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THE NEURONE OF THE HUMAN AUTONOMIC SYSTEM AND THE SO-CALLED 'SENILITY PIGMENT'

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We have recently studied the sympathetic neurones of the rat, mouse and rabbit. Some human material has come into our hands and, as it illustrates in a remarkable manner our views (Gatenby & Moussa, 1949; Gatenby, Moussa & Dosekun, 1949) on the origin and nature of the so-called 'senility pigment', we have made some photographs of sections under the phase-contrast microscope.

MATERIAL

Apart from that of laboratory mammals, our material consists of the lumbar autonomic ganglia of a man of 60 years of age, and a boy of 10½ years. Only the neurones from the man of 60 years are described here. An account of the neurones of the boy will be found elsewhere (Gatenby & Moussa, 1951). The ganglion described here had been fixed in formol alcohol, and stained in Sudan Black B by T.A.A.M.

DESCRIPTION

In Pl. 1, fig. 4, is an Aoyama fixed sympathetic neurone from the coeliac ganglion of the rat. The canalicular system or Golgi apparatus is at '*c*' forming a loop around the nucleus. Senility pigment so-called, can be seen forming above and below '*c*' on the left, and at '*a*' above. Above the nuclear membrane at 3 o'clock is a group of impacted pigment granules.

Now in Pl. 1, figs. 1–3, are sections of three human neurones, each showing the very large aggregation of pigment '*p*' at the axon end of the neurone (*ax*). The close relationship of these granules to the Golgi canals is shown at '*a*' in each photograph. Everywhere in fig. 1, the canals have attached black granules. The granules originate as paler elongate bodies plastered on to the canals (upper '*a*' in fig. 2); these round off and become detached from the canals and make their way forward to take their place with the granules already at the axon hillock.

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As will be clear from fig. 3, the canals of Golgi ('*c*') are extremely tortuous and, although lying close to the periphery of the cell, do not appear to open outwards. Since the material was fixed in formol alcohol and not silvered, the walls of the canals (Golgi substance) are not shown.

DISCUSSION

The older interpretation of the nature of the senility pigment is that these granules constitute cytological, senility 'clinkers', which begin to appear in man after the age of 40 and, thereafter, form a dark yellow or black aggregation, mainly at the axon end of the cell. The prevailing notion is that they are the result of ageing. No cytological explanation of their presence has been attempted (Kuntz, 1932). That they are formed from the Golgi apparatus, we believe to have been established from our work on the rabbit, rat, and mouse. We now consider that these granules are, or contain, a hormone or similar substance representing part, at least, of the neurosecretion of the nervous system.

While it is true that old neurones from other parts of the nervous system (e.g. spinal ganglia) contain pigment granules, these are most noticeable in the autonomic thoracic and lumbar chain. At the present time one of us is examining various parts of the nervous system of the sheep in order to ascertain the relative time of appearance of 'senility granules'; it seems that these granules first appear in the sympathetic ganglia and the spinal ganglia. We have not found them formed as early in the spinal cord or cerebellar and cerebral cortices. The granules are clearly marked in the spinal cord neurones, and a doubtfully comparable, though less granular, area appears to be present in the Purkinje cells. This latter remark applies to material from an old cat. We do not propose to speculate as to the possible nature of any hormone, enzyme, etc., in these granules, which are formed from the Golgi apparatus.

It may be objected that since the protoplasm of the neurone has been claimed to be very viscous, movement of the granules from one end, and the sides of the cell, to the axon hillock would not be possible. However, Murray & Stout (1947) have recently cultured chopped pieces of adult human sympathetic ganglion in medium and kept the neurones alive for months. The neurones migrate out into the medium, and considerable movement within the cytoplasm can take place according to their description. They describe actual disappearance of pigment granules within a space of a few days from the living neurones. While the figures in Pl. 1 show considerable shrinkage, due to the embedding, the neurones are healthy and there is no neuronophagia.

