

ELECTRON MICROSCOPY OF *MYCOBACTERIUM LEPRAE*
MURIUM IN ULTRA-THIN SECTIONS OF
MURINE LEPROSY LESIONS

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In this study ultra-thin sections of lepromas of murine leprosy (Hawaiian strain) were made and examined with the electron microscope. The procedure for making ultra-thin sections is the same as described in former articles (3, 4). The instruments used were the Hitachi HU 10 Model and the Philips electron microscopes.

FINDINGS

Electron microscopy of lepromas of murine leprosy revealed the internal architecture of *Mycobacterium leprae murium* and the morphological characteristics of the murine lepra cells.

Internal structure of M. leprae murium.—The thickness of the cell wall of the bacillus is about 6 μ (5.6-7.8 μ). Inside this cell wall there is a thin, electron-dense line about 1 μ in thickness, and this fine line seems to correspond to the cytoplasmic membrane. The cytoplasm is moderately electron-dense, and in a few cases polar cytoplasmic condensation was observed (Fig. 2).

Along the axis of the bacillus body there is a nuclear apparatus composed of a network, about 9 μ wide, composed of electron-dense threads embedded in an electron-transparent matrix. These fine threads are believed to be the chromosomes or the chromonemas of the bacillus, but as their exact nature is still obscure we have designated them "nuclear threads" (Figs. 2, 3, 4, and 5).

A peculiar tubular structure, 25 μ wide, which seems to connect the neighboring nuclei in the bacillus body was observed (Fig. 5). It is difficult to decide whether this tubular effect is an actual structure of the bacillus body or an artefact due to improper fixation of the specimen.

Degenerated bacilli without any nuclear apparatus, such as are observed frequently in human lepra cells, were never encountered in the murine lepra cells.¹

Structure of the murine lepra cells.—There is a distinct electron-transparent zone around each bacillus in the cytoplasm of the murine lepra cell (Fig. 1). By the presence of these peribacillary zones the bacilli can easily be

¹The leproma of murine leprosy as usually studied is a relatively young lesion, at most only a few months old, and is actively progressive and of course untreated. The bacilli would therefore be expected to show little or none of the degeneration that is seen in larger or smaller proportions of the bacilli in human lepromas, which are much older. It does not appear what would be seen in necrotic areas of the older murine leprosy lesions, in which the bacilli are liable to stain poorly by ordinary methods.—EDITOR.

distinguished from mitochondria or other cytoplasmic components. The mitochondria of the cells have the typical form of mitochondria, characterized by an outer double membrane and cristae mitochondriales. Opaque droplets, which are found in human lepra cells, were not distinct in the murine cells. Also the electron-dense membrane which was found in the foamy structure of human lepra cells was not found.

The cell membrane of the murine lepra cell is continuous, and there are no fenestrations in it. The nuclear membrane is about 17 $m\mu$ thick, and fenestrations about 20 $m\mu$ wide are seen in the membrane. The nucleoplasm is relatively homogeneous.

DISCUSSION

The nuclear apparatus of *M. leprae murium* has an appearance similar to that of *M. leprae*. The breadth of the nuclear threads is nearly the same in both bacilli. These nuclear threads are believed to be chromosomes or chromonemas of the bacilli. We think that the DNA-positive granules of various bacteria which are stained by procedure specific for the presence of aldehydes in DNA freed by acid hydrolysis (¹) and which can be observed with the light microscope are aggregates of these nuclear threads.

Polar cytoplasmic condensations are frequently observed in the murine bacillus, but these condensations do not assume a perfectly spherical form as do the polar bodies of *M. ulcerans* (²).

Although there are electron-transparent zones around all bacilli in the murine lepra cell, foamy cytoplasmic structures as observed in human lepra cells were not encountered, nor were opaque droplets and electron-dense membrane such as are observed in those cells.

SUMMARY

1. Lepromas of murine leprosy were studied in ultra-thin sections with the electron microscope.
2. The cell wall, cytoplasm and nuclear elements of *M. leprae murium* are described.
3. Around each bacillus there is a distinct electron-transparent zone which distinguishes them from other cytoplasmic components of the leproma cells.
4. Foamy structures as are seen in human lepra cells were not observed.

RESUMEN

1. Con el microscopio electrónico se estudiaron lepromas de lepra murina en cortes ultradelgados.
2. Se describen la pared celular, el citoplasma y los elementos nucleares del *M. leprae murium*.
3. Alrededor de cada bacilo hay una zona electrono-transparente bien definida que lo diferencia de los demás componentes citoplásmicos de las células del leproma.

