ilarities have recently been demonstrated between MFGM preparations and plasma membrane fractions from mammary cells[9]. The description 'milk microsomes' is thus misleading since the endoplasmic reticulum membrane, although believed to be related dynamically to the Golgi and plasma membranes, has quite different chemical and enzymic components[9].

Reports of cellular rupture which released endoplasmic reticulum (which would produce milk microsomes) during milk secretion[10,11] have been shown by more recent studies[2,4] to be due to deficiencies in fixation and/or embedding technique. It has been shown[12] that milk normally contains a small percentage of milk fat globules with a cytoplasmic crescent attached, but this is always bounded by a unit membrane. Such crescents are too infrequent for their occasional content of endoplasmic reticulum to make a significant contribution to a milk microsome fraction such as that isolated by MORTON.

The work described in this report demonstrates the uniformity of the behaviour and structure of the MFGM in all species so far examined. In the cow the various categories of milk microsomes and lipoprotein particles can thus now be related directly to the initial MFGM. Since no evidence for any significant direct contribution from the cellular endoplasmic reticulum has been observed, 'plasmalemmasome' would be a more accurate descriptive term than milk microsome for the blebs produced by breakdown of the initial MFGM. The blebbing of the initial MFGM (Figure 1, a–d) is similar to the budding off of virus particles from infected cells, and such blebs are equivalent in size and structure to C type particles[13] isolated from the milk of bovine and human leukemia patients. These particles had been tentatively identified as virus particles[14–16]. However, similar particles were found, though fewer in number, in milk from healthy individuals[16].

Examination of the upper layers of pellets from an MFGM fraction isolated from cream (inset, Figure 2) or from a high speed centrifugation of skim milk (Figure 3) show particles which are indistinguishable from the micrographs of virions in the DUTCHER et al.[15] or DMOCHOWSKI[14] papers. This similarity in both size and appearance of some MFGM vesicles and the virions makes identification of the latter in milk fractions very dubious on morphological grounds alone. DE HARVEN[13] has summarized the morphology of the murine viruses and pointed out the dangers of assuming that any membrane bounded vesicle is the correct size range with dense cored contents may be a virus. The profiles of milk microsomes shown (inset, Figure 2 and Figure 3) look identical to some of the less characteristic (C type) virus particles in DE HARVEN's excellent micrographs or the extra-cellular virus particles from cultured leukemic cow cells illustrated in a recent paper[17]. This emphasizes the danger of any attempt to identify such a virus on purely morphological grounds in milk with its natural content of plasmalemmasomes (in all 11 species so far examined) originating from breakdown of the initial MFGM.

Zusammenfassung. Membranen, welche die Fettkügelchen der Milch umhüllen, sind identisch mit dem Plasmalemm der sezernierenden Zellen und nicht mit Überresten von endoplasmatischen Cysternenmembranen. Das Plasmalemm erfährt nach der Sekretion eine charakteristische Veränderung.

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The Ultrastructure of Thiosomes of the Mouse Brain

The brains of mammals contain periventricularly localized glial cells characterized by the presence of cytoplasmic granulations strongly staining with Gomori's chrome haematoxylin and aldehyde fuchsin following acid permanganate oxidation[1]. These granulations were shown to contain large amounts of cysteine[2,3]. The aim of the present paper was to study the ultrastructure of the cysteine/sulphur/-rich glial granulations.

Small fragments of periventricular brain tissue from adult mice were fixed in buffered glutaraldehyde, post-fixed in osmium tetroxide, and embedded in Epon. Ultrathin sections were contrasted with lead hydroxide after KARNOVSKY[4] and examined in a Tesla BS 613 electron microscope.

The cytoplasmic granules of the periventricular glia of the mouse brain show in the electron microscope features distinguishing them from other known cell organelles. Taking this into account, as well as the fact that they contain very much sulphur, they will be called 'thiosomes'.

The thiosomes are large cytoplasmic organelles, 0.5 to 3 μm in diameter. The shape is generally round or oval (Figures 1, 3, 4), sometimes irregular (Figure 2). A single external limiting membrane is present. The matrix of the thiosome is amorphous or granular (Figure 1), showing sometimes 1 or 2 clear vacuoles. The most characteristic

