THE SARCOSOMES OF THE HEART*

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PLATES 122 AND 123

The electron microscopic picture of the heart muscle differs from that of the skeletal muscle of the same animal, not so much by significant differences in the structure of the myofibrils, but rather by the amount of sarcosomes (1) present in the muscle fiber. In the skeletal muscle there are only a few sarcosomes in each field between the myofibrils, whereas in the heart muscle at the same magnifications there are innumerable masses, filling the space between the individual myofibrils and the space between sarcolemma and myofibrils. This may explain the ability of the heart muscle to work for a lifetime without longer rest, because the sarcosomes contain most important metabolic enzymes. It also explains why, in the electron microscopic picture, the myofibrils of the heart are never seen so tightly packed as in the skeletal muscle of the same animal.

As a rule, these sarcosomes are of irregular, spherical, or ellipsoid shape in the heart, whereas in the skeletal muscle they are more frequently oblong, or ribbon-shaped. The inner structure of the sarcosomes of the heart shows the usual lamellae or cristae of osmiophilic material in a less osmiophilic matrix. These cristae are normally tightly packed, parallel, sometimes concentrically arranged. In some of the sarcosomes no definite lamellar structure can be found, which may reflect functional changes in the sarcosomes.

A certain difference seems to exist between the sarcosomes of the ventricles and the auricles of the same animal. In the auricles, in addition to the sarcosomes resembling those of the ventricles (diameter up to 1 micron), there are a great number of much smaller sarcosomes, whose electron microscopic investigation is still in progress. In the auricle of the heart we have also found much more frequently than in the ventricle, sarcosomes of the ribbon-like, mitochondrial type. The inner structure of these can be seen in Fig. 4.

In striated muscle (leg muscle) of the rat very small spherical sarcosomes with a diameter of about ¼ micron have been seen, besides the usual normal sized sarcosomes. These small sarcosomes are typically located near the Z-bands, singly or in twos, between the individual myofibrils. It cannot yet be decided

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whether these are immature stages of sarcosomes. However, their position near the Z-bands is very typical, and may support the idea, previously expressed (2), that the Z-bands may be a factor in controlling the development of certain sarcosomes.

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EXPLANATION OF PLATES

PLATE 122

FIG. 1. Leg muscle of a healthy guinea pig. Shows beneath the double-lined sarcolemma (*SL*) the tightly packed myofibrils with the typical Z-bands (*Z*) and M-bands (*M*). The M-bands are surrounded by a light zone (H-band) which is itself bordered by two somewhat darker lines. Only a few sarcosomes (*SS*) can be seen between the myofibrils. × 19,000.

FIG. 2. Part of the left ventricle of the same animal used in Fig. 1. The myofibrils, with their Z-, M-, and H-bands, do not show many significant differences from the myofibrils of the skeletal muscle, but they are not so tightly packed, because rows of innumerable sarcosomes are present between them. Notice the inner lamellar structure of the sarcosomes and their form, which is mainly that of an irregular sphere. It is thought that the irregularities are partly due to the pressure of neighboring sarcosomes in this tightly packed mass, which indicates a plasticity of the material from which they are built. The large arrow in the center points to a sarcosome, in which the cristae are apparently lying in three individual groups possibly because the sarcosomes are in division. Notice also the different rings, representing either cross-sectioned tubes or hollow spheres which are distributed between the sarcosomes (*R*). × 19,000.

