paranoid trends. They include real cases of abnormal sexual incompatibility, ranging down to cases which have failed to adjust in regard to contraception, with fears of pregnancy, and menopausal cases, where one of the parties has ceased to desire sexual relations. An appreciation of this saves much investigation of elusive symptoms.

Coming to the special senses, blindness, deafness, and loss of speech may all occur. Elaborate tests to deceive the senses have been evolved to prove the functional nature of the cases. Unilateral blindness is perhaps more usual; conjunctivitis is not uncommon, being easy to produce and resulting in a similar incapacity. Aphonia, where phonation is lost but articulation is preserved, is the common hysterical lesion, as the patient can still converse in a whisper, again suffering incapacity without great inconvenience. The partially adducted state of the vocal cords is characteristic. The adoption of face-saving methods in inducing speech by faradism facilitates cure of this symptom.

Mutism is more generally a sign of stupor, although it may occur in persons fully alert mentally, but silent owing to hysterical or delusional ideas. Among the common causes of stupor may be mentioned post-epileptic phenomena, depressed cyclothymic cases, hysterics and schizophrenics, and cases of so-called idiopathic stupor. Somnolent cases of encephalitis lethargica may resemble this state, and cases of pathological somnolence or narcolepsy, some of which may be associated with organic lesions, such as cerebral tumour. Among the rarer conditions may be mentioned such a phenomenon as cataplexy, a condition in which movement is impossible, although consciousness is retained. While some of such cases have a physiological basis, many on investigation will be found to be cases of hysteria.

Without an adequate history, differentiation between the conditions may be difficult. The principal difficulty is in separating the cases of hysteria from the praecox syndrome. The hysterical type, fully alert to her surroundings, who, under suggestion or other suitable conditions, passes into a hysterical trance, is usually obvious, but when extended periods of stupor, with few if any remissions, occur, with marked dissociation, the fear will be that the case is one of serious schizophrenic dissociation, even when mannerisms and other suggestive schizophrenic symptoms are absent.

In conclusion, I would again repeat that neglect of the psychological aspect leads to failures in diagnosis and treatment, owing to undue emphasis being placed on the individual symptoms. When both physical and mental aspects are considered, a true perspective is obtained, with beneficial results both to doctor and to patient.

With the July issue of the *Fortschritte auf dem Gebiete der Röntgenstrahlen* began the fiftieth volume of a monthly periodical which has rendered very great services to radiology the world over. Founded in 1897 by Heinrich Albers-Schönberg, who was himself a radiological pioneer, it has given publicity to many of the outstanding discoveries in connexion with x rays, and been a foster father to various of the subsequent journals which dealt with the more specific applications of this subject as they came into being. It has been adopted as the official organ of radiological societies in Czechoslovakia, Austria, Hungary, and Russia, as well as in Germany, and has won universal recognition as a sound and reliable as well as a progressive periodical. It is only right that the July issue should begin with the first Albers-Schönberg memorial lecture, which was delivered at the congress of the German Radiological Society in Baden-Baden last April. The present editor is Professor Rudolf Grashey-Köln.

MECHANICAL TRANSMISSION OF TRYPANOSOMIASIS, LEISHMANIASIS, AND YAWS THROUGH THE AGENCY OF NON-BITING HAEMATOPHAGOUS FLIES

(PRELIMINARY NOTE ON EXPERIMENTS)

BY

J. GORDON THOMSON, M.A., M.B., CH.B.,
M.R.C.P.

PROFESSOR OF MEDICAL PROTOZOOLOGY, LONDON SCHOOL OF HYGIENE
AND TROPICAL MEDICINE

AND

W. A. LAMBORN, O.B.E., M.R.C.S., L.R.C.P.,
F.R.E.S.

MEDICAL ENTOMOLOGIST, NYASALAND PROTECTORATE

In this preliminary communication it is not intended to review and discuss fully the immense literature on experimental and field observations regarding the direct transmission of trypanosomes, leishmania, and other blood-inhabiting organisms. It is proposed, however, to emphasize the important part which may be played by non-biting haematophagous flies in the mechanical dissemination of blood-inhabiting organisms, which appears hitherto to have been largely overlooked.

