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ORDINARY MEETING, 20th October, 1910, Mr. H. U. MOFFAT, Vice-President, in the chair. The following papers were read: (1) "The Geographical Distribution of Big Game in Northern Rhodesia," by O. Letcher; (2) "Notes on a Perforated Stone found on the Luana Encampment, North-Western Rhodesia," by Charles Grey, and described by A. J. C. Molyneux.

### THE GEOGRAPHICAL DISTRIBUTION OF BIG GAME IN NORTHERN RHODESIA.

With some Notes on the Localisation of Species and the alleged dependence of the Tse-Tse Fly (*Glossina morsitans*) on the larger Mammals.

By OWEN LETCHER, F.R.G.S.

THE following notes on the geographical distribution of big game in the territories of the Chartered Company lying to the north of the Zambesi river are the results of observations recorded and experience gained in North-Western Rhodesia in 1907 and 1910, and in North-Eastern Rhodesia in 1909. Perhaps they will prove of some interest to members of this Society and to those who treasure the magnificent fauna of Rhodesia as one of the country's richest inheritances, whilst they may too assist in some little way in a solution of the difficult problem recently discussed by Mr. H. U. Moffat before this Society in an exceedingly interesting paper—I refer, of course, to the alleged dependence of the Tse-Tse Fly on big game.

The fauna of Northern Rhodesia belongs to the first of the three great zoological divisions of Ethiopian Africa—that which is generally termed the East Central tract—a division including the Southern and Eastern portions of the continent, together with such of the central districts as do not lie within the Great Forest tract.

But this broad classification is capable of sub-division. Northern Rhodesia may indeed be regarded almost in the light of a distinct zoological tract as compared with Africa lying to the south of the Zambesi, and as compared too with Africa north-east of the southern shores of Lake Tanganyika.

Many animals are common to all three tracts as they are to all Ethiopian Africa, if not to all Africa, but there are certain distinctive absences and certain characteristic species to be noted in

the fauna of Northern Rhodesia, which I submit justify the view that the British South Africa Company's territories lying to the north of the Zambesi are entitled to some distinctive nomenclature in African zoology. As compared with Africa south of the Zambesi, it is noticeable that the following animals, which either constitute to-day or have constituted in recent times, important features in the fauna of Southern Africa are *absent* in Northern Rhodesia, and have, as far as one can ascertain, never been found there:

1. The great White or Burchell's Rhinoceros (*Rhinoceros Simus*).
2. Gemsbok (*Oryx gazella*).
3. Black Wildebeeste (*Connochoetes gnu*).
4. Blesbok (*Damaliscus albifrons*).
5. Springbok (*Antidorcas euchores*).
6. Bontebok (*Damaliscus pygargus*).
7. Cape or Rooi Hartbeeste (*Bubalis cama*).
8. Vaal Rhebock (*Pelea capreolus*).
9. Rooi Rhebock (*Cervicapra fulworufula*), and several smaller Antelopes.

Animals which are found in Northern Rhodesia, but not in Africa south of the Zambesi, are:

1. Crawshay's Sing-sing Waterbuck (*Cobus defassa Crawshayi*).
2. Penrice's Angolan Sing-sing Waterbuck (*Cobus defassa Penricei*).
3. Black Lechwe (*Cobus Smithemani*).
4. Sharpe's Steinbuck (*Rhaphiceros campestris sharpei*).

It may be also remarked that the Situtunga (*Tragelaphus spekei*), Red Lechwe (*Cobus lechwi*), and Puku (*Cobus vardoni*), which are found in Northern Rhodesia, the latter two species in vast numbers, are unknown in Southern Africa, except in the valley of the Zambesi south of the river and in the neighbourhood of the Chobi river, which flows into the Zambesi near Kazungula.