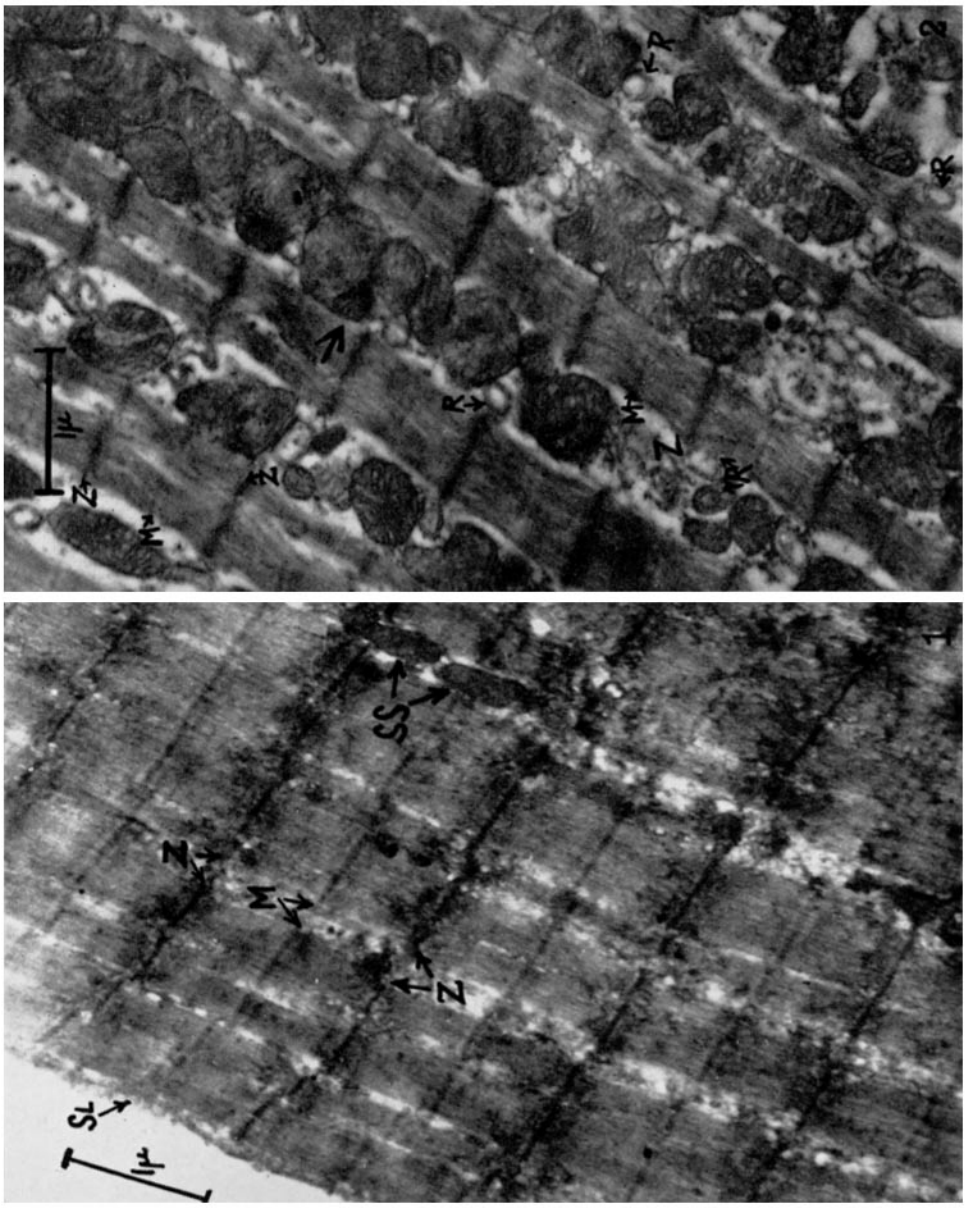

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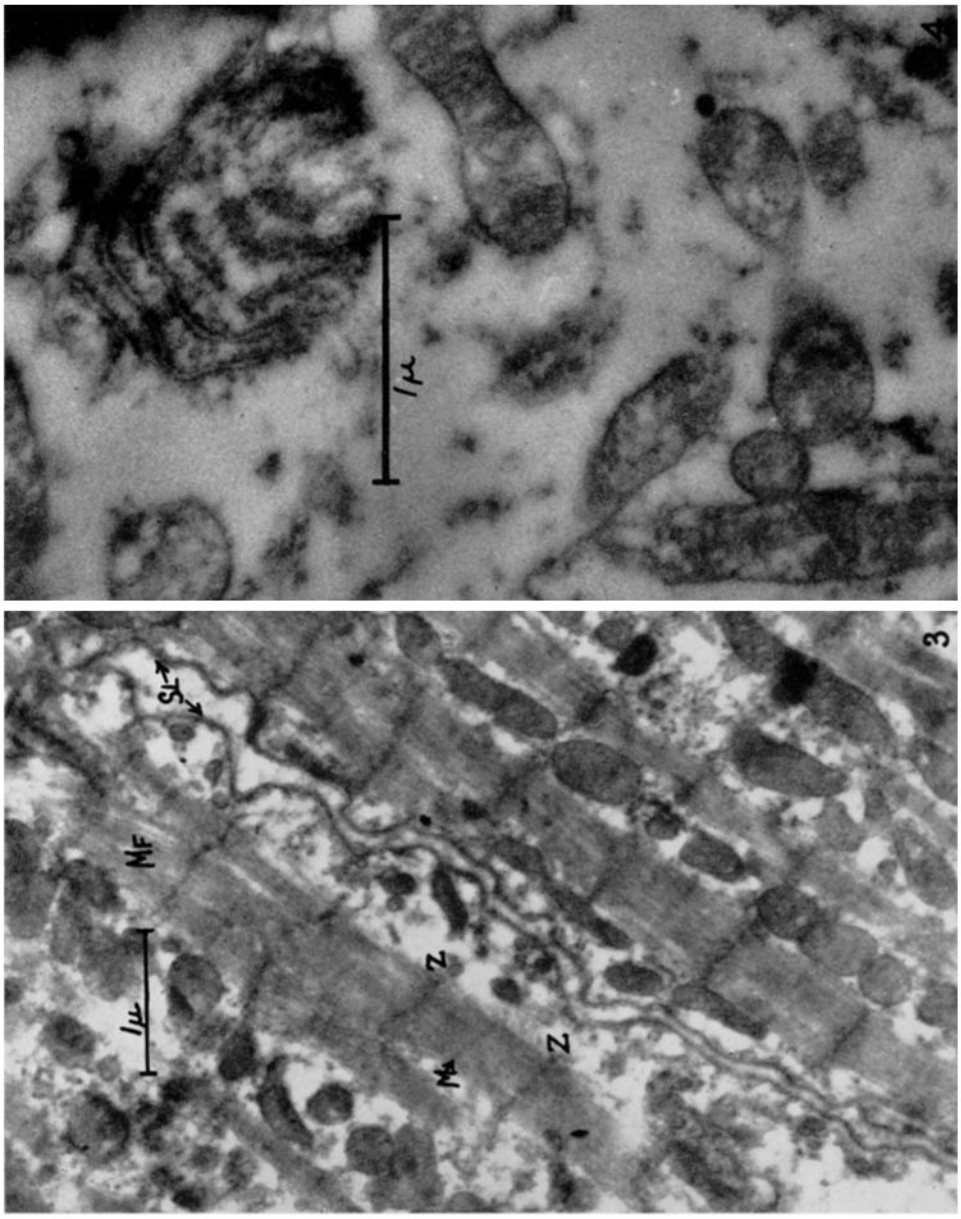
PLATE 123

FIG. 3. Section through the auricle of the same animal. Again the myofibrils show the typical character with the typical bands. Two muscle fibers border each other here. The double-lined structure of the sarcolemma can be seen, separating them from each other (*SL*). Here, as in the usual pictures of the ventricle, sarcosomes lie between the sarcolemma and the myofibrils and between the individual myofibrils. A difference is shown in the polymorphism of the sarcosomes. Much more often than in the ventricle, one finds in the auricle ribbon-shaped sarcosomes of the mitochondrial type, and also very small ones, which are partly in clusters, excluding the possibility of being only smaller segments of a larger sphere. Partly, these small ones have the appearance of small sarcosomes (membrane and content), partly they are very osmiophilic, like small microsomes or lipochondria. A forthcoming paper (3) will report on that. × 19,000.

FIG. 4. Part of a fiber of the same auricle as Fig. 3. Sarcosomes of mitochondrial type can be seen. Above the mark of 1 μ one sees a body without a definite membrane surrounding it (therefore not a sarcosome), consisting of concentrically arranged double-lined tubes or lamellae. Their diameter is about 400 A, and the thickness of their bordering lines, about 150 A. Attached to them are small granules, which remind one of the strongly osmiophilic particles described by Palade attached to the endoplasmic reticulum (4); but they are not strongly osmiophilic, and no opinion can be given at present concerning the significance of this structure. It was occasionally found in the auricle, but up to now not in the ventricle of the animals investigated. × 35,000.



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