COCKROACHES.

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

II.

"In Russia the small Asiatic cockroach has everywhere driven before it its greater congener" (*P. germanica*).

DARWIN (*Origin of Species*).

COCKROACHES do a very considerable amount of damage by consuming food supplies. But they do not stop at food supplies; woollen clothing, newspapers—not a great loss—blackening, ink, leather, and even emery paper, are all to their taste, and being of an economical frame of mind they devour their own cast skins and the dead bodies of their relatives. The late Professor Moseley recorded how on one occasion, when on the circumnavigating tour of H.M.S. *Challenger*, a number of cockroaches took up their abode in his cabin and devoured parts of his boots, "nibbling off all the margins of leather projecting beyond the seams on the upper leathers." He further records: "One huge winged cockroach baffled me in my attempts to get rid of him for a long time. I could not discover his retreat. At night he came out and rested on my book-shelf at the foot of my bed, swaying his antennae to and fro, and watching me closely. If I reached out my hand from bed to get a stick, or raised my book to throw it at him, he dropped at once on the deck, and was forthwith out of harm's way. He bothered me much, because, when my light was out, he had a familiar habit of coming to sip the moisture from my face and lips, which was decidedly unpleasant, and awoke me often from a doze. I believe it was with this object that he watched me before I went to sleep. I often had a shot at him with a book or other missile as he sat on the book-shelf, but he always dodged and escaped. His quickness and agility astonished me.

At last I triumphed by adopting the advice of Captain Maclear and shooting him with a pellet of paper from my air-gun, a mode of attack for which he was evidently unprepared."

It is on record that cargoes of cheeses have been destroyed by cockroaches on ships. Not only do they devour great quantities of each cheese, but these insects defile every one of them with a very tenacious fluid which has a most disgusting smell. This the cockroaches pour out from their stink-glands, making the cheeses of no commercial value.

When a cockroach casts its skin a median longitudinal slit appears on the back of the thorax, and through this

Fig. 1.—Cast skin of older nymph (pupa). $\times 2\frac{1}{2}$.

slit the insect slowly emerges. With much labour and difficulty it squeezes its body through and pulls one limb after another from its old integument, until at last even the long whip-like antennae are completely withdrawn. Certain portions of its inner anatomy, such as the lining of parts of the breathing tubes, or tracheae, are also left behind. Should the discarded skin not be eaten by the emergent insect, it remains on the floor and might easily be mistaken for a sedentary cockroach but for the fact that live cockroaches never are sedentary.

The incomplete metamorphosis, the generalized character of the nervures of the hind wings, the complete separation of the three thoracic segments (or rather their want of fusion so conspicuous in the higher insects—the flies and the bees), and the undifferentiated condition of the mouth organs, all point to the insect being of a primitive type. But there is no doubt that, whether a primitive insect or not, the cockroach is a very successful one; it is an *arriviste*—as "our lively friend, the Gaul," to quote Mr. Micawber, would say—probably owing to its attaching itself in all cases, and with unvaried devotion, to the habitation of men. Not popular with humanity, it nevertheless ceaselessly extends its domain by slowly yet surely entering

into new and hitherto unconquered human habitations. In spite of insect traps and vermin killers, it is extremely difficult to eradicate from a house when once it is well established. It has, in fact, gradually dislodged in most places in Great Britain and Ireland the old domestic

Fig. 2.—Nymph (in last larval stage) escaping from old skin. Magnified.

house-cricket. For in spite of its irritating, and to some people quite maddening, ticking, the "cricket-on-the-hearth" has somehow established itself as a household pet, and one that has won not only our respect but our affection. So curious is our psychology.

"The cockroach has many enemies, and the genus *Sphex* (or *Chlorion*) may be seen hunting about here and there, up and down the roadside and gardens, searching for its favourite prey. It spies out a cockroach, which appears to know intuitively that there is danger at hand, for it shows symptoms of great fright, and seems so confused that it cannot run away. The *Chlorion* pounces upon the insect, clasps it with its mandibles between the head and the corselet, and stabs it in the body with the sting. Then it flies off for a little distance, and awaits the effects of the poison thus introduced; and when the convulsions of the victim have ceased, the clever little insect seizes its stupefied prey, and drags the heavy burden with great efforts to its nest. Usually the opening of the cavity is so narrow that the cockroach cannot be got in, for its legs and wings stick out and prevent its introduction. But the *Chlorion* sets to work and cuts off the legs and the wings, and having thus lessened the difficulty, it strives hard to push the body into the hole, but as this plan usually fails, the hymenopteron enters first of all, seizes the cockroach with its mandibles, and drags it in with all its force. As the integuments of the *Blatta* are more or less soft and flexible, the great insect is at last forced into the gallery, where it never could have been expected to have entered. Such proceedings on the part of the *Chlorion* almost verge upon the domain of reason; and it is difficult to explain them by the notion of that very indefinite quality called instinct, for the manœuvres vary according to circumstances, and there appears to be an intelligent method of overcoming every difficulty."

