inactivity of operated locusts, however long they survived. Implantation of active corpora allata led to the resumption of the normal, high level of locomotor activity. Extirpation of the testis and accessory reproductive glands, on the other hand, had no effect either on spontaneous locomotor activity or on glycogen and lipid utilization.

The hypothesis is therefore advanced that the corpus allatum hormone regulates the intensity of locomotor activity by a direct effect on the central nervous system. Since fat and glycogen form the chief energy reserves of locusts[9], it is suggested that the accumulation of these substances after allatectomy is due to the persistent inactivity of the operated insects.

I thank Sir Vincent Wigglesworth for facilities and advice and the Uganda Government for a research grant.

THOMAS R. ODHIAMBO *

Zoological Laboratory,
Downing Street,
Cambridge.

* Present address: Department of Zoology, University College, Nairobi, Kenya.

[1] Wigglesworth, V. B., *Quart. J. Micro. Sci.*, **79**, 91 (1936).
[2] Pfeiffer, I. W., *J. Exp. Zool.*, **99**, 183 (1945).
[3] Vogt, M., *Z. Zellforsch.*, **34**, 160 (1949).
[4] Thomsen, E., *J. Exp. Biol.*, **29**, 137 (1952).
[5] Bodenstein, D., *J. Exp. Zool.*, **124**, 105 (1953).
[6] Orr, C. W. M., *J. Insect. Physiol.*, **10**, 53, 103 (1964).
[7] Doane, W. W., *J. Exp. Zool.*, **146**, 275 (1961).
[8] Brown, R. H. J., and Unwin, D. M., *J. Insect. Physiol.*, **7**, 203 (1961).
[9] Weis-Fogh, T., *Phil. Trans. Roy. Soc.*, B, **237**, 1 (1952).

MICROBIOLOGY

Salmonella in Bird Faeces

THE contamination of our rivers and beaches with bacteria related to *Salmonella*, caused by the disposal of domestic sewage, is well known. Domestic sewage, collected in the main drainage of the city of Hamburg, has been continually tested for *Salmonella* during the past twenty years. *Salmonella* occurs at a density equivalent to 5,000 organisms in 1,000 ml. of sewage.

After flowing into the Elbe, these organisms are dispersed, but survive, so that some 50–100 organisms can be found in 1,000 ml. of river water.

Steiniger[1] concluded, from his examination of faecal material from birds, that possibly these animals are the origin of the wide spread of *Salmonella* in surface water. In other words, it may not be sewage disposal that contaminates the rivers and beaches; there may exist a sort of *Salmonella* saprophytism in the gut of seabirds, forming an important factor in the spread of *Salmonella* in our environment.

We collected more than 1,000 samples of faecal material from gulls in the area of the biggest sewage disposal works of Hamburg, on bridges and pontoons in the port of Hamburg, and in the streets of the city. 78 per cent of the samples collected at the sewage disposal works were positive for *Salmonella* as were 66 per cent of the samples collected in the port and 28 per cent of the samples collected in the city. The most frequently isolated species, as in water samples of the Hamburg sewers, was *S. paratyphi B*. The faeces of gulls collected in those regions which were free from the influence of sewage never contained *Salmonellae*. As, on the other hand, the faeces of birds collected near the sewage disposal works were positive, one must conclude that the presence of *Salmonella* organisms in these birds is related to a source of infection, and does not present *sui generis* the normal bacterial flora in the gut of birds. Furthermore, this conclusion is confirmed by the range of species isolated, which exactly corresponds to the species isolated from the water of Hamburg rivers. The most frequently isolated species was *S. paratyphi B*, followed in order of frequency by *S. typhimurium*, *S. manchester*, *S. montevideo*, *S. infantis*, *S. senftenberg*, *S. anatum*, *S. stanley*, *S. newport*, *S. braenderup*, *S. san diego*, *S. duisburg*, *S. muenchen*, *S. blockley*, *S. bovis morbificans*, and *S. panama*.

In examining the faecal material of other birds, the most striking fact was the great proportion of pigeons (30 per cent) and ducks (16 per cent) which contained *Salmonella*, while the faecal matters of thrushes (0·15 per cent) and sparrows (0·2 per cent) only occasionally showed a positive result. Birds kept indoors, such as canaries or parrots, were always negative for *Salmonella*. It is thus clear that a lack of source of infection results in a lack of *Salmonella* in the faeces. Faeces of pigeons from Tanganyika and Venice were *Salmonella* positive in 30 and 29 per cent of cases respectively. While the faeces of gulls collected in Hamburg showed a preponderance of the species *S. paratyphi B*, samples of pigeons and ducks frequently contained *S. typhimurium*: samples of pigeon-dirt collected in Hamburg 80 per cent, samples of duck-dirt 80 per cent, samples of foreign pigeon-dirt 90 per cent. The other species isolated were, in order of frequency: *S. manchester*, *S. paratyphi B*, *S. anatum*, *S. newport*, *S. panama*, *S. makumira*. This last mentioned genus was a new species with the antigen-formula 4, 12: enx: 1, 7, first isolated from the faeces of an African pigeon (Rohde and Müller[2]).

The occurrence of *S. paratyphi B* in considerable amounts in the faeces of healthy city-birds leads to the conclusion that this organism, which is important for the epidemiology of man, has a wide distribution. On the other hand, *S. typhi* could not be isolated in any of 3,000 faecal samples from different native birds.

Consequently there must be an epidemiological difference between these two species, although the clinical picture of the infectious disease of man, expressed as a septicaemia, is the same.

GERTRUD MÜLLER

Untersuchungsanstalt für Stüdtehygiene,
Hygienisches Institut,
Hansestadt Hamburg.

[1] Steiniger, Rias, *Sixth Intern. Cong. Microbiol., Rome*, **4**, XII, 193 (1953); Vom Wasser, *ibid.*, XXI, 172 (1954).
[2] Rohde, R., and Müller, G., *Zschr. Hyg.*, **148**, 228 (1962).

Transfer of RNA Extracts from Immune Donor Spleen Cells to *Shigella*-tolerant Recipient Mice

INJECTION of relatively large quantities of non-living antigens into either neonatal or adult animals often results in the establishment of immunological tolerance characterized by specific suppression of antibody formation on subsequent challenge immunization[1]. Immune tolerance to bacteria has been demonstrated most often in mice injected with polysaccharide antigen derived from pneumococci[2,3]. Somewhat similar states of immunological tolerance to antigens derived from other micro-organisms have also been investigated. For example, tolerance to *Shigella paradysenteriae* antigens has been observed in mice after a single administration of a relatively large concentration of soluble *Shigella* antigen within 12–24 h after birth[4]. The resulting tolerance persisted for at least 8–12 weeks, depending on the dose and route of antigen administered at birth. Tolerance to *Shigella* has been terminated in unresponsive mice by transfer of spleen cell suspensions from normal or *Shigella* immune donors[5]. Administration of hyperimmune anti-*Shigella* serum to tolerant mice, however, has not restored agglutinin forming ability[6].

There have been several recent reports concerning acquisition of antibody formation by non-immune normal animals or cell suspensions following treatment with RNA extracted from immune donors[7–11]. Since it is not known whether tolerance to an antigen may be due to selective removal of possible 'clones' of cells potentially