The larger fauna of Northern Rhodesia may furthermore be divided into two divisions determined by the geographical features of the territories, viz.:

1. The fauna of the highlands on the great Congo-Zambesi divide; and
2. The fauna of the Zambesi basin.

The first of these two sub-divisions is most characteristic of the true and typical zoology—in so far as the large mammals are concerned—of the territories under consideration to-night. These high plateaux and escarpments are cut by the Zambesi and its main tributaries, the Kafue in North-Western Rhodesia and the Luangwa in North-Eastern Rhodesia, and it is in the basins of these rivers that a type of fauna occurs which more closely resembles the fauna of Southern Africa than that of the higher lands. It would seem indeed that the Zambesi and its feeders are channels of zoological connection with the south, channels which penetrate deep into South Central Africa, and on account of the existence of which the typical

fauna of Southern Africa is to be found in the midst of a territory where the faunistic features are so characteristic of what may best be termed the Northern Rhodesian tract.

I will first of all deal with the Valley of the Luangwa, than which there can scarcely be a more interesting region in all Africa—interesting not only from the point of view of the big game hunter and the zoologist, but from ornithological and botanical points of view as well.

When I was hunting in the Luangwa in August, September, and November of last year, I found big game extraordinarily abundant, especially so in November, when many of the subsidiary streams and isolated water-holes were dried up and great herds of game had wandered down to the river in search of water. Elephant, Eland (*Taurotragus oryx*), Roan Antelope (*Hippotragus equinus*), Waterbuck (*Cobus ellipsiprymnus*), Puku (*Cobus vardonii*), Impala (*Aepyceros melampus*), Warthog (*Phacocheirus aethiopicus*), and Zebra (*Equus zebra*) I found along the banks of the Luangwa in great numbers. Less common animals were Buffalo, Blue Wildebeeste (*Connochaetes taurinus*), Hartbeeste (*Bubalis lichtensteini*), Rhinoceros (*Rhinoceros bicornis*), Bushbuck (*Tragelaphus scriptus typicus*), Reedbuck (*Cervicapra arundinum*), and Kudu (*Strepsiceros kudu*). Lions and Leopards were there too, but it appears that the larger *Carnivora* are far more nocturnal in South Central than in East Central Africa, and are, therefore, less frequently seen.

Some of these animals remain close to the river all the year round. In flood time the water-loving animals, such as the Puku and Waterbuck, do not migrate, and the Elephant and Blue Wildebeeste flounder around on the flooded banks; but the Rhinoceros, the Roan Antelope, the Lichtenstein's Hartbeeste, and other animals which are not essentially river-loving mammals, retreat towards the base of the M'Chinga Mountains to the west and to the higher lands sloping to the Angonia plateaux on the east.

The distribution of the Blue Wildebeeste in the Luangwa Valley is extremely local. These animals are found in small herds at two or three widely-separated points. They are not known to exist in any other part of North-Eastern Rhodesia, and are not, I believe, encountered again as one proceeds in a south-westerly direction through North-Western Rhodesia, except in extremely localised troops, until the Kafue river has been crossed. This is the extreme northern range of the Blue Wildebeeste. To the east the race is represented by the Nyasaland Brindled Gnu (*C. taurinus Johnstoni*) and to the west of the M'Chinga Range the Wildebeeste is unknown. In British East Africa its place is taken by the White-bearded Brindled Gnu (*C. taurinus albojubatus*).

We have here, then, a striking example of one of the most perplexing things in natural history—the existence of an outlying colony of some particular species cut off from their kith and kin by hundreds of intervening miles. I shall refer to one or two other instances of this localisation later on.

Whilst on the subject, and in connection with the Luangwa Valley, I may refer to the protection of an isolated herd of Giraffe (probably *Giraffa camelopardalis wardi*) on the Lower Luangwa. These are the only giraffes known to exist in North-Eastern Rhodesia, and in order to afford them sanctuary the Administration created the Sassare Game Reserve, within the limits of which they wander.

The Waterbuck of the Luangwa Valley is the (*Cobus ellipsiprymnus*) the common Waterbuck of South Africa, and the presence of this animal constitutes an important link in the chain of zoological correlation with the fauna of the south.