Apart from animals which eat it, there are a number of parasites which infest it, beginning with the parasitic beetle *Symbius blattarum*, whose wingless females attach themselves to the bodies of the cockroaches and feed upon their tissues. Then occasionally a round-worm, *Filaria rhytipleurites*, whose sexual stage is passed in the rat, is found in its larval stage in the fat bodies of the cockroach.

Two years ago Dr. C. Conyers Morrell undertook some investigations and observations as to what part, if any,

Fig. 3.—Egg capsule of *P. orientalis* (magnified). A, External view; B, opened; C, end view.

cockroaches played in the dissemination of pathogenic microbes, his object being, as he says, "first to ascertain what bacilli belonging to the colon group are likely to be conveyed to food and milk by this insect, and secondly to find whether known bacteria and moulds can be transmitted by the faeces." Dr. Conyers Morrell's experiments were conducted on one of the Union-Castle liners sailing to South Africa, and the insects which were investigated

were collected only from the larder or passages adjacent to the kitchens; in no case were they taken from lavatories or from state-rooms. The general condition of the ship, which was almost new, was one of exceptional cleanliness, and thus afforded good conditions for the experiments. Dr. Morrell was of opinion that there was little danger except by contamination from the faeces of the infected insect.

One of his first experiments was to prove that should cockroaches fall into the dough which was being baked for bread the heat of the baking entirely destroyed the bacilli that were in the alimentary canal of the insect. With regard to infection with the colon bacillus he kept an infected insect under the best antiseptic conditions he could compass until it had passed some undigested food. Of this undigested food an emulsion was prepared, and cultures were made from it on bile-salt medium and in litmus-milk. Afterwards special cultures were made in gelatine and peptone solutions. Incubation was conducted in all cases at 37° C., and cultures were made from seventeen specimens. Five of these produced colonies of bacilli on the bile-salt medium, with subculture results as follows: Four produced acidity and clotting of milk, acid and gas in glucose, lactose and saccharose, and production of indol. But the bacilli did not liquefy gelatine, and were Gram-negative. One specimen produced gas in glucose and lactose and liquefied gelatine and coagulated milk. The former in its reaction corresponded with the *Bacillus lactis aerogenes*, the latter with *Bacillus cloacae*. In five cases greenish moulds of the aspergillus variety were found after inoculating litmus-milk.

Cockroaches will devour human sputum with avidity, and are frequently to be found in spittoons (or, as the more delicately minded American calls them, "cuspidors"), and it is interesting to know that after feeding the insects on infected sputum from a tuberculous patient, the tubercle bacilli are found in the faeces within twenty-four hours; two specimens which had been fed on staphylococci showed these pathogenic organisms in their faeces and in the cultures on agar-agar, which were obtained from these dejecta.

I have quoted largely from this important paper, and now propose to quote a good deal more, and thus I append Dr. Conyers Morrell's conclusion of the important experiments he conducted on the Union-Castle liner.

"The foregoing experiments, though insufficient in number to afford a basis for working out percentage results, are, I think, of some value, in that they prove the following facts:

"The common cockroach is able by contamination with its faeces (1) to bring about the souring of milk, (2) to infect food and milk with intestinal bacilli, (3) to transmit the tubercle bacillus, (4) to disseminate pathogenic staphylococci, (5) to transmit from place to place destructive moulds.

"These facts, taken in conjunction with the life-habits of the insect, lead to the conclusion that the cockroach is able to and may possibly play a small part in the dissemination of tuberculosis, and in the transmission of pyogenic organisms; that the insect is in all probability an active agent in the souring of milk kept in kitchens and larders; and that it is undoubtedly a very important factor in the distribution of moulds to food and to numerous other articles, especially when they are kept in dark cupboards and cellars where cockroaches abound. The distribution and numbers of the cockroach are rapidly increasing, and unless preventive measures are adopted the insect is likely in the course of time to become a very troublesome and possibly a very dangerous domestic pest."²

REFERENCE.

¹ *The Transformation of Insects*, by P. M. Duncan. London: Cassell, Petter, Galpin and Co., 1882. ² *BRITISH MEDICAL JOURNAL*, 1911, ii, p. 1531.