4. No se observaron formaciones espumosas como las notadas en las células de la lepra humana.

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DESCRIPTION OF PLATES

PLATE 11

FIG. 1. An ultra-thin section of murine lepra cells. Almost all of the bacilli in the cytoplasm are sectioned transversely. Around each bacillus there is an electron-transparent zone. Magnification, $\times 19,000$.

Symbols: My.1.m.: *M. leprae murium*; E.T.Z.: electron-transparent zone; nuc.: nucleus.

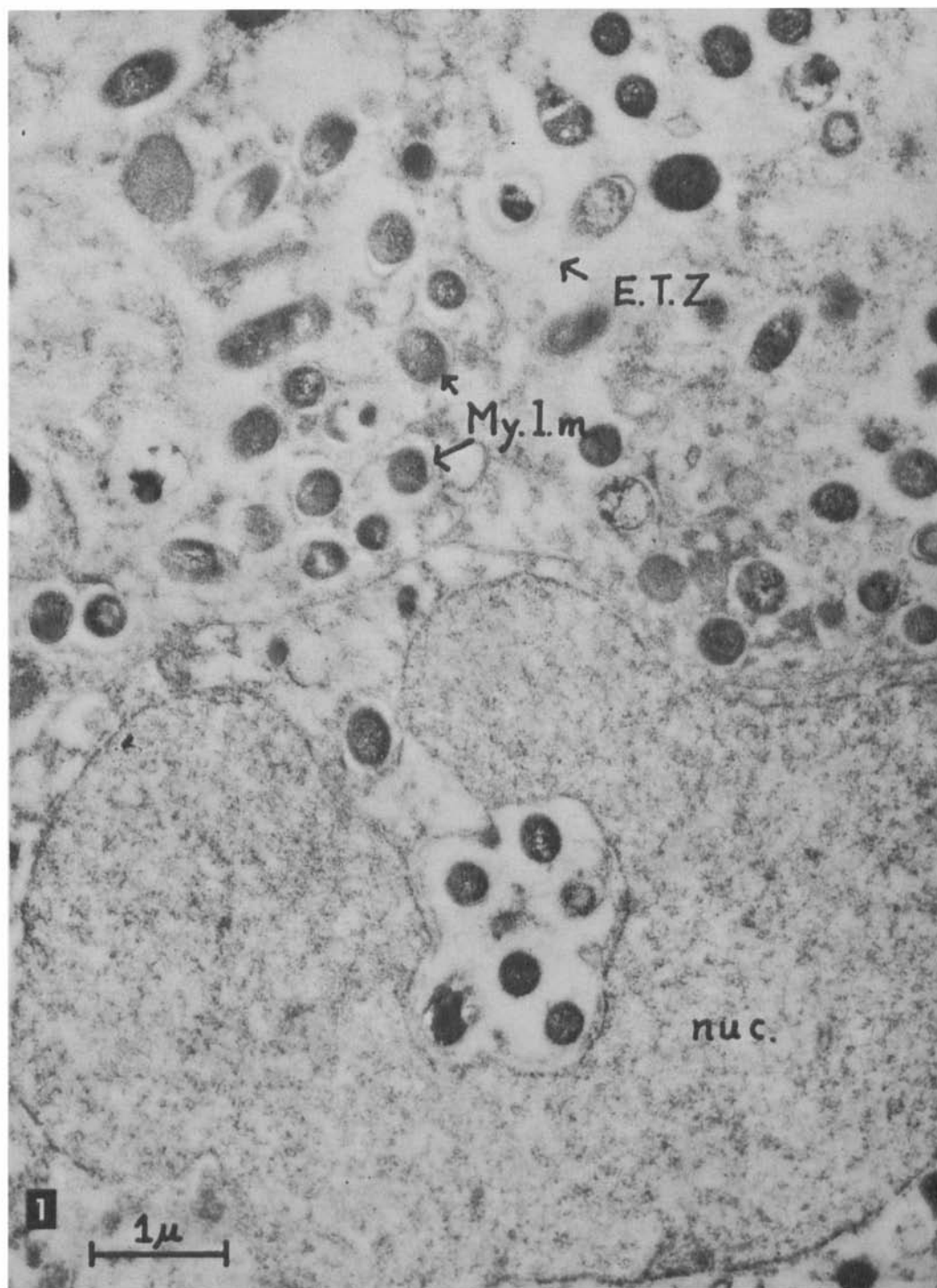


PLATE 11

PLATE 12

FIG. 2. Longitudinal section of a murine leprosy bacillus. Magnification, $\times 110,000$. Symbols: Nuc.th.: nuclear thread; cyt.: cytoplasm; p.cyt.c.: polar cytoplasmic condensation.

FIG. 3. Murine leprosy bacilli in longitudinal section. Magnification, $\times 63,000$. Symbols: Nuc.th.: nuclear thread.

