As a contributory cause, however, it is considered that malnutrition may play a part. In Cases 29, 36, 42, and 48 unilateral optic atrophy followed a severe blow in the region of the eye concerned. In no instance was the blow sufficient to have left any radiological evidence of bony damage, nor was any ocular damage seen apart from the optic atrophy. It seems possible that where a severe concussion injury has caused damage to the optic nerve the nutritional level may be too low to repair the damage and atrophy may result.

One of our cases (No. 46)—that of a soldier aged 37 who complained of the fairly sudden onset of blurring and dimness of vision soon after arrival in Egypt—showed points of similarity to a series of cases from the Middle East (Spillane and Scott, 1945). The majority of these cases retained good physical health, and the skin, heart, lungs, and gastro-intestinal tract were not affected. Within a year of this soldier's return to Rhodesia his vision was reduced to R. 6/36, L. 6/24. His disks showed evidence of post-neuritic atrophy, no central scotoma was demonstrated, his fields being apparently full, but the use of a Bjerrum screen at 2 metres was not made.

There was no significant increase in the number of cases admitted towards the end of the dry season and the beginning of the rains, when food supplies became exhausted. It is at this time of the year that we see, for example, many cases of pellagra, night blindness, and scurvy.

4. Exogenous Toxins

Methyl alcohol, arsenic, and quinine are probably the main toxic agents with which the indigenous population may come into contact. As has already been mentioned, arsenic may play an important part after inadequate treatment of syphilis. Quinine and methyl alcohol blindness were not encountered in this series.

It is possible that a native medicine—not divulged by the patient—may play a larger part than is suspected at the moment. We failed to discover any definite addicts such as the case of optic neuritis in a Qat addict in Somaliland described by Baird (1952).

Summary

Fifty consecutive cases of optic atrophy in Africans from British Central Africa have been analysed. Purely ophthalmic causes, such as chorio-retinal disease with consecutive optic atrophy, and glaucomatous optic atrophy, have been excluded from the series, as the cause in these cases was not in doubt.

Thirty-two of the series were found to be of the post-neuritic atrophy type and 12 were of the primary optic atrophy type. Vascular and temporal atrophy made up the balance of cases.

Various aetiological factors have been considered. In four patients—two of whom died—it was possible to ascribe a definite cause. Of the remainder, it was thought that syphilitic optic atrophy, but with no other neurological lesion, was a probable cause in the majority. A disorder of nutrition does not seem to be an important cause of optic atrophy in Central Africa.

We wish to thank Dr. R. M. Morris for his permission to publish this paper.

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SHIGELLA FLEXNERI ENZOOTIC IN CAPTIVE RHESUS MONKEYS

BY

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The occurrence of dysentery among the rhesus monkeys at the Clifton and West of England Zoological Society's gardens in Bristol proved to be associated with a type of *Shigella* organism which is rarely found in the human population in Great Britain. As the outbreak presents some other interesting features it is reported here.

Macaca mulatta, the rhesus monkey, is kept in the "monkey temple" at the Bristol Zoo. This is an erection in the centre of a concrete pit, well away from direct contact with the public, although the latter can drop food to the monkeys if they wish. The first colony to occupy this temple arrived in 1929. There were 80 monkeys, and many of them died from a disease then regarded as ulcerative colitis, which closely resembled the condition we are now describing as shigellosis. In 1932 the colony began to die from tuberculosis and all had to be destroyed. In the spring of 1933 a second colony arrived, this time without intestinal disease; but again they acquired tuberculosis, and the remaining monkeys had to be destroyed in 1935. In 1936 a third colony of 70 young ones came. They bred well, and showed no signs of intestinal disease or of tuberculosis. However, furious fighting broke out in 1950 and many died of wounds. They were mostly quite old by now, so they were destroyed, except for eight young ones which were kept, and the new colony about which this paper is written was put in with them. In 1949 one monkey of the third colony had died with diarrhoea, and *Sh. flexneri* had been isolated from its faeces, but was not typed. The eight remaining monkeys appeared fit, and it was hoped they did not harbour the organisms.

Cook (1953) reports on rectal swabs taken from 339 freshly imported monkeys received by the Ministry of Supply. From these *Shigella flexneri* type 103 (4a) was cultured once, type 103 Z (4b) 40 times, and type Z twice; *Shigella sonnei* 24 times; *Shigella schmitzi* 50 times, and various other types 6 times. Cook states that bacillary dysentery, pneumonia, and tuberculosis are the main scourges of captive monkeys in this country.

