the English Malaria Expedition²¹ may here be literally quoted, as they seem to me to be very appropriate: "It would appear from the criticisms made on Koch by many writers that they have not taken the trouble to acquaint themselves at first hand with his writings, for views are constantly attributed to him which certainly are not to be found in his writings."

As a matter of fact, R. Koch has in nowise altered his views. Now as formerly he believes that in the majority of cases blackwater fever is the result of quinine poisoning in malaria patients. But, at the same time, he holds that by means of an appropriate quinine prophylaxis malaria, and with it, in the vast majority of cases, blackwater fever, can be stamped out. An imperfect quinine prophylaxis which does not entirely protect against malaria, on the other hand predisposes to blackwater fever, for in such a case plasmodia and quinine unite to act harmfully on the organism.

NOTES AND REFERENCES.

¹ R. Koch, *Reiseberichte*, Berlin, 1898. ² Quoted from Laveran, *Extrait du Bulletin de l'Académie de Médecine*, Séance du 4 Décembre, 1900. See also Foustanos, *La Grèce Médicale*, No. 4. ³ Laveran, *loc. cit.* ⁴ S. Tomasselli, *La Intossicazione Chinica e l'Infezione Melanica*, terza edizione, Catania, 1897. ⁵ F. Plehn, *Ueber das Schwarzwasserfieber an der afrikanischen Westküste*, *Deut. med. Wochenschrift*, 1895, No. 25 et seq. ⁶ Cardamatis, *De la Fièvre Hémoglobinoïdique*, *La Grèce Médicale*, 1900, No. 4. ⁷ G. Laveran, *Traité du Paludisme*, Paris, 1898, p. 197. ⁸ *Loc. cit.* and v. Jaksch, *Klinische Diagnostik*, Berlin and Vienna, 1901. ⁹ Moffat, *Blackwater Fever and Hæmoglobinuria*, *BRITISH MEDICAL JOURNAL*, September 24th, 1898, p. 926. ¹⁰ Harford Battersby, *BRITISH MEDICAL JOURNAL*, October 15th, 1898, p. 1200. ¹¹ Epidemiological Society, *BRITISH MEDICAL JOURNAL*, March 25th, 1899, p. 721. ¹² R. Koch, *Ueber Schwarzwasserfieber (Hæmoglobinurie)*, *Zeitschrift für Hygiene*, etc., 1899, vol. xxx. ¹³ In the history of the patient given under No. 12 the blackwater fever was associated with a quartan ague. ¹⁴ Malaria of course excepted. In Cases 11 and 12 the first blackwater fever attack came on in Germany. ¹⁵ *Loc. cit.* ¹⁶ See Case 14. ¹⁷ *Rapport sur les Travaux du Laboratoire Médical de Léopoldville*, Bruxelles, 1901, p. 96. ¹⁸ Stephens, *Blackwater Fever*, reprinted from the *Lancet*, March 23rd, 1901. ¹⁹ Royal Society, *Reports to the Malaria Committee*, fifth series, London, 1901. ²⁰ *Rapport sur les Travaux du Laboratoire Médical de Léopoldville*, Bruxelles, 1901. ²¹ *Loc. cit.*, p. 21.

THE INFLUENCE OF COLOUR UPON ANOPHELES.

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In pursuing our Studies in Relation to Malaria, which are appearing in the *Journal of Hygiene*, my colleague, Mr. A. E. Shipley, and myself thought 'it desirable, amongst other things, to study the influence of colour upon *Anopheles maculipennis*. From what is known of the behaviour of other insects to colour, and occasional hints we have obtained from observing the behaviour of *Anopheles*, we had concluded that we might, as the result of our experiments, obtain results having a definite practical bearing.

It seemed to us to be a matter of considerable practical utility to determine what influence, if any, colour exerted upon a known malaria-bearing species of mosquito; and we deem our results sufficiently striking to make it worth the while for those who are engaged in similar studies abroad to take the matter up systematically. Our experiments certainly indicate that *Anopheles maculipennis* is attracted by some colours and repelled by others, a matter which would have its practical application in the choice of the colour of clothing and the interior of rooms in malarious districts.

The preference of *Anopheles* for dark and shady places, whither they retreat during the daytime, has been noticed by a number of observers. The behaviour of the insects towards various colours has not as yet received sufficient attention. Whilst engaged upon our experiments we came upon a few data cited in the recent literature.

Austin¹ writes: "If the walls of the room be whitewashed, with a dark dado, it is interesting to note that the insects will always be found upon the dark strips, and never on the white portions of the wall." Buchanan² in India noted that "the men who collect the living *Anopheles* say that the *Anopheles* hide in a black coat, but avoid a white coat, so they hang up one or two black coats in the hospital ward" when they desire to catch the imago. Neither Austin nor Buchanan say anything about the influence of colour. The first, as far

as we know, to refer directly to the influence of colour is Joly, who made observations on mosquitos in Madagascar. He states, without saying what genus, that "mosquitos" there were more attracted to black than to red soil or to white sand. Persons wearing black shoes and socks were more bitten than when these articles of apparel were white. Brown clothes protected less than those of white or blue. He states that the natives of Madagascar know the attraction black offers to mosquitos, and for this reason hang up a black cloth on the rafters of the room for the insects to collect upon. Joly observed that a yellow-haired dog was very much less bitten than a black one. For the same reason the natives are more bitten than the whites, although they suffer less from the after-effects.