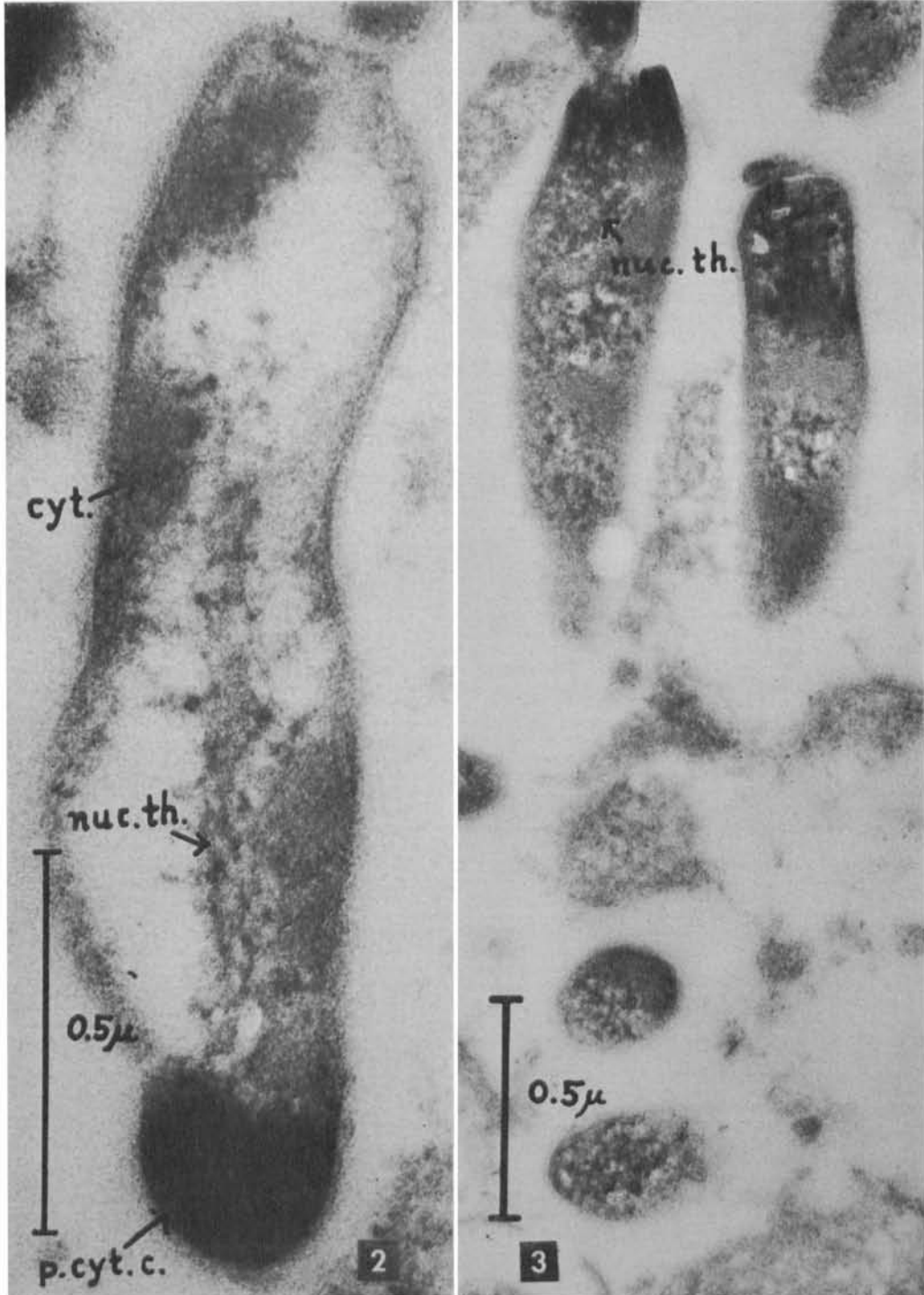


PLATE 12

PLATE 13

FIG. 4. Longitudinal section of a murine bacillus, in which a net-like arrangement of nuclear threads is observed. Magnification, $\times 133,000$.

Symbols: Nuc.th.: nuclear thread.

FIG. 5. Longitudinal section of a bacillus in which is seen a peculiar tubular structure. It is not certain whether this tubular structure is a proper structure of the bacillus body or an artefact due to improper fixation of the specimen. Magnification, $\times 133,000$.

Symbols: Nuc.th.: nuclear thread.

