is grown in the near East in large quantities for this purpose. Wormwood (*Artemisia*) is also recommended.

While wormwood hath seed, get a handfull or twaine,
To save against March, to make flea to refrain;
When chamber is swept and wormwood is strowne,
No flea for his life dare abide to be known.

TUSSER.

The author of *A Thousand Notable Things* suggests the following plan, but, so far, I have not met any one who

Fig. 3.—Pupa of flea.
(After Westwood.)

Fig. 4.—*Ceratophyllus gallinulae*. Male (above) and female (below). Drawn to scale and both highly magnified. These specimens taken from a grouse are of the same genus as one of the plague-conveying fleas.

has tried it: "If you mark where your right foot doth stand at the first time that you do hear the cuckoo, and

then grave or take up the earth under the same; where-soever the same is sprinkled about, there will no fleas breed. I know it hath proved true."

Plastering a floor with cow-dung, which is a common practice in South Africa, is said to be a very efficacious means of keeping down fleas.

But we must, in the long run, treat fleas seriously. Although the *Pulex irritans* is a very common insect, the greatest living authority on fleas tells me it has never been accurately drawn. We have Blake's "ghost of a flea," but what did Blake know of entomology? In distinguishing one flea from another—fleas which may attack man and fleas which have hitherto declined to do so—every hair, every bristle counts (Fig. 4). Hence I illustrate this article with accurate outlines of certain fleas found on the grouse, and for whose accuracy I can vouch. As I have said above, a certain rat-flea (*Xenopsylla cheopis*) and another (*Ceratophyllus fasciatus*) undoubtedly conveyed the bacillus of plague from rats and other Murinae to man and vice versa. The *Bacillus pestis* is unlikely to establish itself in the present war, but *quien sabe!* The Black Death of 1349-51 was conveyed by fleas, and so was Pepys's plague of 1665. Plague—flea-borne, we must remember—is still endemic in places as near Europe as Tripoli, and in numerous centres in Asia. Not a disease altogether to be neglected; but still not a very threatening one in Europe in the twentieth century.

BACILLI AND BULLETS.

AN ADDRESS TO THE OFFICERS AND MEN IN THE CAMPS
AT CHURN.*

BY SIR WILLIAM OSLER,

REGIUS PROFESSOR OF MEDICINE, OXFORD.

I HAVE been asked to say a few words on the question of health in war time, that you may realize its importance. Formerly an army marched on its belly; now it marches on its brain. Only by utilizing existing knowledge, in all grades from commander-in-chief to private, is the maximum of success available. To put the largest number of the enemy out of action with a minimum of loss to his own men is the aim of every general. While in one way modern war merges the individual in a great machine, on the other hand the intelligent action of the unit has never been so important a factor in making the machine work smoothly and efficiently. After all, it is the man behind the gun who wins the victory.

What I wish to urge is a true knowledge of your foes, not simply of the bullets, but of the much more important enemy—the bacilli. In the wars of the world they have been as Saul and David—the one slaying thousands, the other tens of thousands. I can never see a group of recruits marching to the dépôt without mentally asking what percentage of these fine fellows will die legitimate and honourable deaths from wounds, what percentage will perish miserably from neglect of ordinary sanitary precautions? It is bitter enough to lose thousands of the best of our young men in a hideous war, but it adds terribly to the tragedy to think that more than one-half of the losses may be due to preventable disease. Typhus fever, malaria, cholera, enteric, and dysentery have won more victories than powder and shot. Some of the diseases I mention need no longer be dreaded. Typhus, and malaria, which one hundred years ago routed a great English army in the Walcheren expedition against Antwerp, are no longer formidable foes. But enough remain, as we found by sad experience in South Africa. Of the 22,000 lives lost in that war—can you believe it?—the bullets accounted for only 8,000, the bacilli for 14,000! In the long arduous campaign before us more men will go into the field than ever before in the history of the Empire. Before it is too late, let us take every possible precaution to guard against a repetition of such disasters. I am here to warn you soldiers against enemies more subtle, more dangerous, and more fatal than the Germans—enemies against which no successful battle can be fought without your intelligent co-operation. So far the world has only seen one great war waged

* Copies of this address in pamphlet form can be obtained from the Oxford University Press, London, Edinburgh, Glasgow, New York, Toronto, Melbourne, and Bombay, price one penny net.