To the north and west of the M'Chinga range of mountains, which strike right across North-Eastern Rhodesia from the south-western corner almost to the north-eastern frontier, the true Waterbuck is not found. The Luangwa Valley race is there replaced by a variety of the Sing-sing Waterbuck (*Cobus defassa Crawshayi*). A similar replacement is to be observed in North-Western Rhodesia. All the waterbuck I saw and shot in the vicinity of Broken Hill, Mwomboshi, and the Lukanga river were of the sing-sing variety, that is to say, they had a white blaze on their hind quarters instead of the elliptical white ring of the *ellipsiprymnus*. I believe, however, that the sing-sing I have shot in North-Western Rhodesia are not of the Crawshay's variety, but are referable to *Cobus defassa Penricei* (Penrice's Angolan Sing-sing). I am guided to this conclusion by the much darker colour of the face and neck as compared with the waterbuck to be found in the northern parts of North-Eastern Rhodesia, which is, without question, Crawshay's Sing-sing Waterbuck.

When the M'Chingas have been scaled, one finds oneself in a new world, from a zoological point of view. Roan antelope; Lichtenstein's hartebeest, puku, warthog, and zebra are still plentiful, but the elephant is found in more sparing numbers; kudu and bushbuck are rarely seen, the impala is absent, and so is the true waterbuck and the wildebeeste. There are four animals to be found here which are unknown in the Luangwa Valley. In the small swamps on the Manue and Luitakeela rivers and in the great marshes of Lake Bangweolo the situtunga (*Tragelaphus Spekei*) occurs; on the plains between Bangweolo and the woodland country lying to the north of the M'Chinga escarpment the Tsessebe (*Dama-liscus lunatus*) and the Oribi (*Oribia scoparia*) are, with the zebra and the Lichtenstein's hartebeeste, the most common animal inhabitants, and in those seemingly illimitable marshes which surround the shores of Lake Bangweolo the Black Lechwe (*Cobus Smithemani*) is to be found. The penetration of the Bangweolo swamp lands is exceedingly difficult and unhealthy work, but I was rewarded for my labours in channelling through the reeds in a dugout by witnessing some extraordinarily beautiful sights on the shores of the numerous backwaters in the heart of the swamps: One morning I saw a solid half-mile long troop of the magnificent Black Lechwe, so densely congregated that one could scarcely see daylight between them.

The fauna of the northern part of North-Western Rhodesia is very similar to that of this corner of North-Eastern Rhodesia, *i.e.* the region lying between the M'Chinga mountains and Lake Bangweolo. There are, however, one or two striking differences. The Black Lechwe of North-Eastern Rhodesia is replaced by the Red Lechwe (*Cobus Lechwi*), and, as I have already remarked, Penrice's waterbuck appears to take the place of Crawshay's waterbuck. The sable antelope, which is comparatively rare in North-Eastern Rhodesia, is far more plentiful in North-Western Rhodesia, but the most striking difference is the entire absence of the Tsessebe. Although the consorts of the Tsessebe on the Bangweolo plains, the zebra and the oribi, are to be found in this portion of North-Western Rhodesia, and although there are parts of the country where the natural conditions, which, it seems, are essential to the presence of the Tsessebe—broad rolling plains with a sparse bush fringing—are fulfilled, this chocolate-coloured antelope, in my belief, the fastest of all the greater game animals, is not to be found there. Indeed, the Bangweolo plain is, to the best of my knowledge, the only place in Africa north of the Zambesi where the Tsessebe is to be found, with the exception of one or two extremely restricted localities in Nyasaland, and possibly in Northern Portuguese Zambesi.

At any rate, the range of the Bangweolo Tsessebe is distant several hundreds of miles from the range of the same animal in Southern Rhodesia, and between these two localities the Tsessebe is wholly absent.

It is exceedingly difficult to advance any reasons which offer any explanations of this and similar instances of extreme zoological localisation, but it may be that migration and separation were brought about by drought or flood, by the disappearance of some favourite article of diet, possibly by continued oppression from the larger carnivora in a one time favoured locality. When man finds life in his native land unattractive through the scarcity of those things he most desires, or because of persistent oppression, he usually emigrates to better himself, and similar conditions, no doubt, account for such surprising localisations as I have instanced to-night, in the case of the Tsessebe and the Blue Wildebeeste.

In the northern portion of North-Western Rhodesia there is one carnivorous animal, the Cheetah or Hunting Leopard, which is by no means uncommon, although in North-Eastern Rhodesia it is exceedingly rare. It is called "Chewarrawango" by the Walenge natives. I shot one of these, and saw two more to the west of Broken Hill during two days in September last. I mention this because I have only heard of one Cheetah being shot in North-Eastern Rhodesia.