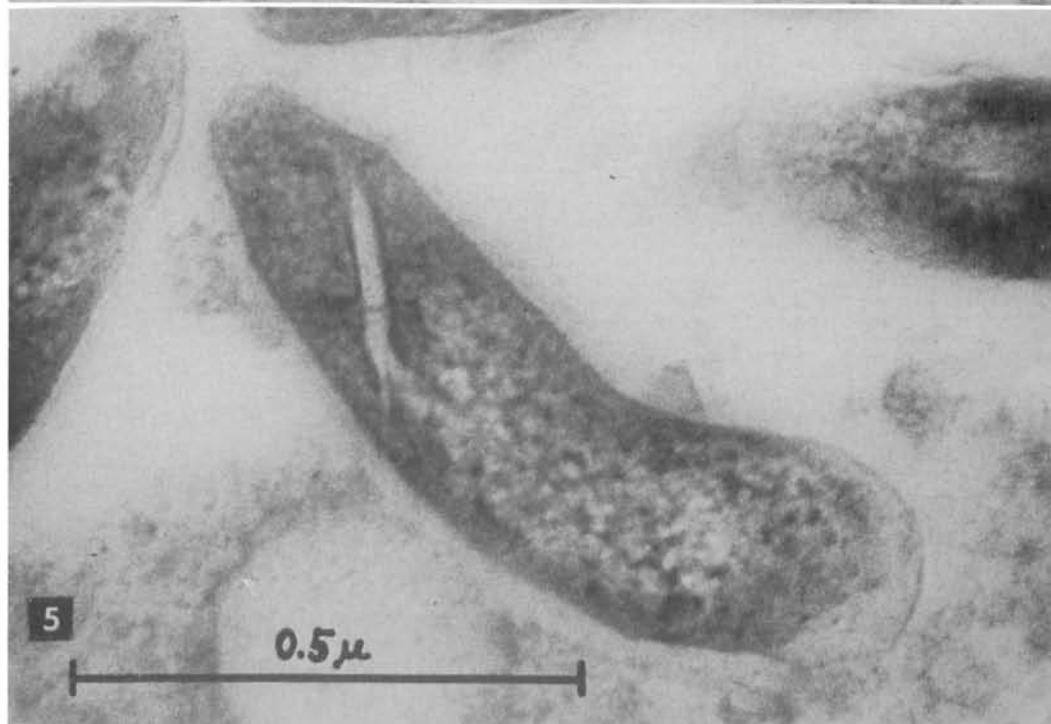
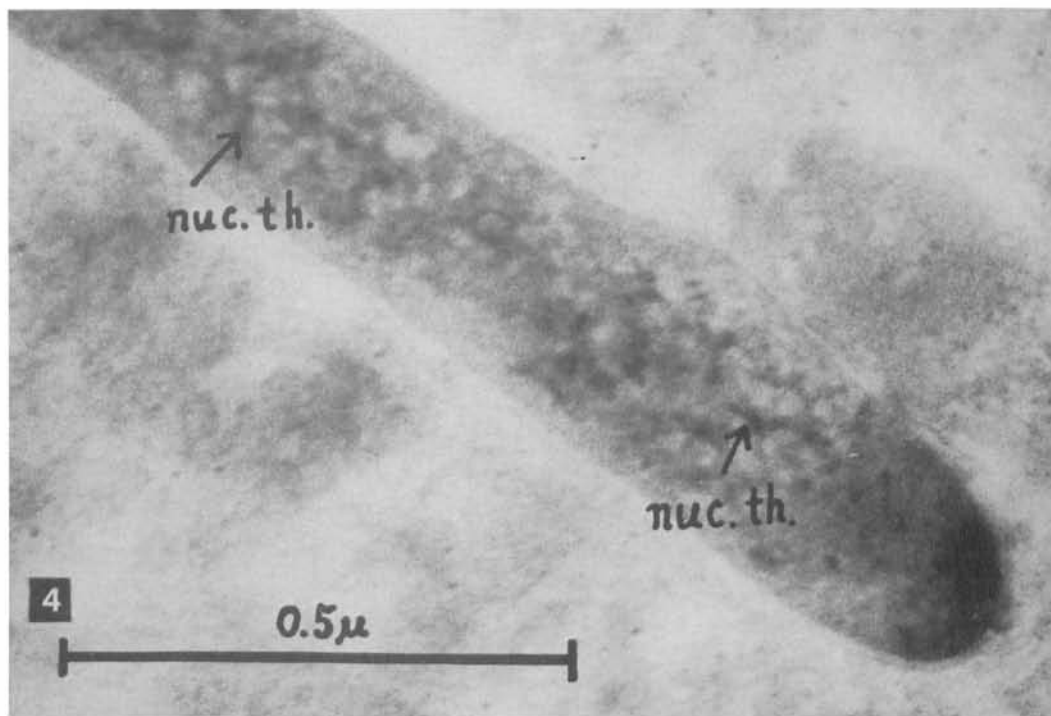


PLATE 13