ute pulse). We scored only cells in which all 13 centromeres were scorable, for example, Fig. 4. Once again it is evident that the distribution of chromatids is random: all labeled chromatids do not inevitably proceed to one pole. In addition to these quantitative results on the broad bean and the rat kangaroo, qualitative results consistent with random segregation have been obtained by others [for example, in human leukocytes (*5*), Chinese hamster cells (*10*), and onion root tips (*11*)]. We believe, therefore, that random segregation is the general rule.

The idea that chromatids might segregate nonrandomly is based upon (i) unequal labeling of daughter nuclei and (ii) the frequency distribution of grains over cells. Unequal labeling of daughter nuclei could arise in a variety of ways, including random as well as nonrandom segregation of chromatids. For instance, in *V. faba* with 12 centromeres segregating randomly at the second mitosis, less than 23 percent of the sister chromatid sets at anaphase would be equally labeled (*12*). Under the same assumptions (*12*), the weighted mean ratio of lightly labeled to heavily labeled sister chromatid sets at anaphase will be 0.67.

The frequency distribution of grains that led Lark to suggest nonrandom segregation of chromatids in *V. faba* (*4*) were obtained at the time when third mitoses after labeling were expected (although the binomial calculation was for second mitoses). Because of asynchrony and the difficulty of determining which mitosis the cells are in, the population observed by Lark (*4*) must have been a mixture of cells in different mitoses after labeling. Even in our experiments in which we synchronized the roots before labeling them, we found that, at the time when third mitoses were expected, second, third, and even first mitoses were present. Furthermore, we found some mitoses that had only about one eighth of the chromatin labeled and so were probably fourth mitoses (although we could not exclude them from our scoring as they could have been third mitoses in which most unlabeled chromatids went to one pole). Thus, even though the cells were labeled at one time, subsequent asynchrony must have distorted the frequency distributions of grain counts in Lark's experiments. We believe that it is this factor which led to the conclusion that chromatids of animals and plants segregate nonrandomly. Our results demonstrate that in the case of *V. faba* and *P. tridactylis* chromatids do segregate randomly at mitosis.

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13. We thank Miss D. Judy Bodycote for her assistance. Work performed under the auspices of the AEC and of PHS grant 5 T1 GM-367-07.

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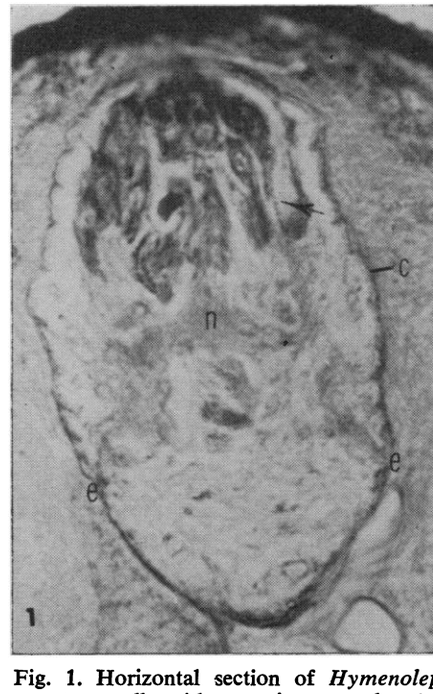
Neurosecretory Cells in a Cestode, Hymenolepis diminuta

Abstract. *A group of nerve cells in the rostellum become progressively more fuchsinophilic during the first 16 days of development; they then release their secretion into their axons at about the time that the first proglottid is released.*

Neurosecretory cells are well known from the free-living flatworms (*1*), and their presence in cestodes has been suggested on the basis of evidence from the electron miscroscope (*2*). Using the paraldehyde-fuchsin technique of Cameron and Steele (*3*), we have demonstrated neurosecretory cells in the scolex of the tapeworm *Hymenolepis diminuta*. The tapeworms were reared by feeding cysticercoids recovered from adult flour beetles (*Tribolium confu-*



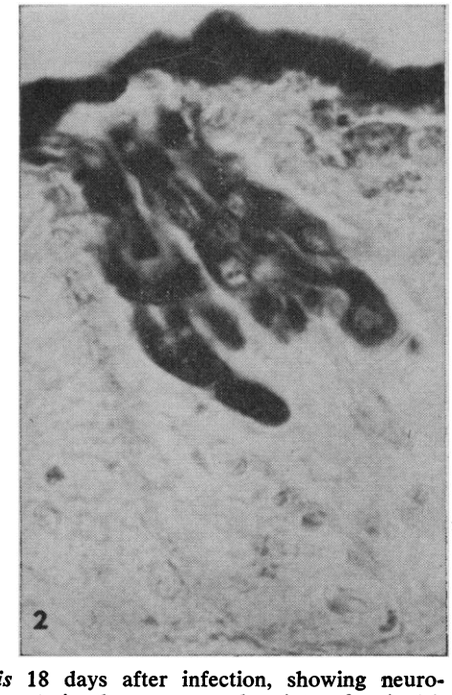


Fig. 1. Horizontal section of *Hymenolepis* 18 days after infection, showing neurosecretory cells with secretion granules (arrow) in the axons, and points of exit (*e*) of nerve tract (*n*) through rostellar capsule (*c*) (× 11,000). Fig. 2. Similar section showing neurosecretory cells in a worm 7 days after infection. Note swollen appearance of cells with abundant secretion (× 1400).

sum) to white rats. Developing worms were recovered from rat intestines at daily intervals from 2 to 22 days after infection, and at less regular intervals thereafter.