In both these northern portions of North-Western and North-Eastern Rhodesia buffalo are plentiful in certain restricted areas, but the north-eastern animals seem to possess a much larger development of horns than those in north-western.

The elephant and the black rhinoceros are found throughout these highland tracts of country in sparing numbers. In the Luangwa Valley and in the valleys in the M'Chinga mountains they are far more plentiful. The elephants of North-Eastern Rhodesia do not appear to attain to the heights of the East African and Uganda animals. The four elephants which I shot in North-Eastern Rhodesia last year, averaged only 9 feet in height, although one of these was apparently an old bull, and carried 144 lbs. of ivory. He measured 9 ft. 2 ins.

Black rhinoceroses swarm in the valleys in the M'Chingas to the east of M'Pika. Both the "Bonili" variety, in which the front horn is longer than the back, and the "Keitloa," in which the back horn is the longer, are to be observed there. Many years ago the differences in the relative measurements of the two horns were thought to indicate a different species, or sub-species, of the *Rhinoceros bicornis*, but this belief does not find much favour to-day, and it certainly seems to have very little to support it.

The Hippopotamus (*Hippopotamus amphibius*) is common in the Luangwa, and it is to be found in most of the larger rivers in both North-Eastern and North-Western Rhodesia. It has been reported that the Pigmy or little Liberian Hippopotamus (*Hippopotamus Liberiensis*) has been observed in Lake Mweru, but I possess no very authenticated information on this point. I cannot discuss the rhinoceros and the hippopotamus without some reference to an animal which is most emphatically stated by the natives to frequent some of the deepest pools and rivers of the Congo-Zambesi watershed. I daresay I shall be ridiculed if I state that I have any belief in its existence, but I would remind you that twenty years ago anyone who professed his belief in the existence of the Okapi (*Okapia Johnstoni*), specimens of which have been brought to England by Sir Harry Johnston, Major Powell-Cotton, and the late Lieutenant Boyd Alexander, would probably have had to bear a good deal of derision. Africa is a vast continent, and we have in reality only just begun to realise some of her wonders. I do not say that I am convinced as to the existence of a huge water rhino in Central Africa, but I do say this, that, in my opinion, it is by no means unlikely that the "Chimpakwe," as the Awisa term it, is something very much more material than a myth. I have asked many old chiefs in North-Eastern Rhodesia about the "Chimpakwe," and they have all assured me that this mighty two-horned amphibian was, many years ago, an inhabitant of the Luangwa river. One old Awisa headman told me that his father had shot one with a gun which an Arab hunter had given him. The natives stated that since the water in the Luangwa has decreased in volume and height, the chimpakwe has disappeared, but that he might to-day be found in the deeper waters of the Luapula, and in one or two deep pools in the northern part of North-Western Rhodesia.

These highlands, then, in both provinces of Northern Rhodesia have a similar fauna, markedly different to the fauna of the hot,

low-lying Luangwa. This is only natural, for it is well known that the distribution of animals is to a large extent governed by geographical features, by climate, altitude, and flora. It would, for example, be as useless to look for a Tsessebe in a swamp as to expect to find a Situtunga on an open plain. How far can these facts be applied to insects, to flies, and especially to the Tse-Tse Fly (*Glossina morsitans*)? The question is one of more than ordinary importance, both from a scientific and economic point of view. I am not here going into all the pros and cons of the problem of Tse-Tse and the alleged association of the fly with the game, but I will state that, whilst my experience has proved to me that the Tse-Tse does most undeniably feed on the larger mammals, including elephant, rhinoceros, and eland, I am strongly of opinion that the Tse-Tse has other forms of nourishment, and I also believe that the zones of the fly belts, which are often localised to an extraordinary degree, are determined quite as much by altitude, proximity to water (although not necessarily to large rivers and lakes), climate, flora, and possibly soil, as by the presence or absence of big game. Altitude is, it appears, the great determinative factor. Personally speaking, I have never seen a Tse-Tse at a height of 4000 feet or more above the sea level, no matter how plentiful game may have been. This is an encouraging feature, for unless my experience in this matter has been wholly unusual, it would seem to indicate that the more healthy highlands of Northern Rhodesia have not to consider the Tse-Tse as being such a mighty hindrance to colonisation after all.