Our experiments were made in a large gauze tent, which had been erected within a disused photographic establishment, the one end of the tent ending against large windows, into which the sunlight poured on bright days. Large stone basins were placed on the floor for the *Anopheles* to breed in, the stock being renewed from time to time.

It was noticed at the beginning that when one entered the tent in dark grey clothes the imagos frequently flew up and settled on the dark cloth, but that they never did this when the person entering the tent was clothed in white flannels. To test the influence of colour, a number of pasteboard boxes were taken which measured 20 cm. by 16 cm. and had a depth of 10 cm. The boxes were lined with cloth, having a slightly roughened surface, to which the insects could comfortably cling. All of the fabrics had a dull surface, and each box was lined with a cloth of different colour. The boxes were placed in rows upon the floor and upon each other in tiers, the order being changed each day after the observations had been made. The interior of the boxes was moderately illuminated by light reflected from the surface of the white tent. On seventeen days during a month, beginning with the middle of June, we counted the number of flies which had accumulated in the boxes. Counts were actually made on seventeen sunny and cloudy days, and with the following result:

Colour of Box.		Number of <i>Anopheles maculipennis</i> Counted in each Box during Seventeen Days.	
Navy blue	...	...	108
Dark red	...	...	90
Brown (reddish)	...	...	81
Scarlet	...	...	59
Black	...	...	49
Slate grey	...	...	31
Dark green (olive)	...	...	24
Violet	...	...	18
Leaf green	...	...	17
Blue	...	...	14
Pearl grey	...	...	9
Pale green	...	...	4
Light blue (Forget-me-not)	...	...	3
Ochre	...	...	2
White	...	...	2
Orange	...	...	1
Yellow	...	...	0

We see from the above table that dark blue was most attractive, the other colours being less and less attractive in the order of numbers given. A marked fall in the number of insects resting in the boxes begins with the "blue" box; the colour in this case was a rich full blue. Pale green, light blue, ochre, orange, and yellow, especially the last two colours, seemed to repel the insects.

The khaki uniform at present in vogue should therefore offer advantages besides being invisible to the human enemy. It is of course true that the *Anopheles* bite more frequently during twilight and at night, but the choice of clothing having a repellent colour should afford a measure of protection against the insects which may bite during the daytime. In any case, the number of insects congregating in dwellings might very well be lessened by the choice of colours of a suitable character applied to the walls. It has also occurred to me that some sort of trap might readily be devised, lined with a suitable colour, such as dark blue, within which the insects would congregate and easily be destroyed in considerable numbers. Our experiments with boxes have been so striking that such a plan immediately suggested itself. Unfortunately for the experiment we are not living in a country where *Anopheles* are numerous, so we will hope that those who are placed in more

favourable circumstances will make the attempt to see if colours can be made to afford a practical means of protection.

REFERENCES.

¹ *Practitioner*, March, 1901, p. 341. ² *Indian Medical Gazette*, April, 1901, p. 195. ³ *Arch. de Parasitologie*, May, 1901, p. 259.

A FURTHER NOTE ON THE BIOLOGICAL TEST FOR BLOOD AND ITS IMPORTANCE IN ZOOLOGICAL CLASSIFICATION.

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In a former number of the *BRITISH MEDICAL JOURNAL* I published a preliminary note regarding the results of experiments with specific antisera, a complete account of which appeared in the *Journal of Hygiene* for July. As stated in the latter publication we had gone a step further than mentioned in the preliminary note, finding it possible to detect human blood, or any other blood for which we had prepared a test serum, when that blood had been mixed with five or six other bloods, each blood in the mixture being present in the proportion of 1 to 500 or 1 to 600. In the papers above cited it was stated that 36 bloods had been tested. I have since tested 140 bloods, the result being consistent with what has been already described.

The 140 bloods tested were derived from all classes of vertebrates. None except monkey bloods gave a reaction with the antiserum for human blood. The monkey bloods tested were the following: Family *Cercopithecidae*, *Semnopithecus entellus* (India), *Cercopithecus Campbelli*, Waterh. (W. Africa), *C. patas* (W. Africa), *C. lalandi*, Is. Geoffr. (S. Africa), *C. diana* (W. Africa), *C. melogenys* (W. Africa), *C. callitricha* (W. Africa), *Macacus rhesus* (India, 3 blood samples); *M. cynomolgus* L. (India, 2 blood samples) *M. assamiensis* (India). Of the South American monkeys, family *Cebidae*, only two bloods have been tested: *Mycetes seniculus* (Colombia) and *Cebus albifrons* Geoffr. (South America).

