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RAT LEPROSY IN NORTH QUEENSLAND.

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Since the discovery by Stefansky (1903) of a disease in rats closely resembling leprosy in man, and caused by a similar acid fast bacillus, much work has been done with rats in the hope of elucidating some of the problems of this disease in man.

Rat leprosy, as it is now called, has been found in almost all parts of the world, where it has been sought. Its occurrence in Australia has been previously noted by Tidswell (1904) and Bull (1910). On the other hand, Brinckerhoff (1910) examined 16,000 rats in Hawaii, without finding a single infected animal; and Bayon (1913) has not found a marked case of the disease in the examination of 368 rats in South Africa.

Whilst examining a number of rats in Townsville, it was thought of value to observe the frequency of the disease, and the features which it presented.

Stefansky described two chief types of the disease—one, musculocutaneous, affecting primarily the skin and muscles; and the other, lymphatic, almost confined to the lymphatic system. This distinction is a convenient one, but the two types merge imperceptibly into each other. The *lymphatic* form is the one more frequently encountered.

The infected rats are to all appearances perfectly healthy, even on section. The inguinal or axillary lymphatic, or more rarely other groups of glands, are in some cases distinctly enlarged, but in several of our rats showing fairly heavy infection of the glands, there was not the least enlargement. Most of the glands which were found to contain acid fast bacilli were somewhat pigmented, but this again was not always seen.

Stefansky (1903) and Rabinowitch (1903) found that the axillary glands were more often affected than the inguinal, but Marchoux and Sorel (1912) state that the inguinal glands are affected at least as often as the axillary, and this agrees with our findings.

Smears made from the apices of the lungs showed, in several cases of this form, scanty acid fast bacilli similar to those found in the glands, but bacilli were never found in any other organ.

The *musculocutaneous* form is much the more interesting from the great resemblance it bears to human leprosy. In advanced cases the animals are cachectic and quite lethargic. There are patches of alopecia of varying size, scattered about the body, in our cases, mostly on the posterior half of the body. One rat showed a single small patch of alopecia at the root of the tail, but in the subcutaneous tissue in this area, scanty acid fast bacilli were observed. The skin is difficult to detach, and beneath the patches of alopecia there are generally nodules, sometimes attaining large dimensions. In some cases there are large areas of ulceration, in one case covering fully half the dorsal surface of the body.

On section, the lymphatic glands throughout the body may be found to be enormously enlarged. Lesions in other organs have been rarely encountered by other observers, and were not found in this series. Smears made from the nodules, or from the lymphatic glands, show enormous numbers of acid fast bacilli, many within large cells, resembling those found in human leprosy. Microscopical examination of sections of the subcutaneous tissues shows an almost complete absence of fat, and in the nodules practically every cell is filled with bacilli. Sections of the lymphatic glands show large areas of cells, packed with bacilli, and large giant cells are occasionally met with, but no caseation. The striated muscles are also invaded to a considerable extent by the bacilli, and show hyaline degeneration.

In sections the bacilli are always found to be intracellular, although in smears most of the bacilli are free, due no doubt to the rupture of the containing cell. The arrangement of the bacilli within the cells is quite haphazard, differing from the regular arrangement in sheaves, or "bundles of cigars," which one finds in human leprosy.

Bacilli may generally be found in the lungs, and we have observed translucent patches, especially in the apices, which contain abundant bacilli. Bacilli were not encountered in other organs, with the exception of the spleen in one case. In this case the spleen was greatly enlarged, and contained numerous bacilli.

The Bacilli.—These resemble very closely the bacillus of Hansen. They vary in size to some extent, but are usually 3-5 microns in length, and ½ micron in width. When stained with hot carbolfuchin they are strongly acid and alcohol fast. They are gram positive. They may have an uniform appearance or may be beaded. Frequently they are curved; exceptionally one end is clubbed. Some of these clubbed forms resemble very closely the bacillus of diphtheria. Marchoux and Sorel (1912) have shown that it is a simple matter to infect fresh rats, by inoculation, and to reproduce the disease in all its forms. Two white rats and two wild rats were inoculated subcutaneously, with minute fragments of a lymphatic gland, from an infected rat. One of the wild rats died shortly afterwards, and the remaining three rats were killed and examined six months later. The two white rats were found to have well marked lymphatic infection, while no bacilli were found in the wild rat. None of these rats showed any external lesions. The bacillus has only been cultivated once—by Bayon (1912), and he has produced typical lesions in rats by inoculating them with his cultures. We have so far had no success in this direction, and cultures obtained from Bayon became contaminated with fungi before any experimental work could be done.

