tumor-Ratte – eher eine untergeordnete Rolle zu spielen. Zum Schluss sei noch auf die passive Übertragung der heterologen Tumortransplantationsimmunität hingewiesen, die durch Implantation von Lymphdrüsen immunisierter Tiere erfolgen kann. Nur diejenigen Lymphdrüsen, die im Abzugsgebiet der subkutanen Tumoren liegen, haben einen immunisatorischen Effekt.

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Medizinische Universitätsklinik, Zürich, den 29. Januar 1955.

Summary

Heterologous transplantation of tumors is made possible by pretreatment of the recipients with X-rays or Cortisone. Using the transplantation of the mouse Crocker sarcoma S180 on young rats, active or passive immunisations hinder the growth of these tumors even though the hosts were pretreated with Cortisone or X-rays. Acquired immune bodies seem to play a most important role in the destruction of heterologous tumors. Of minor significance are natural resistance, inflammatory reaction, formation of granulation and fibrous tissue. The influence of Cortisone and X-rays on heterologous tumor transplants consists in suppressing immune body formation. Once immune bodies are formed, Cortisone and X-rays have no effect on their action. Passive transfer of transplantation immunity was made by transplanting lymphnodes, draining the tumor implant.

Neurosecretion and Incretory Glands in a Tectibranch Mollusc

The presence of true incretory glands has–so far–been demonstrated clearly only in vertebrates and arthropods. When, in more recent years, the process of neurosecretion was detected, it was found to be closely connected to some of the incretory glands, mostly in such a way that certain brain cells produce the neurosecretory substance which, then, is transported to a special storage organ to which incretory activity is customarily ascribed.

The very close connection between neurosecretion and incretory activity in vertebrates as well as in arthropods makes it reasonable to make a search for some sort of incretory organs in other invertebrate groups, using the modern methods for selective staining of the neurosecretory granula. Already, a number of such investigations have demonstrated the presence of neurosecretory cells in the central ganglia of animals belonging to quite a number of different groups (SCHARRER[1]).

During a study of the anatomy and histology of the tectibranch mollusc *Cylichna cylindracea* (Pennant), it became of interest to identify somewhat more precisely the position of the neurosecretory cells which, through the investigations of SCHARRER[2] and GABE[3], have been shown to exist in several of the larger ganglia in tectibranchs. I am much indebted to M. THOMSEN for his valuable help in staining serial sections of two entire specimens of the said mollusc, using the Gomori chrome-haematoxyline-phloxin method.

In most of the cells described by SCHARRER and by GABE as probably being neurosecretory, I found surprisingly few of the bluish-black staining granules. Nevertheless, many of these cells could be identified, partly by way of their large nuclei and the abundance of vacuoles in their vicinity, indicating a rich production of some substance, and partly by the strong affinity of the cytoplasm to the phloxin part of the stain. In many of the large nerve cells, and in quite a number of the smaller ones too, this red colour is quite distinct, in the axons as well as around the nuclei.

Later, my attention was drawn towards the peripheral nerves which came to stand out strikingly because of a content of dark-staining granules, arranged in the "pearl-strings" typical of neurosecretory pathways. A very strong contrast appeared between on one side the light colour of most of the ganglia and of the bases of the different nerves arising therefrom, and on the other side the blackish granulation which proved to be so very characteristic of the finer nerves, that it was possible to trace even the most minute branches (figs. 1 and 2). In specimens treated similarly, except that they had been stained in normal haematoxyline-erythrosine, this granulation never appeared.

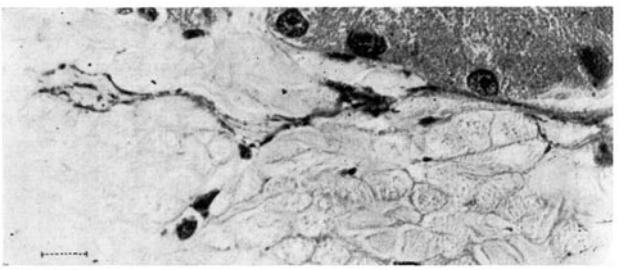


Fig. 1.–Neurosecretory granula in a tiny branch of the nervus anastomosis running below the prostate gland towards the epithelium of the lateral furrow on the head.