Most authorities are in agreement that, apart from cyclical transmission through the agency of tsetse flies, direct methods of infection by *Tabanidae*, *Stomoxys*, and other biting flies play an important part in the active spread of trypanosomiasis. Thus Duke (1919, 1921, 1923) believes that the sleeping sickness epidemics which sweep over certain parts of Africa are due to mechanical infection from man to man by tsetse flies; and Hornby (1921) states that the direct spread of trypanosomes among domestic stock is by no means uncommon as the result of the introduction of an infected animal into a clean herd living in a tsetse-free area. Wenyon (1926), in summing up the evidence on mechanical transmission, says it has been clearly demonstrated that a purely mechanical infection may occur by a biting fly contaminating the wound it inflicts with infective blood which it has recently taken into its proboscis from another host.

Earlier Observations on Fly Transmission

In proportion, however, to the amount of research that has been undertaken on direct transmission, the positive experimental evidence that has been brought forward incriminating these biting flies is so meagre as to suggest that the mechanism of this method of transmission is not fully understood. It was concluded so recently as 1933, at the conference at Entebbe on the tsetse and trypanosomiasis, that further information based on experimental work was necessary to elucidate the problem of mechanical transmission.

Work on the transmission of the tissue-inhabiting pathogenic protozoa by Diptera other than the biting species, *M. domestica* in particular, is on record, though the observations are scanty. Castellani (1907) fed *M. domestica* and allied species of flies on scrapings from yaws which contained *Treponema pertenue*, and afterwards, by transferring them to scarified sores on monkeys, produced an infection in one of the experimental animals. The flies were kept in position on the sores of the monkeys for two hours. Darling (1913) reported mechanical transmission of *T. evansi* (*T. hippicum*) to animals through the agency of house-flies which infested the open sores on mules in Panama. Laveran (1880) first suggested that oriental sore in Biskra might be due to transference of infection by flies, and Wenyon (1926) stated that it was highly probable that the house-fly, which swarms round

exposed oriental sores, especially in children, might sometimes carry the causative organism on its feet or proboscis to abrasions on the skin of another person. The same observer thought that leishmania bodies might pass rapidly through the gut of the fly and so be deposited with the dejecta.

Observations relating to non-biting haematophagous flies appear to be very few, probably from the fact that most observers have failed to distinguish the various species from *M. domestica*. It is apparent, however, from a study of their life-history and habits, that they are far more likely to be agents in the dissemination of blood-inhabiting protozoa than *M. domestica*. Patton recognized that the wounds produced by biting flies might be infected subsequently through the agency of non-biting blood-drinking muscids. His observations related to an Indian species named by Austen (1910) *M. pattoni*. Patton and Cragg also give a chapter on the haematophagous flies in their classical textbook, and emphasize their character and habits.

The Non-biting Muscid in Nyasa

In Nyasaland various species of these muscids abound, one in particular—*Musca spectanda* Wied—being, as recent work by W. A. Lamborn has shown, almost entirely dependent throughout its whole life on man. The eggs are laid solely on human excreta, on which the larvae feed to maturity. The adult flies, often in large numbers, especially in the early morning, settle on man, awaiting the opportunity to slake their thirst and deposit their eggs on his freshly excreted faeces. Swarms of non-biting haematophagous flies, including *M. spectanda*, may be found infesting abrasions and sores on domestic animals. They drink greedily the blood which oozes from the bites of *Tabanus*, *Stomoxys*, and other biting flies, and actually hustle them off in order to secure a meal. *M. spectanda* appears to be almost unique in the way in which it concentrates on man. It attacks persistently and with great determination scratches, wounds, open sores, tropical ulcers, yaw nodules, etc., and greedily drinks to repletion blood, serum, or secretions from the nose, eyes, or mouth. In one instance thirty-five *M. spectanda*, all females, were captured in three-quarters of an hour from a linear scab half an inch long on the dorsum of the foot of a native, when, despite the abundance of *M. domestica* in the neighbourhood, not a single specimen was included in the catch. Catches of fifty to sixty *M. spectanda* can be made readily within an hour in the early morning from the shoulders of any native.