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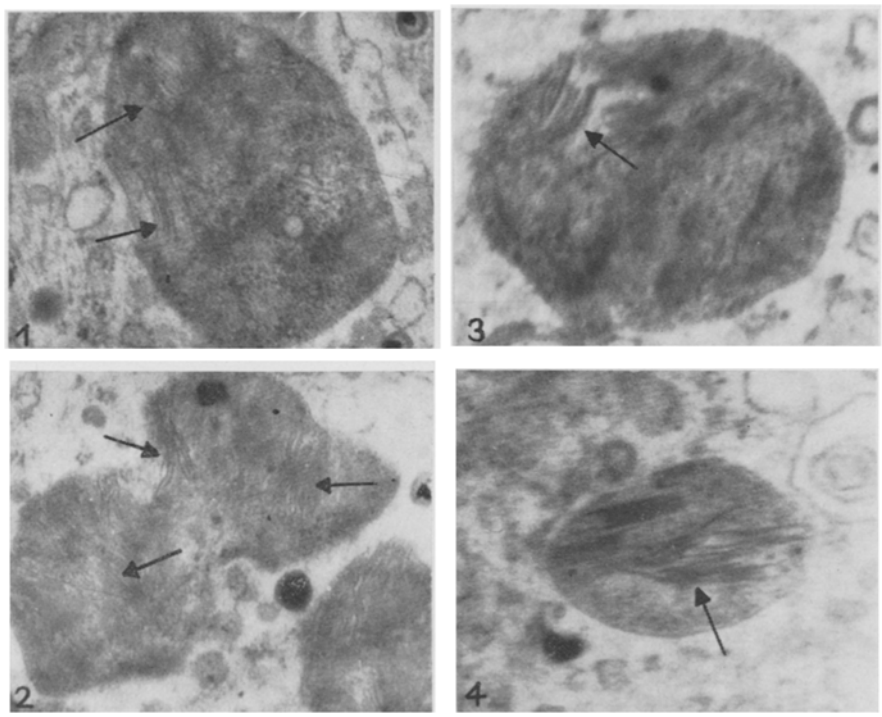

Fig. 1–4. Thiosomes in periventricular 'Gomori-positive' glial cells of the mouse brain. The thiosome in Figure 1 contains much grossly granular matrix, that from Figure 2 being formed predominantly by the lamellar stacks. The latter are indicated by the arrows. The magnification in Figures 1 and 2 is × 25575, in Figures 3 and 4, ×36270.

and unique feature of the thiosome is the presence of lamellar structures (Figures 1–5). Individual lamellae are thin, approx. 70 Å, and are arranged into piles of 4 to 12. They appear to arise from invaginations of the outer limiting membrane and have connections with membranes of the rough endoplasmic reticulum (Figure 5). The lamellar structures of the thiosomes are distinct from myelin figures occurring sometimes in the lysosomes and lipofuscin granules.

The cytoplasm of the 'Gomori-positive' glial cells contains, in addition to the thiosomes, numerous profiles of saccules and cisternae of the rough and smooth endoplasmic reticulum, and numerous 2000 Å large, double membrane-walled vesicles with a core showing strong peroxidase activity[5]. The mitochondria are sparse.

The biological role of the thiosomes is unknown. They have been shown to be distinct both from lipofuscin[1] and lysosomes[3]. It has been also shown that, in addition to the large amount of sulphur present, the thiosomes contain large quantities of ferric iron[6]. Iron-sulphur proteins have been isolated from a variety of sources of bacterial, plant, and animal origin[7]. In plants they serve as part of an electron transport system in the chloroplasts[7]. Surprisingly, the thiosomes contain the characteristic lamellar stacks, very similar morphologically to chloroplast grana (Figure 4). This may be, of course, only a superficial and accidental resemblance. Nevertheless the thiosome appears to be a novel cytoplasmic organelle characterized by the presence of an iron-sulphur protein. In animals such a protein has been isolated from the adrenal cortex[8]. The adrenal iron-sulphur protein is a hydroxylase and such may be also the function of the glial iron-sulphur protein. Various drugs and toxins are inactivated by hydroxylation and our recently published[9] and unpublished data provide an indirect evidence for such a function of the thiosomes. A significant numerical increase of the thiosomes has been found to occur after treatment of the animals with various drugs[9] and following ether anaesthesia. Thus, the hypothesis of a protective role played by the thiosomes in the brain[1,10] can be further extended.

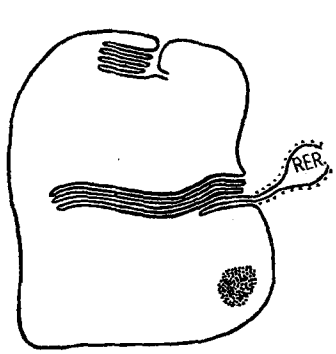

Fig. 5. Schematic drawing of a thiosome. Only the lamellar structure is shown. RER, rough endoplasmic reticulum.

Zusammenfassung. Nachweis, dass die chromhämatoxylinen, Gomori-positiven Granula in periventrikulären Gliazellen des Säugetiergehirns grosse Organellen mit hohem Schwefelgehalt (Thiosomen) und charakteristischer lamellärer Binnenstruktur darstellen.

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