The Epizootic

The present (fourth) colony of 103 monkeys was imported by air from Calcutta on March 19, 1951. They were mostly under 2 years old. Eight days after arrival the new young monkeys began to die. The weather was very cold and snowy. Post-mortem examination was carried out in all cases (Table I). The first eight died of pneumonia; then diarrhoea was noticed, and in the three months up to the end of June a further 18 died. Faeces from 15 of these were examined *post mortem*, and *Sh. flexneri* was isolated from 8, and typed in 6 cases as *Sh. flexneri* 103 (4a). In December, 1951, three more monkeys died, the faeces of two of which were examined, and from these the same organism was isolated.

Early in 1952 sporadic deaths occurred, reaching a peak in April with four deaths, one producing *Salmonella typhi*.

TABLE I.—Isolation of *Shigella* Organisms

	Deaths	Monkeys Examined post mortem for Dysentery	<i>Shigella</i> <i>flexneri</i> Isolated	<i>Shigella</i> <i>flexneri</i> Typed 103 (4a)
March, 1951	7	—	—	—
April–June	19	15	8	6
July–Sept.	—	—	—	—
Oct.–Dec.	4	2	2	2
Jan.–March, 1952	3	3	3	3
April–June	6	5	3	3
July–Sept.	5	4	3	3
Oct.–Dec.	3	1	—	—
Jan.–March, 1953	10	10	5	5
April–June	2	1	1	1*
July–Sept.	2	2	2	2
Oct.–Dec.	2	2	2	2
	63	45	29	26+1*

* Type 103 Z (4b).

murium and two *Sh. flexneri* type 103 (4a). Deaths occurred into the summer, when several monkeys were advanced in pregnancy, and an occasional death was associated in one way or another with this. By winter, dysentery had started again, once more associated with pregnancy, and this time also with *Haemophilus influenzae*, then common in the human environment. *Sh. flexneri* type 103 (4a) was found in four out of a batch of seven dead monkeys, the first four of which were pregnant and the last five of which had worms, so that two were both pregnant and worm-ridden. All except one of this batch had ulcers in the colon, some of the ulcers being very large. The one without colon ulcers nevertheless produced *Sh. flexneri* type 103 (4a). It had a very heavy infection, mainly in the lungs and pleural cavities, with *H. influenzae* (type B), was not pregnant, had no prominent mesenteric lymph nodes, and had only a very small number of *Trichuris trichiura* ova in the faeces. Since that time there have been occasional shigella-positive stools from dead monkeys, and in April, 1953, another type, *Sh. flexneri* type 103 Z (4b), was isolated for the first and only time from this colony. Type 103 (4a) has been isolated four times to date since then (end of December, 1953).

Bacteriology

Faeces and occasional rectal swabs obtained at necropsy were plated direct on to desoxycholate citrate medium and also concentrated in tetrathionate broth. Dysentery organisms were isolated only by direct culture on the desoxycholate plates, but the concentration method was used to safeguard against missing any other intestinal pathogens which might be present. On one occasion *Salm. typhimurium* was isolated by this means.

The isolated dysenteric organisms fermented glucose and mannitol, gave a negative indole reaction, and agglutinated with type 103 (4a) antiserum. The identification was confirmed in most instances by Dr. Carpenter, of the Dysentery Reference Laboratory.

The single isolation of *Sh. flexneri* Boyd type 103 Z (4b) presents an unsolved problem. Antigenically, the relation of type 103 (4a) to type 103 Z (4b) is in the group antigenic components only. Though the subtype 103 Z (4b) does have group-antigen factors in common with type 103 (4a) it also has other factors shared by the types VZ and Z, which type 103 (4a) does not, and there is to date no evidence of change between one Flexner type and its subtype. A possible explanation is that the monkey was infected with type 103 Z (4b) before it entered the zoo, and for one reason or another the type did not spread round the colony. The source of infection of this monkey is unlikely to have been a human contact in this country because of the extreme rarity of this type in human infections in Great Britain.

Reports from Elsewhere

Cruickshank and Bray (1950) reported an outbreak, in the London School of Hygiene and Tropical Medicine, of infection with *Sh. flexneri* type 103 Z (4b) where there was

inflammation and ulceration of the bowel, with which several monkeys died. The organism was isolated from one which at necropsy showed no signs of dysentery.

Rewell and Bridges (1948) reported four deaths in 1947 at the London Zoo, and four more at the Institute for Medical Research from the same imported batch, a *Shigella* organism they called "*mulatta*" being isolated. This strain was described as a group variant of type 103, and is certainly type 103 Z (4b). In the zoo animals there was ileal and colonic inflammation, but there were no ulcers. Mesenteric lymph nodes were inflamed. Type 103 (4a) occurs sporadically in the human and is frequently isolated outside Britain. Type 103 Z (4b) occurs in America quite often in man, and has been reported by Carpenter and Sandiford (1952) from a child with dysentery, and from the faeces of a monkey with which the child had contact. Carpenter and Forbes, in a letter from the Dysentery Reference Laboratory in 1953, informed us of the rarity with which types 103 (4a) and 103 Z (4b) are isolated there from human material. However, very many more examples of these types are isolated from primates.