Relationship to Human Leprosy.—The relationship of the disease to human leprosy is a very interesting and very important one. The lesions in the musculocutaneous form are practically identical with the lesions in tubercular human leprosy. The bacilli resemble each other extremely closely, and the distribution in the body is similar. The difference in the arrangement of the bacilli in the cells has already been noted.

Bayon (1912) has succeeded in producing in rats, by the injection of ground-up material from a case of human leprosy, a localised infection, and the tissue from the site of the infection, injected into other rats, produced lesions, identical with those of rat leprosy.

George Dean (1905) has shown that the serum of a human leper agglutinates the rat leprosy bacillus, while normal human serum has no effect.

The cultures obtained by Bayon (1912) (1) from human and from rat leprosy resemble one another very closely.

An interesting discovery, having a bearing on the lymphatic form of rat leprosy, has been recorded by Leboeuf (1912), who found leprosy bacilli on gland pucture of apparently healthy persons, in association with leper patients.

Marchoux and Sorel state that human leprosy bears the same relation to rat leprosy as human tuberculosis does to avian tuberculosis. Bayon goes further than this, and says that the relationship is as close as that between human and bovine tuberculosis.

The evidence which has, up to the present, been brought forward, does not warrant a definite statement as to the relationship of the two diseases, but undoubtedly the relationship is not a very distant one. As with human leprosy, the mode of transmission of the disease in nature is unknown. Heavily infected rats frequently harbour numerous ectoparasites, such as Laelaps. We have found acid fast bacilli, resembling leprosy bacilli, in the bodies of Laelaps, taken from diseased rats; but considering the enormous numbers of bacilli contained in the skin and subcutaneous tissues of the diseased rats, it would be surprising if such a resistant germ as the leprosy bacillus were not found occasionally within the ectoparasites.

In this series, 220 rats have been examined; 12 rats were infected with leprosy bacilli. Of these, six showed the disease in the lymphatic form and six in the musculocutaneous form. This shows that 5.45 per cent. of the rats were infected, 2.72 per cent. lymphatic form and 2.72 per cent. musculocutaneous form. All the infected rats were *Epimys norvegicus*.

The lesions in the rats affected with the musculocutaneous form varied from a single patch of alopecia, with a single nodule, containing scanty bacilli, to very advanced cases of the disease, with hardly any hair on the body, and very numerous nodules.

Marchoux and Sorel (1912) found that, in sewer rats in Paris, the percentage of infected rats was 5 per cent., the musculocutaneous form accounting for only 6 per cent. Similar results were obtained by Stefansky (1903) in Odessa. McCoy (1908) found this form 22 times in 13,500 rats in San Francisco, *i.e.*, 16 per cent. Our percentage of 2.72 per cent. for the musculocutaneous form is, then, surprising, and in distinct contrast to the findings of other observers. The number of rats observed is, of course, small, but should be sufficient to give a general idea as to the prevalence of the disease, especially as the infected rats were very evenly distributed among the non-infected.

Marchoux (1912) (2) has insisted on the importance of secondary infection, in the production of this form of the disease in experimentally inoculated rats. A point of interest in this connection is the clinical observation that even the slightest wounds readily become infected in Townsville, and this may be a factor in the large percentage of rats showing the musculocutaneous form of rat leprosy.

Summary.—Rat leprosy has been shown to be present in the rats in Townsville, North Queensland. The disease presents the same features which have been described as occurring in other parts of the world. Two hundred and twenty rats were examined, and 12 found infected. Six of the rats showed the lymphatic form and six showed the musculocutaneous form of the disease. The percentage of rats presenting the musculocutaneous form is very much greater than has been described in other parts of the world. A suggestion is put forward as to the possible cause of this.

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NOTES ON SOME SURGICAL CASES.

Read before the New South Wales Branch of the British Medical Association.

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Case 1.—*Wound of Brachial Artery—Arteriorrhaphy*: A man, aged 37 years, was admitted to the Royal Prince Alfred Hospital on 26/9/13, with a history of having been hit on the upper arm by a minute fragment of steel. A slight abrasion of the skin was detected. The arm began to swell rapidly immediately after the accident and became very painful. On the following day the arm was greatly swollen, tense, and still very painful; the radial pulse was very much weaker than the corresponding pulse on the other side, and there was pulsation in the swelling. A fortnight after the accident, as the swelling persisted, pulsation was still present, the patient was suffering great pain, and the radial pulse on the affected side was imperceptible, operation was performed. After