Often, in the stronger nerves, the granules are largely concentrated into a special layer closely inside the neurilemma. In the figure 2, two axons are seen to be given off, one from each of two branches of the nervus infrapallialis. Each of these axons runs to one of the large unicellular glands appearing as dark patches in the figure. Even these axons contain a rich supply of the dark granules. On one of the glands, the axon is seen ending at a cell in which the nucleus is surrounded by still more granules, probably representing an "end organ" transmitting the influence of the nerve to the gland.

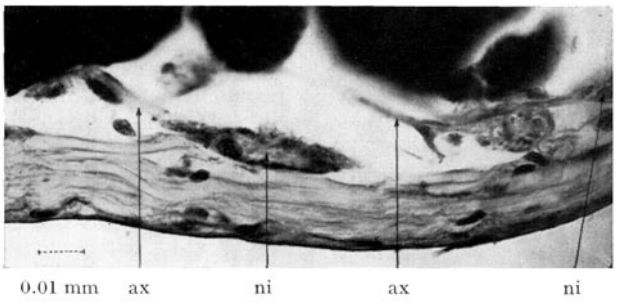


Fig. 2.–Innervation of two large subepithelial unicellular glands through single axons (ax.) arising from two branches of the nervus infrapallialis (ni.). The darker appearance of the periphery of the nerves is due to their content of bluish-blackish staining neurosecretory granules.

[1] B. SCHARRER, Pubbl. Staz. Zool. Napoli *24* (suppl.), 38 (1954).
[2] B. SCHARRER, Pubbl. Staz. Zool. Napoli *15*, 132 (1935); Naturwiss. *25*, 131 (1937).
[3] M. GABE, C. r. Acad. Sci. Paris *236*, 2166 (1953); L'Année Biologique (3) *30*, 44 (1954).

In spite of its very rich contents of dark-staining granules in the distal parts, the nervus infrapallialis does not show any amount of granula for a long distance proximally. As the same holds true in most other nerves, it appears necessary to suppose that neurosecretion is not solely a function of some few central ganglionic cells. Probably, a reasonable part of this activity is taken over by more peripherial cells. Possibly, this function is concentrated into the many granula-containing cells scattered along the periphery of most of the nerves, but the evidence for this assumption is not conclusive.

From the above it appears that, in the rather primitive mollusc *Cylichna*, histological indications of neurosecretory activity are not confined to special cells in the central nervous system, as in vertebrates and arthropods. This takes us to the basic problem whether neurosecretion should be regarded as a secondarily acquired mode of nervous activity–e.g. by transformation of extrasecretory cells to make them deliver their products directly to other cells or to storage organs. It may just as well be that neurosecretion is to be regarded as a primitive form of nervous activity, equal to and perhaps contemporary with the normal nervous stimulus. The evidence from the specialized groups of vertebrates and arthropods has been in favour of regarding neurosecretion as secondarily acquired, but the new observations on *Cylichna* seems to suggest that this is not the whole story. Studies on animals belonging to quite a number of more primitive invertebrate groups are much needed to elucidate these problems, and we are urgently in need of experiments on the functions of the neurosecretory substance in such animals.

Turning now to the question of incretory organs in molluscs, nothing has hitherto been known. However, owing to the correlation between neurosecretion and some of the incretory functions in vertebrates and arthropods, it may be supposed that neurosecretory granula could be used as a sort of tracer to find some of the incretory organs also in other groups of animals.