Lesions at Necropsy

The lesions vary greatly, from slight hyperaemia with no lymph-node involvement to very large ulcers with gross lymph-node enlargement. The colon is nearly always the only part affected, and it is the caecal and ascending part which suffers most; the transverse part is affected less often and the descending colon and its most distal reaches very seldom. Sometimes there are deep abscesses beneath the ulcers. There may have been some other cause for these, but none has been found. Worm infestation may play a part. Even with severe infections producing widespread mucosal ulcers there is often no free fluid in the peritoneal cavity, and the outside of the bowel may look quite normal. However, there are always prominent lymph nodes to guide to the affected sites. Chronic infections cause much thickening of the bowel wall, and this fact and the large ulcers suggest that the shigellosis has been present for a long time. The thickening is due to muscle hypertrophy, oedema, and fibrosis. In all cases in which ulceration was present and *Sh. flexneri* was isolated it seemed highly probable that death was due to the shigellosis.

Parasites

Association with worms is not invariable. It happened in the bad-weather epizootic of 1951, and in the period associated with *H. influenzae* in 1953. The animals may nearly all have had worms when they came from India. Certainly, in the lungs of all the first ones which died there was evidence of this in the form of little dry abscesses, which could be seen when the pneumonia epizootic had passed over and the dysentery had begun. The first worms were identified as *Oesophagostomum bifurcum*. By 1953 all these had evidently disappeared, and the whipworm, *Tr. trichiura*, had taken its place. Whipworm ova are still seen in the stools of the monkeys which die sporadically. In the most affected cases worms were found as high as the duodenum, but they usually lived in the colon, attaching themselves by their narrow heads to the sound mucosa between ulcers, and occasionally to the floors of the ulcers where these were not too necrotic. Recently a fresh problem has arisen in the finding of *Giardia lamblia* in the stools of nearly all the dead monkeys, whereas they had not been seen before, although all faeces examined were searched for parasites of all kinds.

Discussion

There are two possible sources whence the organisms might have reached this batch of monkeys in captivity—namely, the handlers and cage-monkeys at Calcutta, or the residue of the previous batch in Bristol—so that there is no evidence here which might help to solve the problem of whether *Sh. flexneri* is confined to captive monkeys or occurs in the wild state. During the three years covered

by this paper no human case of dysentery has produced either *Sh. flexneri* type 103 (4a) or 103 Z (4b) in the Bristol area (in 1952 6,500 specimens of faeces were examined here for dysentery and *Salmonella* organisms). The incubation period is short and no dysentery was observed until eight days after the arrival of the colony in the zoo. Another point of interest lay in the association of death from dysentery with other difficulties encountered by the monkeys—such as extreme youth, worms, bad weather, pregnancy, and *H. influenzae* infection. An uncomplicated dysentery epizootic did not occur. Perhaps both the carrier state and the deaths were encouraged by the associated poor condition. A third point of interest was the persistence of a major infector, *Sh. flexneri* type 103 (4a), in spite of isolated occurrence of *Sh. flexneri* type 103 Z (4b) and *Salm. typhimurium*. Attempts to eradicate the infection by oral sulphaguanidine proved unsuccessful, confirming Cook's (1953) observations; but injection of streptomycin as recommended by him has not been tried. The monkeys now seem to have reached a state of comparative equilibrium with their dysentery and their parasites.

TABLE II.—Summary of Data

No. of monkeys from old colony	..	..	..	..	..	8
.. .. young monkeys flown from India	..	..	..	..	..	103
Total No. of deaths	..	..	..	..	..	63
Faeces examined at necropsy	..	..	..	..	..	45
<i>Sh. flexneri</i> isolated from these	..	..	..	..	..	29
.. .. typed —103 (4a)	..	..	..	..	..	26
.. .. —103Z (4b)	..	..	..	..	..	1
.. .. not typed	..	..	..	..	..	2
Ulceration in colons	..	..	..	..	..	33
Diarrhoea	..	..	..	..	..	28
Worms	..	..	..	..	..	17

Summary

An epizootic appeared to attack a new colony of 103 young monkeys which arrived in Bristol Zoo in bad weather in March, 1951. Sporadic deaths continued to occur into 1953. *Sh. flexneri* type 103 (4a) was isolated from 26 of the 63 monkeys which died. A single monkey gave *Sh. flexneri* type 103 Z (4b) and another gave *Salm. typhimurium* at necropsy.