These observations by Lamborn, and the hypothesis put forward by him (1932) concerning the part muscids may play in the spread, not only of trypanosomiasis, but also of cutaneous leishmaniasis, led to the experimental work described below, for which the senior author was largely responsible. As will be noted, the most important fact that has emerged is that this group of flies is capable of taking up and actively depositing blood-inhabiting protozoa and spirochaetes, either by regurgitating them from the proboscis or by passing them unchanged and alive in the excreta over a period of five to six hours.

Mechanical Transmission of *Trypanosoma brucei* through the Agency of *Musca spectanda*

In these experiments over 200 flies, both bred and wild, were used. The usual procedure was to feed them on blood exuding from a puncture of the ear of a dog or from the tail of a rat infected with *T. brucei*. A certain proportion of flies thus fed commenced in about five minutes to pass in their dejecta either pure blood or blood-stained fluid full of actively motile trypanosomes,

while some flies continued to pass, at intervals, living trypanosomes for a period of at least six hours after an infective feed. A smaller proportion of flies were seen to blow a blob of blood containing living trypanosomes from their proboscis five or ten minutes after a feed.

Blood-stained excreta and regurgitation of blood were observed not only in the case of the flies fed on infected blood but in those fed on the normal blood of man and domestic animals and on other fluid material. The blood-passing capacity of various batches varied to a very marked degree. This variation may be associated possibly with the food requirements necessary for the maturation of the ova in the female.

Thus in one experiment twelve flies were fed on a dog infected with *T. brucei*, and although numerous drops of clear excreta were passed over a period of five hours in no instance was either blood or trypanosomes detected. This batch of flies was killed after five hours, and motile trypanosomes were seen in the gut of eight of them.

In another experiment seven out of twelve of the flies fed on a dog infected with *T. brucei* commenced to pass drops of blood-stained excreta in from five to ten minutes, and continued to excrete numerous drops for five hours. All these drops contained active trypanosomes. One fly also regurgitated a drop of blood from its proboscis full of active trypanosomes.

Over a period of five hours one fly passed forty-one drops of dejecta, another seventeen drops, and a third fifty-three drops, all of which were blood-stained and contained living trypanosomes. As an example of the extraordinary capacity of this muscid to deposit living trypanosomes in its excreta it may be stated that a batch of ten, fed to repletion on the blood of a dog infected with *T. brucei*, passed in six hours 265 droplets stained with blood and containing living trypanosomes.

In carrying out experimental infections flies, after a feed on *T. brucei*, were placed in specimen tubes covered with gauze, and the drops of excreta containing living trypanosomes passed on to the sides of the tube were drawn up into a capillary in saline or citrate solution.

Into one rat excreta containing trypanosomes was introduced intraperitoneally, infection duly taking place. A second rat was successfully infected by placing a drop of excreta on a small fresh cut on the ear, and a third rat developed an infection with *T. brucei* after a drop of the fly's excreta had been placed on a drop of blood exuding from a fresh puncture made by a tabanid, *T. fraternus* Ric.

From the experimental observations here recorded there cannot be any doubt that, apart from any mechanical transmission by the action of biting flies *per se*, the combined action of these and the non-biting blood-drinking species is capable of bringing about the transmission of trypanosomes under natural conditions. The presence of hordes of these flies, which persistently infest and annoy both man and other animals—especially when abrasions or sores are present—is a significant fact when it is realized that their capacity for distributing viable trypanosomes is so perfect. Their predilection for the mucous surfaces, moreover, suggests a means whereby infection with trypanosomes may take place. Experimental work to test the possibility of infecting rats through the eye, nose, and mouth by the excreta of these flies containing *T. brucei* was, however, unsuccessful.