THE next Ophthalmological Congress will be held at Oxford on July 15th and 16th, when a discussion on industrial diseases and accidents will be opened by Dr. Frank Shufflebotham. The honorary secretary of the congress is Mr. Bernard Cridland, of Wolverhampton.

THE Georgia State Sanitarium at Milledgeville has been chosen by the United States Government as a station for experimental work on pellagra. The patients will be separated and kept under special treatment—carried out under the charge of two experts of the United States Public Health Service.

A CASE OF TETANUS TREATED BY INJECTIONS OF CARBOLIC ACID.

BY
PURVES STEWART, M.D., F.R.C.P.,

AND
J. T. C. LAING, M.B., C.M.,

THE following case of tetanus appears worthy of record, in view of the fact that the disease, in spite of treatment by antitetanic serum, was steadily advancing. In such cases it may be useful to remember that we have other methods of treatment at our disposal.

The patient, aged 27, was an officer who, on October 27th, sustained several shell wounds—one in the right groin, another in the right knee, a third, more severe, in the right hand. The wound of the hand became septic, and appears to have been the point of entrance of the tetanus infection. The patient came under the care of one of us on October 28th, in the Robert Lindsay hospital for officers.

On November 3rd—that is, seven days after the wounds—tetanic rigidity of the jaw muscles commenced. On the same evening he was given a subcutaneous injection of 1,500 units of antitetanic serum. The rigidity continued to spread, and extended to the abdominal and spinal muscles.

On November 4th 1,500 units of antitetanic serum were injected intrathecally by Mr. Tyrrell Gray. The foot of the bed was subsequently elevated for several hours, in order to assist diffusion upwards of the serum. On November 5th a third dose of 1,500 units was given subcutaneously. The patient was also given full doses of bromide and chloral.

Notwithstanding the foregoing measures his condition became steadily worse, and on November 6th the rigidity of the jaws was extremely marked. The teeth could not be separated more than a quarter of an inch. The facial muscles were rigid, with risus sardonius. The sterno-mastoids were tonically contracted, also the spinal and abdominal muscles, and slight stimuli produced typical tetanic spasms. The patient perspired profusely; his temperature was normal.

At this stage it was decided to commence treatment by means of carbolic acid. Accordingly 2 c.cm. of a 5 per cent. solution were injected hypodermically into the abdominal wall every two hours. Improvement commenced on the same day. The spasms of the jaws, sterno-mastoids, and facial muscles steadily improved. The tetanic spasms diminished in frequency, and on November 7th he had only one spasm, as compared with twelve on November 5th. The carbolic injections on November 7th were reduced in frequency to four-hourly, but on November 8th, owing to a slight recurrence of tetanic spasms, the injections were again increased to two-hourly for a couple of days. The spasms promptly diminished. From November 9th onwards the patient's convalescence was uninterrupted. The thoracic and abdominal muscles were slower than the other muscles in losing their tonic spasm.

On November 12th a diffuse, red, punctate rash appeared in both flanks, apparently a carbolic rash. The temperature remained normal throughout. The urine, which was examined daily, never showed any pigmentation nor the slightest trace of albuminuria. From November 13th to November 18th the injections were reduced to four-hourly. They were then stopped. The patient was discharged on December 5th, completely cured.

This case exemplifies the efficiency of the carbolic acid treatment of tetanus, originally introduced by Baccelli some fifteen years ago. From a study of the statistics of published cases treated by antitetanic serum, the gross mortality varies from 78.9 per cent. in Permin's 199 cases to 61.8 per cent. in Iron's 225 cases. On the other hand, the statistics of the carbolic acid treatment, as recorded by Baccelli, give a gross mortality of 17.4 per cent. in 190 collected cases. These figures are suggestive, and we consider it of the highest importance that cases of tetanus which may occur amongst our wounded officers and men during the present war should be given the chance of this treatment, which in no way supersedes tetanus antitoxin as a preventive, but appears to have certain advantages as a remedial agent once the disease has actually developed. It appears to us that the value of antitetanic serum lies chiefly in its preventive action.

THE New York Rockefeller Institute for Medical Research will receive £40,000 under the will of Mr. Henry Rutherford, to be applied to the investigation of cancer.

A ROENTGEN RAY ASSOCIATION, intended "to improve the practice and study of roentgenology and to form a closer association among roentgenologists or x-ray experts," has recently been founded in New York. The founders are Drs. George S. Dixon, I. Seth Hirsch, Adoniram Judson Quimby, William A. La Field, and Archibald P. Evans.