The relation of this finding is shown to other afflictions, including *H. influenzae*, pregnancy, and parasites; but emphasis is laid on the association of colonic ulceration with the finding of *Shigella* organisms, and the probability that most of the deaths were due to shigellosis.

Reference is made to other published accounts of similar rhesus monkey infections.

This report was made possible by the co-operation of Mr. R. E. Greed, superintendent of the Clifton and West of England Zoological Society; and of Dr. R. E. Clarke, medical adviser to the Society, who supplied the information about the first three colonies of monkeys. It was carried out under the direction of Professors T. F. Hewer and K. E. Cooper, of the University of Bristol, who made many helpful criticisms. Our thanks are due to Dr. Carpenter, of the Dysentery Reference Laboratory, for her many detailed comments and her continued interest in our work on the monkeys; and to Dr. H. D. Crofton, of the University of Bristol Zoology Department, and Mr. E. Guise, chief technician in the public health laboratory in Bristol, for identifying the parasites.

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Dr. E. H. WALKER, who is retiring shortly from his post as lecturer in public health at Manchester, was recently guest of honour at a gathering of former D.P.H. students. Dr. F. N. MARSHALL presided, and with Dr. T. P. SEWELL paid tribute to Dr. Walker's qualities as a friend and colleague. Dr. Walker was appointed lecturer in 1931.

Medical Memoranda

Infective Hepatitis in a Boys' Hostel

The hostel for maladjusted boys which serves the town and county of Northampton has 20 places for boys whose ages range from 7 to 14 years. On October 13, 1953, a boy fell ill with headache and fever, and jaundice developed three days later. This boy had been admitted to the hostel 20 days previously from a remand home in London, and, although his medical certificate stated that he was not subject to quarantine for any infectious disease, there had, in fact, been three cases of jaundice in the home shortly before he was transferred. As soon as it was ascertained that he was suffering from infective hepatitis he was removed to hospital, the hostel was closed for admissions, and routine precautionary measures were instituted, particular emphasis being placed on the sterilization of crockery and advice on hygiene to the staff and boys. Despite these measures, a second boy, who slept in the same dormitory as the first, was unwell on November 11 and developed jaundice two days later. Finally, on December 14 a third boy, who slept in a different dormitory, developed the disease; in his case jaundice was not manifest until six days after the onset of illness. These two boys also were removed to the infectious diseases hospital as soon as the nature of their illness had been diagnosed.

The general position with regard to the hostel was then reviewed. Since the beginning of the outbreak several of the boys had been discharged to their own homes, and it was appreciated that the maintenance of a hostel with vacant places over a considerable period was to be avoided if possible. Fortunately, through the co-operation of the Public Health Service Laboratory, supplies of gamma globulin were made available, and, after obtaining the consent of the parents, the unaffected boys and staff were inoculated with 9 ml. each of the solution during the first week in January. This was an average dose of 0.11 ml. per lb. (0.24 ml. per kg.) of body weight among the boys and 0.06 ml. per lb. (0.14 ml. per kg.) of body weight among the staff. On January 30 specimens of blood were taken from all the boys and, through the co-operation of the Northampton Hospital Laboratory, were examined for thymol turbidity and bilirubin. The results indicated that none of the boys had suffered from a subclinical infection, and, as no cases of jaundice had occurred after December 14, it was decided to re-admit boys to the hostel.

Control of Spread.—When the incubation period of an infectious disease is as long as five weeks there is a tendency for its infectivity and the control of its spread to be overlooked. The outbreak described in this report illustrates the consequences of admitting to a hostel a child who was incubating the disease. Apart from the illness of the boys, this admission resulted in wasted accommodation and unnecessary expenditure. Moreover, experience has shown that elimination of this infection in a closed community can be very difficult. There would seem, then, to be every reason for imposing quarantine restrictions on contacts of infective hepatitis who are about to enter residential accommodation.

PASSIVE IMMUNIZATION

The value of passive immunization by the administration of gamma globulin in outbreaks of viral hepatitis has been described in several American investigations. Stokes and Neefe (1945) found it to be effective in a dose of 0.15 ml. per lb. (0.33 ml. per kg.) of body weight; Havens and Paul (1945), by administering the gamma globulin earlier after exposure, found that a dosage of only 0.08 ml. per lb. (0.18 ml. per kg.) of body weight was required; while in an outbreak in a Chicago orphanage Stokes (1953) ascertained that doses as small as 0.06 ml. per lb. (0.14 ml. per