Passage of Living Leptomonads of the Cultural Forms of *Leishmania donovani*, *L. infantum*, and *L. tropica* through the Intestine of *Musca spectanda*

Observations on visceral leishmaniasis indicate that this form of the disease has the same geographical distribution as sandflies of the *major* group—*Phlebotomus argentipes* in India, *P. chinensis* in China, *P. perniciosus* in Italy,

Malta, and Algeria, and *P. major* in Greece. Cutaneous leishmaniasis, on the other hand, occurs where *P. papatasi*, *P. sergenti*, or *P. caucasicus* are found.

The problem of the relationship of these flies to the transmission of leishmaniasis has been ably reviewed by Wenyon, and more recently by Adler, and it would appear that the entire mechanism of transmission through their agency requires further elucidation. It is a curious fact that out of numerous attempts to transmit leishmania through the bites of infected sandflies very few positive results have been obtained. Shortt, Swaminath, and Krishnan recorded one successful transmission of *L. donovani* to a Chinese hamster through the bites of sandflies, and more recently Napier, Smith, and Krishnan report further successes. The numerous negative results in transmission through the bites of these flies is not easily explained when it is considered that the Chinese hamster is a very susceptible animal. Napier, Smith, and Krishnan (1933) have shown that both the rounded tissue forms and the flagellate forms of *L. donovani* can produce infection in hamsters when introduced intra-peritoneally, subcutaneously, percutaneously, orally, and conjunctivally. A very high proportion of infections was produced by both forms of the parasite by all the routes tested, and it was further shown that except by the conjunctival route the flagellate form was always the more infective.

It would seem that, apart from infection through the agency of sandflies, direct or mechanical transmission by non-biting haematophagous flies of both visceral and cutaneous leishmaniasis is possible. Considering the capacity of these flies for taking up blood or tissue parasites, it is difficult to conceive of a more ideal method whereby all species of leishmania can be distributed to abrasions or to the conjunctiva, mouth, or nose, especially as this group of muscids is so well represented in the countries where leishmaniasis is endemic. Oriental sores during ulceration can be a source of infection to the flies, and in kala-azar of man and the dog involvement of the cutaneous tissues allows haematophagous flies easy access to the leishmania bodies. Moreover, as it has been shown that viable leishmania occur in the faeces of man, it is quite possible that the flies could ingest them and pass them on as a result of the habits already described.

Experimental Observations.—In our opinion the following experiments point definitely to the fact that all the species of leishmania in man could be transmitted directly to healthy individuals by these flies, either through skin abrasions, or through the mouth or conjunctiva.

Cultures of *L. donovani* (three different strains) of Indian origin and cultures of *L. tropica* and *L. infantum* (dog strain) were obtained from the London School of Hygiene and Tropical Medicine and maintained in Nyasaland. About 250 *M. spectanda* were fed in groups on these cultures, almost invariably to repletion, and, as in the experiments with *T. brucei*, many of the flies passed living leptomonads of all three species in their excreta from five minutes up to a period of three hours afterwards. One insect, fed on a culture of *L. donovani*, passed, during a period of three hours, twenty-three droplets of excreta containing living flagellates, and during the first five minutes after feeding regurgitated from its proboscis a drop containing them alive. A second fly, fed on the culture of *L. tropica*, passed in the same time thirty-one drops, all containing active flagellates, and a third, fed on a culture of *L. infantum*, passed eleven drops containing living leptomonads, also within the same time.

Unfortunately, owing to the fact that it was impossible to obtain the rounded tissue forms of the various species of leishmania, experimental work to ascertain the viability of these in the fly was not carried out, but from the work on the viability of trypanosomes and the flagellate forms of leishmania, it would seem to be practically

certain that these tissue forms would be readily passed viable in the dejecta of the flies over a period of several hours. It is hoped that an early opportunity may be made available to test this important point, as it is possible that during their sojourn in the gut of the fly some, at least, of the tissue forms may make an attempt to flagellate, especially if retained for several hours.

