AKADEMIJA NAUKA I UMJETNOSTI BOSNE I HERCEGOVINE

RADOVI

KNJIGA LVII

ODJELJENJE MEDICINSKIH NAUKA

Knjiga 19.

Urednik
SEID HUKOVIĆ,
redovni član Akademije nauka i umjetnosti
Bosne i Hercegovine

SARAJEVO
1975.

RADIVOJ MILIN*, VASILIJE DEVEČERSKI, MILIVOJ DEDIĆ,
JOSIF MILIN and MILAN KECMAN

EARLY BEHAVIOUR OF THE SUBCOMMISSURAL ORGAN IN IRRADIATED EPIPHYSECTOMIZED RATS

(Accepted on the session of Department of medical sciences 30. IX 1974.)

The question of histophysiological correlation between the pineal gland and the subcommissural organ has presented a special problem in studies on morphophysiological characteristics of the epithalamus. In lower vertebrates the presence of nerve fibres from the structure of the nervous pineal tract was decribed (Oksche, 1956), as well as the vascular connection between the epiphysis and the subcommissural organ (Oksche, 1961). There are views concerning the functional unity of the epiphysis and the subcommissural organ (Roussy and Mosinger, 1946; Mollgaard and Moller, 1973; Leatherland and Dodd, 1968), unlike the hypotheses of their mutual functional independence (Lenys, 1965; Sterba, 1969).

The subcommissural organ reveals reactive changes in its structure after epiphysectomy: in rats sacrificed 7 and 15 days after ablation of the pineal gland, these changes are of involutive character; in rats sacrificed after one or more months after epiphysectomy, these changes are of progressive character (Šćepović, 1963).

In our previous studies on the effect of irradiation upon histophysiological characteristics of the epithalamo-epiphyseal complex in rats irradiated in toto by the lethal dose of 800 r, we found some correlative reactive changes of progressive character in the pineal gland, the subcommissural organ and habenular ganglions (Milin e, Šćepović and Devečerski, 1964; Milin e, Werner, Šćepović and Devečerski, 1963; Milin e, Devečerski, Dedić and Milin e, J., 1972), as well as the protective activity of the pineal extract against irradiation

---

* Institute of Histology and embriology Medical faculty, N. Sad.

(Miline, 1960). It is our wish in this paper to present the results of the studies on the behaviour of the subcommissural organ posterior to irradiation by the lethal dose of 800 r in rats previously pinealectomized.

MATERIAL AND METHODS

White male laboratory rats weighing 180—250 grs, divided in two groups, were used for the experiment. The experimental group (40 animals) consisted of the rats epiphysectomized 6 weeks before the begining of the experiment; the control group (20 animals) consisted of the rats which suffered the same surgical trauma, but without the ablation of the epiphysis. The irradiation was performed by a Siemens »Stabilipan apparatus, 180 KV, 20 mA, filter 0.5 mm Cu, focal distance 40 cm, tubus 24x20, 75 r/minute, 800 r/10'30«.

Each experimental rat was individually irradiated in toto by the lethal dose of 800 r, housed in a cardboard box of suitable size, with perforated sides. The experiment was carried out in November, during the forenoon. Housing conditions and food were the same for all the rats.

The sacrificing of the animals was by decapitation 24—72 hrs after the irradiation, also performed in the course of the forenoon. The following histochemical and enzymic methods were applied: permanent staining after Florentin, Gomori-Bargamann; reactions to acid phosphatases (Barka, 1960), non-specific esterases (Nachlas and Seligman, 1972 and succinodehydrogenases (Nachlas et al., 1975). The prefixation of the organs for electron microscopy was in 6% glutaraldehyde, 0.: M Na cacodylat fixative pH 7.4; the postfixation was in 1% Os O_4, dehydration in acetone, inclusion in Epon 812; sections were cut on a Reichert Sitte ultramicrotome; samples were contrasted in saturated water solution of uranyl acetate and lead citrate (Reynolds), and examined i a LEM 4C »Iskra« electron microscope.