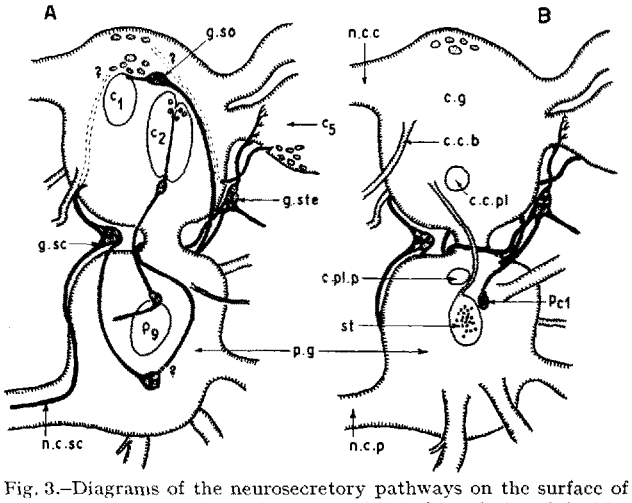


Fig. 3.–Diagrams of the neurosecretory pathways on the surface of the cerebral and pedal ganglia as seen (*A*) in frontal view (left side) and (*B*) from behind (right side). c_1) nervus oralis. c_2) n. labialis. c_5) n. tentacularis. *c.c.b.*) connectiva cerebrobuccalis. *c.c.pl.*) c. cerebropleuralis. *c.pl.p.*) c. pleuro-pedalis. *c.g.*) cerebral ganglion. *g.sc.*) ganglion subcerebrale. *g.so.*) g. suborale. *g. ste.*) g. subtentaculare. *n.c.c.*) nervus commissuralis cerebralis. *n.c.p.*) n.c. pedalis. *n.c.sc.*) n. c. subcerebralis. p_{c1}) pedal c_1-cell. p_9) nervus pedalis anterior. *p.g.*) pedal ganglion. *st.*) statocyste.

In the figure 3, a diagram is given of the central nervous system in *Cylichna*, showing the cerebral commissure (*n.c.c.*) which connects the two cerebral gangial above the pharynx (this last organ is not shown in the figure). Another, very tiny subcerebral commissure (*n.c.sc.*) connects the same two ganglia below the pharynx, enclosed into the neurilemma of the pedal commissure (*n.c.p.*). The cerebral as well as the pedal commissures are practically devoid of neurosecretory granula, whereas the subcerebral one proved to be easily recognizable by its darkness due to a rich supply of this substance. On each side, this tiny commissure was found to be inflated through the presence of 5–6 cells forming a diminutive ganglion which I have termed the subcerebral ganglion (*g.sc.*). It would be strange to believe that such a tiny extra connection between the two cerebral ganglia should be an invariable part of the nervous system in these molluscs, if it does not have a special function. No explanation has hitherto been produced, but it is tempting now to suppose some incretory function to be responsible for the arrangement.

Further, in the whole group of the Bullacea within the tectibranchs, some peculiar anastomoses are known to connect in a very constant way one of the pedal nerves to some of the sensory nerves of the cerebral ganglion. Now, a branch of this "nervus anastomosis" proved to contain another concentration of cells. This small ganglion has been termed the subtentacular ganglion (*g.ste.*) and it is as full of the dark granula as is the subcerebral one. The nerve continues from here into the base of the nervus tentacularis (n_5). Another branch of the nervus anastomosis was shown to contain a similar aggregation of cells, the suboral ganglion (*g.so.*) before joining the base of the nervus oralis (c_1). Quite a number of additional slender connectives have been found to run along the surface of the cerebral and the pedal ganglia, mostly enclosed in the perineurium, and connecting these small ganglia to each other and to some still smaller groups of similar cells. The whole system, as hitherto unraveled, is shown in figure 3. The detailed description will be published elsewhere. It is remarkable that one of the large, neurosecretory cells in the pedal ganglion (the p_{c1}-cell) sends out a strong axon running directly to the subtentacular ganglion described above. This is direct proof that there is a connection between the neurosecretory cells as described by SCHARRER and by GABE (including the p_{c1}-cell), and the intricate neurosecretory pathways on the surface of the ganglia as here described.