Passage of Living *Treponema pertenue* through the Gut of *M. spectanda*

In these experiments three cases of yaws were used, and about eighty flies, all of which were bred.

Before feeding the flies on the yaws sore, the presence of the causative organism was determined by dark-ground illumination and by staining. Two of the cases had spirochaetes numerous enough for easy detection after passage through the flies. The sores were then cleaned thoroughly to get rid of any surface pus, and the flies were allowed to feed on the exuding fluid. They did so greedily, and again a certain percentage commenced to pass fluid, which was found to contain living *T. pertenue*. In this experimental work the spirochaetes were only detected up to a period of one hour after a feed. Lack of time prevented a fuller determination of the period they will remain viable in the excreta of the flies.

Flies could infect any breach of the surface of the skin either through their dejecta or by regurgitation, as already indicated in the previous paragraphs. In this connexion it is significant that primary yaw sores have been recorded as arising not infrequently on such sites.

Summary

1. Non-biting haematophagous muscids feed readily to repletion on blood, serum, serous exudate, ulcers, sores, and also secretions from the nose, eyes, and mouth. After a meal a certain proportion of these flies pass blood or serum in their numerous dejecta, which may contain large numbers of living trypanosomes, leishmania, or the *Treponema pertenue* of yaws.

2. These haematophagous flies have their preferred hosts—for example, *Musca spectanda* Wied, which occurs in great abundance in Nyasaland, favours man. It lays its eggs exclusively in human faeces, breeding very freely; it derives moisture from human faeces, and could thus take up *L. donovani* from this source, since the organism is known to occur sometimes in this medium. Large numbers attack persistently and with determination scratches, cuts, and sores of the skin of man in search of food, and also haunt the eyes, nose, and mouth in search of fluid.

3. *Trypanosoma brucei* in the blood of rats and dogs are readily ingested by *M. spectanda*, and during a period varying between five minutes and six hours these flagellates can be passed alive in the numerous droplets of dejecta passed through the gut of the fly. Rats were experimentally infected by the intraperitoneal injection of these dejecta by placing a drop on a fresh cut on the ear and by placing the dejecta on a drop of blood exuding from the bite of a tabanid. *T. brucei* in the dejecta introduced into the eye, nose, and mouth did not produce infection. Certain flies after a feed extrude a drop of the ingested blood containing living trypanosomes from their proboscis five to ten minutes after a full meal.

4. Living leptomonads in cultures of *L. donovani*, *L. infantum* (dog strain), and *L. tropica* are freely ingested by *M. spectanda*, and are passed viable in the droplets of excreta for several hours after a feed. There can be no doubt that these flies could ingest the round tissue forms of all the human forms of leishmaniasis and pass them in a viable state either through the gut or by regurgitation from the proboscis to sores or mucous membranes. It would seem certain that both kala-azar and oriental sore could be actively transmitted through the agency of these flies.

5. *Treponema pertenue* of yaws passes rapidly in a viable form through the gut of *M. spectanda*, and so could easily be deposited on cuts and abrasions.

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THE POST-OPERATIVE COMPLICATIONS AND RESULTS OF TONSIL AND ADENOID OPERATIONS IN CHILDREN*

BY

B. ELIZABETH NESBITT, B.Sc., M.B., F.R.C.S. Ed.

SURGEON, EAR, NOSE, AND THROAT DEPARTMENT, EDINBURGH HOSPITAL FOR WOMEN AND CHILDREN; FORMERLY CLINICAL ASSISTANT, EAR, NOSE, AND THROAT DEPARTMENT, ROYAL INFIRMARY, EDINBURGH

This clinical investigation into the post-operative complications and results of tonsil and adenoid operations on children under 14 years of age was suggested by Dr. J. S. Fraser, surgeon, ear, nose, and throat department of the Royal Infirmary, Edinburgh.

Source of Material

1. *Hospital Patients* (1,457 cases).—These cases were operated on as out-patients in the three years 1927–9 inclusive in Dr. J. S. Fraser's department. Out of the 1,457 hospital out-patients 1,138 reported at the Royal Infirmary, and 315 were visited at their homes by the hospital social service. The post-operative complications were considered in all the cases, but only in 1,138 of them were the operation results noted.