RESULTS

A. Light Microscopy

In the rats sacrificed 24 hrs after the irradiation, in comparison with the control group, an increase of the height of the ependyma in the structure of the subcommissural organ, more frequent presence of dark, and more intensified vacuolation of the cytoplasm of light ependymocytes were found. The cytoplasm of both kinds of cells contains secretory granules with more pronounced hyperchromatic property, situated at the supranuclear as well as at the infranuclear pole of the cells. The secrete which covers the ventricular part of the organ is present to a considerable extent (Fig. 1); the Reissner's fibre shows greater density. In the very beginning of the fibre, in the anterior part of the subcommissural organ, in its horizontal sections, its sinuous and thicker fibrilar threads, with sporadically dilated parts of hyperchromatic character, can be noticed (Fig. 2). In the experimental animals the nuclei of many ependymocytes are hypertrophied, placed on less uniform heights than the nuclei in the control animals. The nuclei of light cells occur at the basal pole, whereas those of dark cells at the apical pole. The hypendyma in the control animals is characterized by an increase of its density, especially in the caudal part of the organ, as well as by the presence of the light cytoplasm highly vacuolated.

In the rats sacrificed 72 hrs after the irradiation an intensified activity of succinodehydrogenases, i. e. considerable amount of formasane granules unequal in size and greater density can be observed throughout the organ, as distinct from the ascendency in the activity of this enzyme in the inner half of the organ in the control animals. The activity of acid phosphatases is greatly pronounced throughout the organ (Fig. 3). It can be noticed at the supranuclear and infranuclear poles of ependymocytes, as well as in the structure of the hypendyma, especially in the vicinity of capillaries. In the experimental animals an intensified activity of this enzyme can be seen in the structure of the Reissner's fibre. Non-specific esterases are also present to a greater extent in the experimental animals (Fig. 4). Positive reaction to these enzymes is noticed all over the cytoplasm of ependymocytes, in contrast to their activity better manifested at the supranuclear than at the infranuclear pole of ependymocytes in the control animals.

B. Electron Microscopy

The ventricular part of the subcommissural organ possesses very uneven surface. The apical poles of ependymocytes stick out into the cavity of the ventricle in the shape of ridges variable in width and length (Fig. 5). From the sides and tops of these ridges, microvilli diverge, together with cilial processes, being more numerous than those at the apical poles in the control animals. These abundant ridge-shaped protrusions of the apical poles of ependymocytes, which immerse in the cerebrospinal fluid, are characteristic of both light and dark ependymocytes (Fig. 5). Secretory granules distributed in these parts of the cytoplasm which stick out into the cavity of the third cerebral ventricle are more variable in density and size than in the control animals, but more numerous too. They are pressed between secretory vacuoles and mitochondria which reach up to the apex of the cell, viz. its ramifications. The findings of the discharge of content of secretory vacuoles as well as of vesicles into the cavity of the ventricle are frequent. The relationship between light and dark cells in their supranuclear part, as well as in the protruded parts of their apical pole, is greatly polymorphous. Laterally, their intercellular spaces abound in rather long, curved, indented ramifications. At the apical pole of the cell, there are desmosomes which are very sinuous, thickened in places, and with intensified osmiophilia. Microvesicles and dense bodies, which by their structural characteristics correspond to lysosomes, are present to a considerable extent at the apical poles of both light and dark ependymocytes.

1. Ependyma

The nuclei are characterized by greater polymorphism, due to the presence of numerous invaginations and incisures, than those in the control animals, especially in the structure of light cells. They are multilobular and appear as if being divided in a considerable number of segments connected to one another by bridges unequal in thickness and structure. In some nuclei the bridges are located in the outer part of the karyoplasm enveloped in the nuclear membrane (Fig. 6). The nuclei which belong to light ependymocytes are characterized by chromatin marginally distributed, the presence of small granules and filaments unequally distributed over the light karyoplasm. The nucleoli are hypertrophied, either excentric or partly immersed in the marginal mass of chromatin which is pressed against the nuclear membrane. They are very heterogeneous. In some of them, the nucleolonema is characterized by increased osmiophilia, in others it is made up of granules different in size and osmiophilia. Figures which correspond to heterochromatin are frequent. Pericapillary spaces in the nuclei of light cells are enlarged in places, the outer leaf of the membrane is uneven. The occurence of pores very unequal in size is considerably frequent. The presence of ribosomes pressed against the outer leaf of the membrane is very variable, in contrast to increased concentration of ribosomes freely distributed in the parts of the cytoplasm characterized by numerous incisures. In the nuclei of dark cells, chromatin mass is very variable present and shaped: in some nuclei, it is marginally situated, present to a less extent, in others scattered in other parts of the karyoplasm as well, partly marginally oriented, i. e. pressed against the nucleus (Fig. 7). Their pericapillary space shows expansions in places, even some vesicular ones which stick out into the neighbouring part of the hyaloplasm. These vesicles possess either denuded membrane or are covered by variable quantity of ribosomes. Dark cells are characterized by the presence of numerous mitochondria which encircle the nucleus (Fig. 7). One can notice closer contact between mitochondria and the outer leaf of the nuclear membrane.