In the accompanying table I have endeavoured to record a few personal observations on these matters. It will be observed that, where possible, the altitudes, temperature, and nature of the surrounding bush are stated, in addition to observations on the game, present or absent, and the existence or non-existence of Tse-Tse Fly in the areas under consideration.

It is clear from these observations that there are parts of South Central and East Central Africa where game is exceedingly plentiful, and there are no Tse-Tse; whilst, on the other hand, there are other areas in which there is no game, or virtually none, and Tse-Tse are abundant. As to the absolute dependence of Tse-Tse on the blood of buffaloes, I must say that I have not observed facts which in any way support this contention, although the Tse-Tse does feed on buffalo. But, as I have already remarked, I believe that the *Glossina morsitans* has other means of nourishment than the big game. I never saw a single Tse-Tse Fly on the Mau escarpment in British East Africa, where I was hunting in 1908, and where big game was exceedingly plentiful, neither did I see one on the Bangweolo plains last year, where also large game was in abundance.

The conditions which I believe are essential to the Tse-Tse are densely-bushed and forested country, lying at a low altitude and in proximity to water. Such conditions are, too, favoured by the larger mammals, and particularly by the elephant, rhinoceros, and buffalo. They are, on the other hand, eminently unsuited for

DATE.	LOCALITY.	ALTITUDE.	TEMP.	GAME.	FLORA.	TSE-TSE.
1909 Aug. 23	Near Namungas, Luangwa valley, N.E.R.	ft. 1700	Hot.	Plentiful. Buffalo, Water-buck, Puku, etc.	Fairly dense bush and mopani	Absent
Sept. 11-15	Between Nyamadzi and M'Pamadzi rivers, N.E.R.	1900-2000	Very hot	Plentiful. Elephant, Rhino, Eland, Roan, etc. No Buffalo	Fairly dense bush	Very plentiful
Sept. 17	Foot of M'Chinga mountains, N.E.R.	2500	Hot	Practically no game	Fairly thin forest	Very plentiful
Sept. 18	M'Chinga mountains, N.E.R.	4700	Cool	Practically no game	Thin forest, palms, etc.	Absent
Sept. 30	Luveze river, N.E.R.	2850	Hot	Elephant and Rhino plentiful; no other game	Bush, alternating with thin forest	Swarming with Tse-Tse
Oct. 20	Edge of Bangweolo plains, N.E.R.	3690	Hot	Plentiful. Eland, Tsessebe, Zebra, Hartbeeste	Thin forest on edge of plain	No Tse-Tse
Nov. 1	N'Dombos village, N.E.R.	2180	96 Mid-day	Game scarce	Thin forest	Few Tse-Tse
Nov. 7	Luangwa river, N.E.R.	2000	103 Mid-day	Game plentiful, including Buffalo	Dense forest and bush	Swarming with Tse-Tse
Nov. 24	Near Lilongwe, Nyasaland	about 3500	Warm	Game fairly plentiful. Eland, Sable, Waterbuck	Thin forest	No Tse-Tse
Aug.	Near M'womboshi, N.W.R.	—	Warm	Plentiful. Greatherd Buffalo	Thick forest and bush	Saw two Tse-Tse in five days
Aug.	20 miles W. of M'womboshi, N.W.R.	Lower altitude than M'womboshi	Warm	Plentiful, but no Buffalo	Thin forest	Plenty of Tse-Tse

colonisation by the white race. What I would like to see done before a general crusade of annihilation of the big game seriously is considered, would be the selection of some low-lying and restricted area, well stocked with big game and infested with *Morsitans*, and to drive out the game from this area. A small party of trained observers should then be employed carefully to note

- (a) If the fly died.
- (b) If the fly migrated with the game.
- (c) If the fly preserved its biting energies in this same area.