At the same time, it is seen that, in the place just described, a situation exists which is a close parallel to what is known to be characteristic of neurosecretory cells in vertebrates and arthropods, namely the connection from a neurosecretory ganglionic cell to a small organ outside the ganglia, consisting of smaller cells between which the neurosecretory product is stored. At least one other similar system has been observed in *Cylichna*, too. The main nerve of the alimentary tract (the nervus gastro-oesophagealis) arises from the vicinity of the buccal ganglion. Close to the base of this nerve, it contains a group of 3–4 highly active neurosecretory cells, in all respects similar to those described by SCHARRER from the central ganglia. A fortunate section has disclosed that, from the most active one of these cells, an axon runs to a group of smaller cells placed nearby, at the spot where the said nerve enters the wall of the oesophagus. The smaller cells appear similar to those constituting the subcerebral, the subtentacular, and the suboral ganglia. The whole system is another example of neurosecretory cells being connected to a storage organ formed by a group of smaller cells. In these storage organs, it could not be stated whether the neurosecre-

tory granula are placed inside or outside the cells proper but, from the experience at hand from vertebrates and arthropods, it appears probable that the granules are placed between the cells.

The evidence from these observations, therefore, points towards the existence of a rather intricate system of incretory glands in molluscs, although probably of a somewhat more diffuse character than those of the vertebrates and of the arthropods.

H. LEMCHE

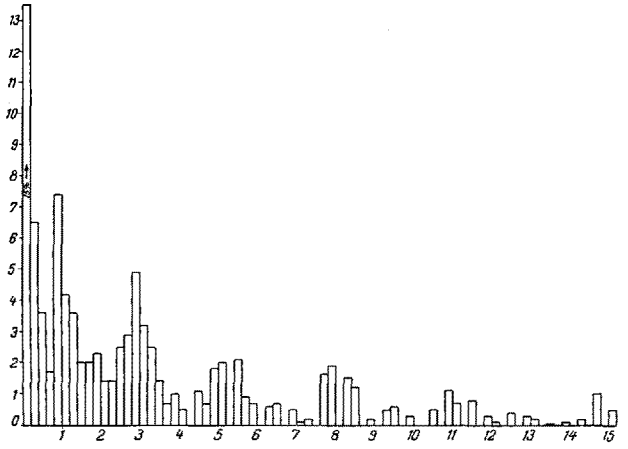
Universitetets Zoologiske Museum København K., Danmark, April 4, 1955.

Zusammenfassung

Unter Anwendung der Gomorischen Chrom-Hämatoxylin-Phloxin-Färbung wird die Existenz neurosekretorischer Granula in den feineren und feinsten Nerven der tectibranchen Molluske *Cylichna cylindracea* (Pennant) nachgewiesen. Dazu kommt die Entdeckung einiger Verbindungen zwischen den vorher nachgewiesenen, zentral liegenden, neurosekretorischen Riesenzellen und einigen speziellen kleinen, vermutlich inkretorischen Organen, die nahe an der Oberfläche der zentralen Ganglien liegen, und die – untereinander mit einer ganzen Anzahl speziellen Nervenfasern verbunden – bei dieser Molluske einen ganzen Komplex von inkretorischen Organen zu bilden scheinen.

Zytologische Untersuchungen an der Reblaus-Blattgalle

Die meisten Pflanzengallen sind morphologisch und histologisch bereits gut untersucht. Dagegen liegen über deren Zytologie erst wenige Angaben vor[1].



Volumina von 2550 Zellkernen aus 25 Reblaus-Blattgallen an *Vitis Rup.* ST. GEORGES. – Ordinate: Anzahl der Kerne in %; Abszisse: Volumina der Zellkerne in Messeinheiten. (Kerngrössentyp 8, der etwa bei der Messeinheit 18–19 liegt, und Typ 9, der bis zur Messeinheit 40 reicht, sind im Säulendiagramm nicht mehr berücksichtigt.)