Mitochondria reveal changes in their structure, as well as in their size. Besides tubular mitochondria with slanting crests, whose structure is relatively preserved in light as well as in dark cells, there are numerous swelled mitochondria, globular or oval in shape, whose structure is greatly changed. In many of them, osmiophilia of the nuclear membrane decreases, in others one cannot see both its leaves. The crests are rather reduced in number, disjointed, unequally spaced. There are mitochondria with vacuolated crests, as well as mitochondria of comb-like appearance. One can often find mitochondria, especially in light cells, with the signs of narrowing in their middle part and at the ends, and of gradual fusing of bordering membranes, which results in, such is the impression, their fragmentation.

The behaviour of the endoplasmic reticulum is greatly variable. There are light cells with the vacuolated hyaloplasm (Fig. 7), characterized by the traces of the granulated as well as of smooth endoplasmic reticulum. Sparse ribosomes are noticed in places, occurring either individually or grouped in a small number of rosettes. In these cells, one can see vacuoles unequal in size, globular or oval in shape, at both cell poles. They are bordered by the membrane of unequal osmiophilia, and of smooth surface. The findings of mitochondria pressed against vacuoles are frequent. There are light cells whose hyaloplasm is not vacuolated to that extent, i. e. comb-like appearance, but with better preserved structure. Both their poles are characterized by frequent findings of the granulated, as well as of smooth endoplasmic reticulum, especially of ribosomes freely distributed, found in some cells to a greater extent than in the control animals (Fig. 8). It is striking that in these cells there are rather rare findings of enlargements of the endoplasmic reticulum in the form of light cisterenae, unequal in size, characteristic of the structure of normal animals. Unlike these findings, one can observe abundant dark cells in ribosomes freely distributed in the cytoplasm, viz. the presence of their rosette-shaped groups (Fig. 7, 8). This phenomenon is equally manifested at both cell poles. In dark cells as well, one can notice considerably numerous tubules, i. e. filaments which most frequently occur grouped in the shape of a bend, running the length of the lateral parts of the cell, parallel to the plasma membrane, pressed against mitochondria (Fig. 9).

The polymorphism of secretory granules is very pronounced. They appear in light as well as in dark cells, being more numerous in the latter. They are present to a greater extent in these cells of the experimental animals than in those of the control animals. They exist at both cell poles, in light cells the hyaloplasm of which preserved its structure, as well as in dark cells. Generally speaking, they are noticed, in comparison with the control animals, to a greater extent in dark cells. There are oval, globular, cylindrical, and polygonal granules, densely grouped, enveloped in the osmiophilic membrane. They contain particles densely packed, with intensified osmiophilia, either diffuse or homogeneous in distribution. They are grouped very close to the nucleus, in the immediate vicinity of the Golgi region, as well as in other parts of the cell. Some secretory granules are pressed against the plasma membrane either in the area of the apex or on the lateral border- line of ependymocytes. There are frequent places of discontinuity of the plasma membrane and penetration of secretory granules or discharge of their content into the cavity of the ventricle, i. e. intercellular spaces. There exist some figures of secretion which present the cisternae of the endoplasmic reticulum with densely granulated osmiophilic content, indvidually distributed or partly, or in the form of a net, connected to one another (Fig. 8). In places, their surface contains densely grouped ribosomes which are very numerous in interstices. Lateral invaginations in these cisternae, with ribosomes occurring on their surface in that area, can be observed. By density of their content, size, and shape, these formations of the products of secretion differ from light cisternae which are characteristic of the enlarged endoplasmic reticulum. While observing the position, structure, and size of secretory granules in numerous electron micrographs, we could not help associating what we saw with the phenomenon detected by Murakami (1962), i. e. the possible genesis of secretory gra nules at the expense of mitochondria too. Thus in some mitochondria from the structure of light and dark cells, one can notice the fusing of crests and the matrix at one of the poles or throughout mitochondria, the making of homogeneously granulated osmiophilic formation which penetrates the hyaloplasm in the forms analogous to secretory granules, as well as to secretory granules in genesis in the Golgi region.