Such fields for experiment are not difficult to find in Central Africa. I know of two or three valleys in the M'Chinga mountains which fulfil these conditions. The results of such observations would, I feel sure, be of far more value in solving the Tse-Tse problem than any simple Commission of enquiry. Different observers have had different experiences, and are inclined to absolutely opposite views. On the one hand, we have Sir Alfred Sharpe, the late Governor of the Nyasaland Protectorate, Major Stevenson-Hamilton, warden of the Northern Transvaal game reserves, Mr. R. C. F. Maughan, and many others, who have spent years of their lives amongst big game, contending most emphatically that the Tse-Tse stands in no greater need of the blood of mammals for its nourishment than do the various types of mosquito. On the other hand, there are equally experienced observers, amongst whom may be mentioned Mr. F. C. Selous, Mr. H. U. Moffat, and Major A. St. Hill Gibbons, who hold to an absolutely opposite view. I notice that Mr. Guy Marshall, of the British Museum of Natural History, has recently issued in a circular letter a series of questions with a view to securing a foundation of accurate knowledge of the *Morsitans*. Many of these questions open up most interesting lines of thought, and I find myself entirely in accord with many of the inferences which one may draw from Mr. Marshall's queries, namely, that altitude, climate, vegetation, soil, seasons of the year, and many other natural conditions will have to be thoroughly investigated before a campaign against the Tse-Tse, which is warranted by actual knowledge, can be formulated.

#### FURTHER DISCUSSION ON TSE-TSE FLY AFTER READING OF MR. O. LETCHER'S PAPER ON THE DISTRIBUTION OF THE BIG GAME.

Mr. MOFFAT: I quite agree with Mr. Letcher that the fly belts are determined as much by altitude, climate, and flora as by any connection with the big game, but this does not, to my mind, in any way alter the fact that the game is also an absolutely necessary factor. The fly is not found above a certain altitude. Mr. Letcher's limit of 4000 feet is, however, too low; I should put the limit at about

4500 feet. I have previously mentioned that there is plenty of fly round Bwana M'Kubwa, which is about 4300 feet above sea level, and it is found up towards the head waters of the Kafue, and along the watershed towards Kansanshi, over a country which must be well over 4000 feet high.

Altitude, of course, governs temperature, and, as the Tse-Tse, unlike the house and many other flies, is essentially a tropical insect, it would not live where it is very cold; a few degrees of frost would probably kill it. I do not think it is in any way connected with any special kind of trees or bush, but, as I have already stated, it is only found in bush or forest country, and is never found in the open.

I note Mr. Letcher supports my opinion that the buffalo is not necessary for the fly, as he observed fly belts where there are no buffalo.

It is, I think, necessary I should refer to the correspondence which has appeared in the *Chronicle* on the fly question and in regard to my paper. I am interested to note that Major Gibbons, who has had such a long experience in Northern Rhodesia, inclines to the belief that the game is necessary to the fly!

With regard to Mr. Musson's letter, which appeared last week, I must point out that this gentleman is quite wrong in one or two points. In the first place, it is not the case that the fly lays its eggs in the dung of the buffalo. Sir David Bruce in Zululand, many years ago, observed, and has definitely stated, that the Tse-Tse does not lay eggs at all, but produces a larva, which eventually turns into the full-fledged fly—there is no egg stage in the life cycle of the "Fly." The larvae bury themselves in the sand or dry earth, where they remain till the fly comes out. The old buffalo dung theory has, therefore, been absolutely exploded.

With regard to the question of killing out the game, and Mr. Musson's remarks on the subject, I would emphasise the fact that I have never advocated the wholesale destruction of all the game of the country. I have made a special point of the fact that it will be only necessary to attack the game in the known fly belts. I must thank, in this connection, "Fairplay" for his short note in the *Chronicle* pointing out this fact.

In my opinion, by this means we shall get rid of the fly, and will still have the game, as there are large areas teeming with big game, and including buffalo, where there is no "Fly." And I am of opinion that this is the only way we can get rid of the fly! There is another factor which is necessary to the fly, viz., shelter and shade, in the shape of bush and trees, and by absolutely clearing a fly belt of bush, the fly might be got rid of, but this is impracticable, and there would be the danger that the fly might, when deprived of its shelter, migrate into the adjoining bush and establish a fresh fly belt there, although, as I have already pointed out, under ordinary circumstances, the Tse-Tse sticks very closely to the limits of his "belt," and appears to migrate very little.