SUMMARY

1. The sympathetic neurones of a man of 60 years of age contain an axon group of senility granules. These are considered to originate from the Golgi apparatus, situated in the cell body, and to migrate to the axon hillock region.

2. The senility granules probably contain some form of neurosecretion. Even after paraffin wax embedding, the granules stain densely in Sudan Black B. This dye does not appear to be exclusively a fat stain, as some workers believe.

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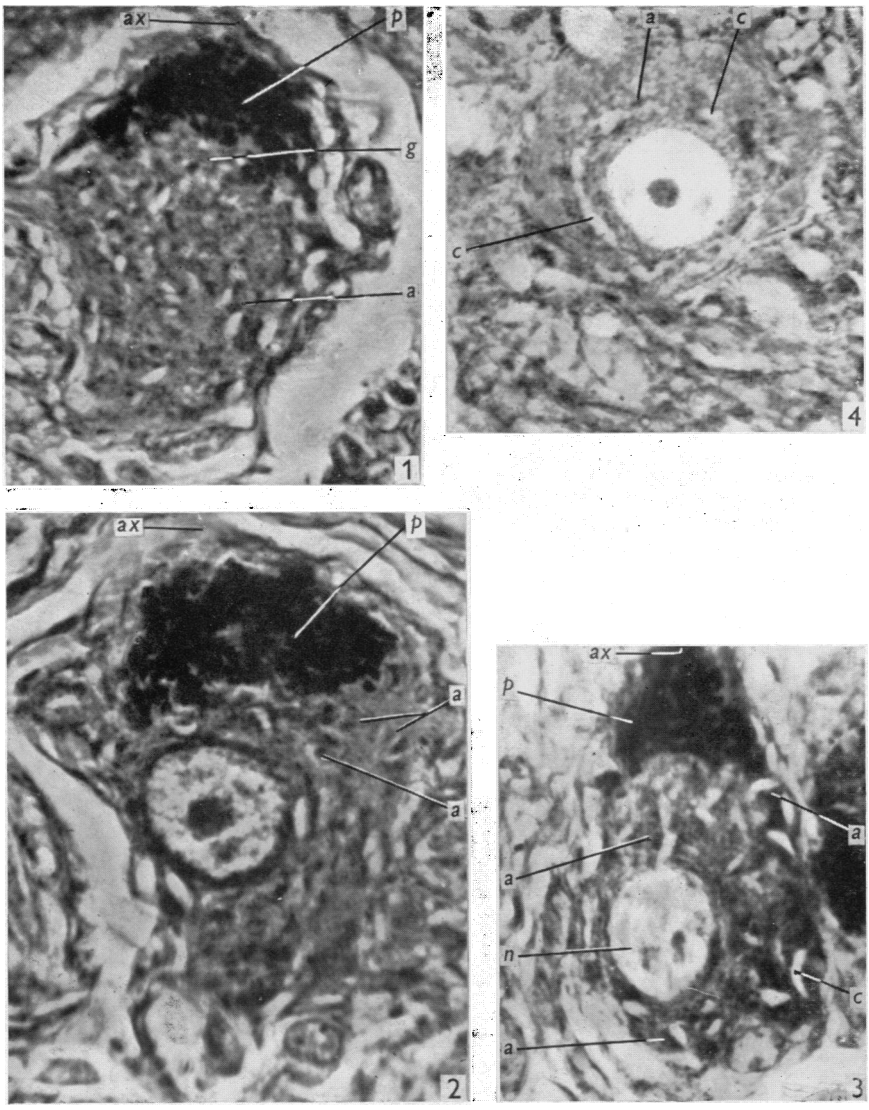

Figs. 1–3. Phase-contrast pictures of sections from man stained in Sudan Black B, after wax embedding.

Fig. 4. Aoyama fixed neurone of young adult rat, similarly stained.

Letters: *a* = formed and detaching pigment granule (*g*) still in contact with canalicular system of Golgi; *ax* = axon end; *c* = canal of Golgi; *n* = nucleus; *p* = pigment.

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