Golgi zones are elongated, especially in dark cells (Fig. 8). Some saccules form their structure, of hyperosmiophilic property, rectilinear or sinuous, possess osmiophilic content variable in density. Others have ampular enlargements with light content, following one another. Vacuoles and mitochondria are grouped predominantly in the outer parts of the region. There one can notice microvesicles with light content and the osmiophilic membrane, microvesicles of the same size or larger, with the coated membrane, as well as microvesicles with osmiophilic content whose density is intensified by gradual increase of the volume of microvesicles, i. e. their maturation and turoning into formations which, by their structure, correspond to primary ribosomes. In the Golgi region one can notice more numerous ribosomes, and, in its vicinity, some parts of the granulated and smooth endoplasmic reticulum. Lysosomes are found also in distant parts of the cytoplasm, at both their poles. There are signs of the fusing of primary lysosomes and secretory granules.

2. Hypendyma

Reactive changes in ultrastructural characteristics of hypendymocytes are manifested in all their constituent parts. Nuclei are more distorted, more irregular in shape than those in the control animals. More numerous invaginations occur, even incisures, which are entered by the parts of the cytoplasm with more numerous ribosomes. Chromatin mass is marginally situated, while the nucleolus is greatly variable in its behaviour. Some of them within the nucleolonema are characterized by numerous, densely packed hyperosmiophilic granules, while the others contain larger osmiophilic granules forming globular figures.

Mitochondria are very unequal in size, shape, and structure (Fig. 9, 10, 11), some of which possess greater size than those in the control animals. Tubular, globular, and oval mitochondria are the most frequent. There are mitochondria in the shape of a saddle, or saddlebags, pear-shaped, or in the shape of a lancet. The population of large mitochondria is noticed especially in the parts of the cytoplasm close to capillaries. In some mitochondria crests are diagonal, unequal in size and thickness, in others differently oriented, very rarefied. There are mitochondria with only stumps of the basal parts of crests. The density of their matrix is variable. In swelled mitochondria it is lighter than the density of the hyaloplasm. One can notice some ependymocytes with the parts of the cytoplasm deprived of cellular organelles, of very light density, or with only remnants of mitochondria, the membrane of which is ruptured, with fragments of crests and the matrix.

The endoplasmic reticulum of both types is present to a greater extent. Tubuli of the endoplasmic reticulum go, mutually parallel, through the processes of hypendymocytes invaginated between the basis of ependymocytes and satellite neurogliar cells. Some parts of this reticulum are partly extending through the paranuclear area too. Ribosomes freely distributed are found in the cytoplasm to a greater extent than in the control group. Ribosomes are more numerous in the outer leaf of the nuclear membrane.

The Golgi region, placed close to the nucleus or in the part of the cell body which borders capillaries, is dilated. The whole Golgi complex is enlarged. In its outermost parts there are greater concentrations of the granulated endoplasmic reticulum, the presence of small bodies with intensified density, enveloped in the osmiophilic membrane, which gradually increase their volume. These are the formations which could correspond to different phases in the genesis of lysosomes.

Oval or polygonal secretory granules are scattered over the peri capillary parts of the cytoplasm and in their processes (Fig. 10). They are more numerous than those in the control animals. One can often observe close contact of these granules with mitochondria, as well as their penetration through the ruptures in the plasma membrane into intercellular and pericapillary spaces. Lysosomes occur more frequently as well as their fusion with secretory granules and mitochondria. In the processes of dark ependymocytes, intertwined with the processes of hypendymocytes, one can notice vacuoles, conglomerates of vesicles unequal in size, with lighter density of their cavity, as well as numerous groups of ribosomes in the shape of a rosette, or densely packed parts of the granulated endoplasmic reticulum.