There is one very strong point in the connection between the

fly and the big game which has been left severely alone, both by my critics and by those who hold opposite opinions to mine, and that is that, even if the fly can live without the game, the *Trypanosome* of *Nagana* and *Dimorphon* (that is the fly diseases) are preserved and kept going by the game, so that, even if the fly remained after the game had been driven out, it would have no host or reservoir from which to draw the poison, and would no longer be harmful to domestic animals. The game, if not responsible for the fly, is responsible for the disease, which is just as bad.

Mr. Musson further complains that I have given no reasons for any connection between game and fly. The connection is the blood! The Tse-Tse is essentially a blood-sucking fly! I believe it has been practically proved that it must have blood to live. The way in which it attacks animals strongly points to this—those of you who have been in the fly belts know what a voracious little beast it is. Well, granted this, it seems to me the big game is the only thing which can provide a reliable, constant, and plentiful supply of blood. As I pointed out in my paper, under certain special conditions the human may supply the blood, as, for instance, on a constantly-travelled path, but such cases are rare, such routes alter, and such traffic ceases as villages shift and die out. The game is the one certain and constant supply, till a disease such as rinderpest wipes it out or the rifle drives it away, and then, with the disappearance of the blood supply, the fly, as I have pointed out, also has disappeared. Reptiles and birds I cannot regard as supplies of blood to the fly.

Then, referring to the buffalo theory, if the fly must have blood, it is hardly reasonable to suppose that it *must* have buffalo blood. We know that he bites and gets blood from any buck, eland, zebra, roan, etc., just as much as buffalo! I grant that the buffalo, owing to its habits, may suit him best, that is to say, is a more convenient source of supply than the other game, but it would be very extraordinary if there were some special property in the blood of the buffalo which is necessary to the fly, especially as we know he does draw blood from the other game, and also from humans when he can get them.

In conclusion, I should like to state that I welcome discussion and criticism, as it is only by means of this that we can get to the root of the question, and eventually find the "Truth."

FRANKLIN WHITE, *Re* MR. OWEN LETCHER'S PAPER  
ON BIG GAME AND TSE-TSE FLY.

THE tabulated statement given by the author of the paper is a very valuable way of recording information on various points required to increase our knowledge of the habits and the conditions under

which this pernicious insect can exist. If continued, such tables as these will assist in giving the information asked for by Mr. Guy Marshall. The fact that this information is asked for, proves the want of knowledge of the habits of the fly both in England and in this country. We know the damage which it causes, and how it hinders the opening up of useful parts of the country, but we really know little more as yet.

I do not think, however, that the statements made by the author are supported by the comparatively small number of instances given in his table. Low altitudes are given, and in some cases the comment is made "no Tse-Tse." On the other hand, the chairman is correct in stating that from near Broken Hill to the Congo border, a high plateau, exceeding 4000 feet in altitude, Tse-Tse Fly is abundant. It is possible that temperature affects the fly as much as altitude, for while in Bulawayo (20 degrees south) we have slight frosts, in the region referred to, although at about the same elevation, the temperature does not fall so much, owing to its being near the Equator (13 degrees south).

It is only by collecting and recording facts, however, that we can hope to obtain sufficient information on which to base theories and lines of investigation which will be useful in the future.

Mr. Musson might perhaps find some support for his theory that the *Glossina morsitans* requires the dung of the buffalo in which to breed if he could find that the larvae find this to be a suitable material in which to complete their development, but even if this were proved, it would be still necessary to explain how it is that where buffalo does not exist, or is extremely rare, the *Morsitans* does exist in considerable numbers. I am inclined to consider that instead of the buffalo being essential to the existence of the Tse-Tse Fly, it should only be looked upon as being typical of all big game from which the fly derives the *Trypanosome* (*Brucei* or *dimorphon*), which being transmitted by it to domestic animals, causes their death. It is acknowledged that most of the big game carry these *Trypanosomes* in their blood, but I have not seen any statement as to whether they are to be found in the blood of lesser animals, such as stembuck, duiker, orrubi, etc. The Tse-Tse Fly might obtain from these the blood it requires to prolong its existence after the larger animals have died out or migrated, and thus continue to inhabit tracts of country for some time after the big game has gone. Our Veterinary Department might study this with advantage.

The paper under discussion will form a valuable addition to our knowledge of the localities in which different species of big game are to be found.

# PROCEEDINGS

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