2. *Private Practice* (900 cases).—These patients were operated on in private by Dr. J. S. Fraser and Dr. W. T. Gardiner during the ten-year period 1919–28.

The following points were ascertained from the parents of each out-patient who reported, and by means of a questionnaire sent to each private patient's doctor: (a) occurrence of any post-operative complications; (b) disappearance of the preoperative symptoms; and (c) condition of the general health since operation.

The following routine is adopted in Dr. J. S. Fraser's department as regards the out-patient operations on children under 14 years of age. Only those who live within a radius of three miles from the Infirmary are operated on as out-patients. Exceptions are admitted as in-patients—namely, (a) very delicate children, or children with some complication requiring observation (for example, acute suppurative otitis media), and (b) patients living in overcrowded or unsuitable houses. The parent is given full written instructions as to the pre-operative preparation and post-operative care of the patient. The clinical assistants give the anaesthetics and do the operations (tonsil guillotine enucleation and removal of adenoids by curettes) under the supervision of the clinical tutor. When the haemorrhage has ceased the patients are put to bed in a ward for three or four hours after the operation. A clinical assistant examines each patient's throat before the parents take the child home in a taxi.

* Read in opening a discussion in the Section of Oto-rhinolaryngology at the Annual Meeting of the British Medical Association, Bournemouth, 1934.

Statistics

Preoperative examination of 1,138 hospital cases gave the following results:

Enlarged tonsils and adenoids	...	...	1,109 cases
Enlarged tonsils, no adenoids	...	...	10 "
Adenoids only (tonsils previously removed)	...	...	19 "
			<hr/> 1,138

There was a previous history of a peritonsillar abscess in three cases, and a fourth patient presented himself for operation, but owing to the existence of a peritonsillar abscess his tonsil was not removed.

Operations in the 1,138 hospital and in the 900 private cases were as follows:

	Hospital	Private
Tonsils and adenoids removed...	1,089	825
Tonsils only	10	0
Adenoids only	39	75
	<hr/> 1,138	<hr/> 900

Results of tonsil and adenoid operations in the private and hospital cases:

Tonsils	Hospital per cent.	Private per cent.
Complete enucleation	80.3	97.0
Incomplete enucleation	19.0	3.0
Results unascertained (refused examination)	0.7	—

Complete enucleation of one tonsil with the guillotine and dissection of the other was done in eleven of the private cases.

Adenoids	Hospital per cent.	Private per cent.
Complete removal	81.8	99.5
Adenoids remains	17.5	0.5
Results unascertained (refused examination)	0.7	—

The above percentages of incomplete tonsil and adenoid operations are somewhat high in the hospital cases, but these operations were done and the anaesthetics given by thirty-three successive clinical assistants.

Post-operative Complications

The material reviewed below comprises 1,457 hospital and 900 private patients.

HAEMORRHAGE

In all cases, to safeguard against avoidable haemorrhage, a careful inquiry was made as to any tendency to haemorrhage—for example, from an ordinary wound or tooth extraction. If the patient was known to be a haemophilic the coagulation index of the blood was ascertained and appropriate preoperative treatment adopted. In the groups of hospital and private patients under consideration there was no case of congenital haemophilia.

Attention to some points in the preoperative preparation and immediate post-operative treatment of the patients is productive of quick haemostasis. They are: (1) preliminary injection of atropine sulphate, (2) short ethyl chloride anaesthesia, (3) the use of a blunt tonsil guillotine and sharp adenoid curette, and (4) immediate post-operative treatment: this consists of sponging the face and neck with ice-cold water, and the adoption of the sitting position when the patient has recovered from the anaesthetic.

It should be noted that the age of the children is important, as under 14 years severe haemorrhage occurs less frequently than in older children.

Reactionary Haemorrhage.—Out of 1,457 hospital cases sixteen (slightly over 1 per cent.) had some reactionary