Bei zytologischen Untersuchungen an Blattgallen, die die Reblaus (*Dactylosphaera vitifolii* SHIM.) an der Rebe (*Vitis*) hervorruft, konnte nun gefunden werden, dass das Wachstum der seit langem bekannten, abnorm grossen Zellkerne im Gallgewebe zumeist nicht kontinuierlich erfolgt. Wie die Beobachtungen über die Häufigkeit verschiedener Zellkerngrössen an Gallen aller Entwicklungs- und Altersstadien ergaben, verläuft das Zellkernwachstum der sich entwickelnden Galle stufenweise. So findet man in jungen Gallen neben Zellkernen mit normalem Volumen im allgemeinen zwei oder auch drei weitere Kerntypen mit grösserem Volumen. Bei der vollkommen ausgebildeten Blattgalle können dann im Endstadium stets mindestens fünf, oft aber sieben oder acht solcher Kerngrössenklassen unterschieden werden, von denen jede im Säulendiagramm durch ein Maximum in Erscheinung tritt (siehe Abb.). Mit dieser stufenweisen Grössenzunahme ist aber das Wachstum der Gallzellkerne nicht in jedem Falle erschöpft, denn man findet bei sehr grossen Gallen stets eine kleine Anzahl von Zellkernen, die einem noch grösseren, neunten, in sich aber uneinheitlichen Grössentyp angehören. Offenbar erfolgt das Wachstum derartiger Riesenkerne nicht mehr stufenweise, sondern kontinuierlich.

Wenn auch durch diese Befunde vorerst noch kein direkter Beweis erbracht werden konnte, so legen sie doch den Gedanken nahe, dass die Kerngrössenklassen in der Reblausgalle durch endomitotische oder endomitoseähnliche Vorgänge bedingt sind. Die Grössenklassen der Zellkerne aus dem Gallengewebe dürften dann vermutlich den Polyploidiegraden $2n$, $4n$, $8n$, $16n$, $32n$, $64n$, $128n$, und möglicherweise sogar $256n$ entsprechen, was mit den gefundenen Durchschnittswerten der einzelnen Gruppen recht gut übereinstimmen würde. Allerdings liegen keine einfachen Volumenverdoppelungen vor. Vielmehr sind die Verhältniswerte der kleinen Kerntypen grösser als einfache Verdoppelungswerte, diejenigen der grösseren Kerntypen dagegen kleiner. Die Verhältniszahlen der Kerngrössenklassen sind, wenn $2n = 1$ gesetzt wird, etwa folgende: 1; 3, 3; 9; 18; 27; 37; 50. Diese Befunde sprechen keineswegs gegen eine endomitotische Polyploidisierung. Ganz ähnliche Verhältniszahlen haben bereits TSCHERMAK-WOESS und HASITSCHKA[1] bei nachweislich endomitotisch polyploiden Ruhekernen bestimmter pflanzlicher Haarzellen gefunden. Ausserdem wissen wir von polyploiden Pflanzen, dass deren Genomverdoppelungen so gut wie nie exakte Volumenverdoppelungen der Zellkerne zur Folge haben[2]. Ferner spricht eine weitere Beobachtung für das Vorhandensein endomitotischer oder endomitoseähnlicher Vorgänge in der Reblausgalle. Man findet nämlich oft (besonders häufig bei grösseren Kerntypen und stets bei Riesenkernen mit einem geschätzten Polyploidiegrad von mehr als $256n$) prophaseähnliche Zustände, die den Chromomerenbau der Chromosomen deutlich erkennen lassen[3]. Es könnte dies so aufgefasst werden, dass der Schritt von einem Kerngrössentyp zum nächsten im Verlaufe eines prophaseähnlichen Zwischenstadiums erfolgt.

Im allgemeinen folgt einer Volumenvergrösserung des Kernes immer eine entsprechende Zunahme des Zellvolumens. Dies gilt im grossen und ganzen auch für die Zellen in der Reblausgalle. Die Zellen in der Nähe der Einstichstelle des Parasiten verhalten sich jedoch abweichend. Sie bleiben relativ klein, obwohl gerade ihre

[1] E. KÜSTER, Forsch. Fortschr. *21/23*, 143 (1947).

[1] E. TSCHERMAK-WOESS und G. HASITSCHKA, Chromosoma *5*, 574 (1953).

[2] F. SCHWANITZ, Züchter *23*, 17 (1953).

[3] Bei bestimmten Zynipidengallen der Eiche scheinen die Dinge ganz ähnlich zu liegen. In diesen Gallen kommen ebenfalls abnorm grosse Zellkerne vor, in denen E. WOLL Strukturen beobachtete, die er als Anzeichen von endomitotischer Polyploidie auffasst (E. WOLL, Z. Botanik *42*, 1 [1954]. – L. GEITLER, Fortschr. Botanik *16*, 1 [1954]).