All the bloods of the Old World monkeys gave a very marked reaction, less powerful, however, than that of human blood. They also reacted to weak antiserum. On the other hand, the South American monkeys gave but a slight reaction with human antiserum as compared with that of the other monkeys, and a weak antiserum produced no precipitation in the blood of *Mycetes seniculus*. Of course these tests require further study, but the result is in striking accord with the Darwinian theory as to the relationships existing between man and apes, the relation of the former, according to that theory, being closer to the Old World apes.

Tested on 140 bloods, the antiserum for dog's blood only gave a reaction with the blood of the jackal (*Canis mesomelas*) from South Africa. I have not as yet had an opportunity of testing the blood of other members of the canine family. None of the 140 bloods gave a reaction with the antiserum for horse blood; in this case no other members of the horse family were tried. The antisera for ox and sheep blood only gave a full reaction with their homologous bloods, besides the slight reactions already mentioned in my previous communication.

Further tests have shown that ox antiserum produces a slight reaction with the blood of the goat, and a faint clouding in that of the roebuck and Burrhel sheep (*Ovis Burrhel*, from the Himalayas, of which two samples were at my disposal). Sheep antiserum furthermore gave a marked reaction with the blood of the Burrhel sheep and of another wild species of sheep, a slight but distinct reaction with the blood of a goat, and a faint clouding with that of the roebuck.

My investigations have been greatly furthered by the kind interest of Mr. Frank E. Beddard, F.R.S., Prosector of the Zoological Society's Gardens, and his assistant, Mr. E. Ockenden, as also by friends in different parts of the world, whose assistance I shall take occasion to acknowledge more fully elsewhere. I shall be greatly indebted to any readers of this article who may aid in the prosecution of this work, which I contemplate pursuing on an extended scale. I shall

naturally fully acknowledge any aid which may be given. The object of my research is to gradually produce various antisera besides those already mentioned, and by means of them to study the reactions which take place with the bloods of various groups of animals. It seems certain that interesting results from the point of view of zoological classification will thus be brought to light. Apart from this, owing to the importance of the reaction from a medico-legal standpoint, the test should be applied to as large a number of bloods as possible. The method of collecting bloods for the above-mentioned purpose is exceedingly simple, and is as follows:

METHOD OF COLLECTING BLOOD.

Blood may be collected from dead or living animals. It does not matter which, nor does it have any effect on the test if the animals have been dead as long as twenty-four hours, except in tropical countries. The method is so simple that sportsmen can readily collect samples whilst out shooting. The method consists in soaking up the blood (avoiding clots) upon strips of pure filter paper about 3 inches wide by 5 inches long.

One end of the strip is left clean, so that the name of the animal (both common and scientific), the date, place (of collection or natural habitat) and name of the collector can be noted thereon in lead pencil. The notes should be written clearly, this being facilitated by resting the paper upon a hard surface. The strips of paper dry rapidly when suspended in the air (sunlight can be used for hastening the drying) by being pinned against the edge of a table, shelf, or upon the branch of a tree. Strips of paper saturated with different bloods should not be brought in contact with one another in a moist state. If the collector is unable to wait for the strips to dry he can place them between sheets of impervious paraffined paper. The whole outfit can be carried in an ordinary envelope. When the strips have dried thoroughly, they may be folded and placed together in an envelope for transmission, at the collector's convenience, as an ordinary letter through the mails. It does not matter if the dried strips have been preserved for a month or two before being sent.

One strip of paper saturated with each kind of blood will suffice for the purposes of the investigation. I shall be happy to forward strips of filter paper, etc., to those who may be interested or willing to collect. Blood samples may be addressed to me as noted.

If it is desired to collect bloods from living animals this can be readily accomplished by pricking the skin with a needle, and soaking up a few drops on different parts of the filter paper.

INOCULATION AND THE INCUBATION STAGE OF PLAGUE.

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DR. CALMETTE is reported to have given it as his opinion that a person in the period of incubation for a slight attack of plague would find the disease considerably aggravated if he submitted during this period to a preventive inoculation of Haffkine's vaccine. The case would almost certainly end fatally.¹

The same opinion is again urged in the third Harben Lecture,² lately delivered by Calmette in London, and the advice given to refrain from inoculating those in direct contact with a plague case, though the measure is recommended as a means of immunising a population living round a plague centre.

As Haffkine, on the contrary, has all along maintained that inoculation with his vaccine is harmless in the incubation period of plague, and that this method of protection should be pushed with the utmost vigour amongst those immediately in contact with plague cases, it becomes necessary to examine this matter afresh, in the light of the extensive experience gained in India and elsewhere in the use of the plague prophylactic.

Calmette's ideas have been derived from laboratory experiments, for he has had no opportunity of studying the effect of plague vaccination during an epidemic among human beings. In India, on the contrary, hundreds of thousands of persons have been inoculated with Haffkine's plague vaccine,