The cells described here are located in a cluster in the rostellum. Their axons enter a nerve tract within the rostellum. This nerve tract is connected to nerves which lead to the lateral ganglia of the central nervous system (Fig. 1).

The bipolar cells contain abundant material which stains heavily with paraldehyde-fuchsin (Fig. 2). Anteriorly, the cells are prolonged into filaments, a characteristic of sensory cells in cestodes (*2*). This finding suggests that these cells are sensory, as has been decribed for neurosecretory cells in a parasitic nematode (*4*).

The cells undergo a cycle of secretion associated with development of the adult tapeworm. The cells can be recognized in the cysticercoid, but they are entirely devoid of fuchsinophilic material. Fuchsinophilia develops in worms 3 days after infection and rapidly becomes maximum (Fig. 2). This development is associated with an increase in the size of the cells. Granules of fuchsinophilic material first become obvious in axons of worms fixed 16 to 18 days after infection (Fig. 1). At the same time, the amount of fuchsinophilic material in the cells begins to decrease, and, by 40 days, the cells again fail to display fuchsinophilia.

It is impossible to assign a precise function to these cells on the basis of these studies. However, the release of neurosecretion as evidenced by the first appearance of fuchsinophilia in the axons is correlated quite closely with the shedding of the first proglottid, an event which occurs 16 to 17 days after infection. On the other hand, fuchsinophilia in the neurosecretory cells first appears just before the time that strobilization begins.

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Colostral Immunoglobulin-A: Synthesis in vitro of T-Chain by Rabbit Mammary Gland

Abstract. *When minced mammary tissue from lactating rabbits was incubated in vitro with C^{14}-labeled lysine and isoleucine, it incorporated radioactivity into colostral immunoglobulin A. The only portion of this colostral molecule with significant labeling was T-chain, with little or no labeling of light or heavy chains. It was thus demonstrated that T-chains are synthesized by mammary gland. Because the remainder of the molecule was derived from unlabeled material, in vivo it was probably derived from serum.*

Colostrum, saliva, and certain other external secretions are rich in immunoglobulin A (γA), an immunoglobulin usually present only in low concentrations in serum. It has been established that secretory γA differs from serum γA and from other immunoglobulins in that the molecule contains, in addition to the usual light and heavy chains, a third kind of polypeptide called "T-chains." In man, the existence of an additional chain has been deduced from a series of studies with antiserums specific for it (*1–3*); in the rabbit, T-chains have been demonstrated in the light-chain fractions of reduced and alkylated colostral γA (*4*). Polyacrylamide electrophoresis of these light-chain fractions showed a rapidly migrating component in addition to the usual light-chain bands. In both man and rabbits, it seemed that much of the T-chain component was not covalently linked to the whole molecule (*3, 4*).

The difference between low concentrations of serum γA and the high concentrations found in secretions could be explained either by local synthesis or by some concentrating mechanism. Attempts to show transfer in humans of γA from serum to parotid saliva have either been unsuccessful (*1*) or have resulted in such small and inconstant amounts of transfer (*2*) that a concentrating mechanism seemed unlikely. Furthermore, Tomasi *et al.* (*1*), using immunofluorescence, have shown in the interstitial tissue of parotid glands many plasma cells containing γA.

To investigate a possible concentrating mechanism, secretory tissue containing few lymphoid cells but producing secretions with large amounts of γA is required. In that rabbit mammary gland fits these criteria and the constituent polypeptide chains of rabbit colostral γA can be identified (*4*) so readily, we wanted to determine which of the chains was formed by the gland.

A New Zealand White rabbit (2500 g) with a litter less than 8 hours old was killed by cervical fracture. Taking care to avoid adjacent lymph nodes, we excised the mammary gland. This gland was minced in Hanks's balanced salt solution, and six portions of about 100 mg were incubated in roller tubes in a medium containing C^{14}-lysine and isoleucine. One of the culture fluids and samples of each of the fractions described below were analyzed for the presence of labeled γA by immunoelectrophoresis and autoradiography. Both the incubation and analysis were performed as described by Hochwald *et al.* (*5, 7*). The remaining five culture fluids were pooled, passed through a diethylaminoethyl (DEAE) cellulose column, and eluted stepwise (*6*). Because most of the γA appeared to be in the 0.2*M* fraction (Table 1), this was dialyzed against 0.1*M* borate buffer, *p*H 8, and passed through a column of Sephadex G-200. The volume expected to contain excluded material was the only fraction that contained labeled γA and accounted for 8 percent of the radioactive material precipitable by

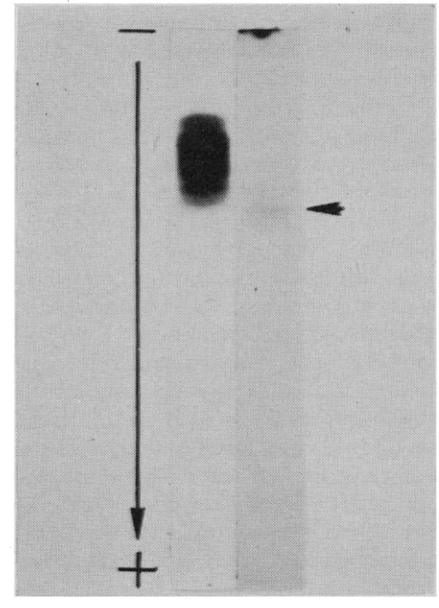

Fig. 1. Polyacrylamide electrophoresis of light chains, with autoradiograph. (Left) Dried, stained electrophoretic pattern (gel); (right) matched autoradiograph (film). A labeled band (arrow) is seen in a position anodal to the fastest light-chain component.