Bodies with periodical structures (Fig. 12) are present next to cpaillaries; they also enter deep into the hypedyma among the proce sses of hypendymocytes, microgliar cells, and the processes of astrocytes which abound in filaments containing also considerable quantity of glycogen. Endothelial cells of capillaries are characterized by microvilli which contain, as well as the very wall of capillaries, pinocytotic microvesicles more numerous than in the control animals. Among pericytes, located in the duplication of the basal membrane, and the endothelium of capillaries, there are more numerous electronoptic empty microvesicles (Fig. 13).

There are specific findings in terminal parts of nerve fibres, i. e. in their terminal bundles, which extend throughout the intercellular space in the hypendyma, forming very close contacts with some branches of hypendymocytes or ependymocytes. Their structure is characterized by densely packed microvesicles, those with light as well as those with osmiophilic content, with prevalence of the latter (Fig. 12). The structure of their mitochondria is changed, with the signs of vacuolation and rarefication of crests, and with lighter density of the matrix.

DISCUSSION

The changes found in the structure of the subcommissural organ under the influence of the lethal X-ray dose bear witness to great sensitivity of the examined parts of the epithalamus to the effects of this aggressive factor. They also present manifestations of the reaction of the subcommissural organ to the irradiation stress.

In some light ependymocytes, the phenomenon of vacuolation of the cytoplasm was found, followed by the fragmentation of some cell organelles in its area. In other light ependymocytes, one can observe hypertrophy of the nucleus with numerous invaginations, pronounced polymorphism, and swelling of mitochondria, conspicuous increase of the number of secretory granules, and the presence of cisternae of the endoplasmic reticulum with light content. On the basis of these reactive changes of light cells in the early days following the irradiation, one could suppose that in the structure of the ependyma in the experimental animals the phenomenon of relative dystrophy takes place: depressive changes in morphokinetics of some light ependymocytes, and progressive in morphokinetics of the others. Reactive changes in the ultrastructure of dark ependymocytes manifest the reaction of evolutive character. Their abundant presence in mitochondria with relatively preserved structure, in the endoplasmic reticulum, especially in ribosomes and secretory granules situated at both cell poles, testifies to significant role of cell organelles in the elaboration of secretory granules, a kind of stimulating activity of these cells from the structure of the ependyma, under the irradiation stress.

There are different opinions on the character of light and dark ependymocytes. Some authors include them in the same cell group, considering them to be two functional variants of one and the same kind of cells originating from the ependyma (Lenys, 1963; Bugnon, Lenys R., and Lenys D., 1963). Others, basing their studies mainly on the properties of nuclei, class them as the special kind of cells from the structure of the ependyma (Palkovits, 1965; Palkovits and Lukács 1963). Ependymocytes which are characterized by numerous light cisternae and light secretory vesicles, especially those formed at the expense of proliferation of the perinuclear space, are supposed to secrete active polypeptide forms (Sterba, Kabisch, Schneider and Hoheisel, 1972), whereas secretory granules correspond to protein-polysaccharide complex abounding in cystine (Afifi, 1964; Lenys, 1964; Palkovits, 1965). In normal animals secretory vesicles, light cisternae and secretory granules are differently present in the cells of both types. In view of these facts, on the basis of the obtained results of the reaction of ependymocytes under the acute irradiation stress in epiphysectomized animals, we are inclined to think that there exist one and the same family of cells with polyvalent biological properties, which prevail in different parts of the same kind of cells in dependence on the needs of the organism in counteracting an aggressive factor or stressor.

The decribed characteristics of the hypendyma, with special reference to the cytodynamics of hypendymocytes, argue, predominantly, for stimulating activity in this constituent part of the subcommissural organ too. This is also proved by changes in the structure of hypendymocytes as well as of capillaries. The changes found in terminal parts of nerve fibres which extend from the commissura present the morphological proof of their correlative participation in the determinism of complex processes in morphodynamics of the subcommissural organ under the irradiation stress.

Comparing the results of this investigation with those of our previous studies of the influence of the same X-ray dose upon the behaviour of the subcommissural organ in animals with preserved pineal glands (Miline, Devečerski, Dedić and Miline J., 1974), one tends to believe that subcommissural organ in epiphysectomized animals is considerably more sensitive to the irradiation stressor. In epiphysectomized animals the reactive changes described in the ultrastructure of more numerous dark ependymocytes are in prevalence. Considering these changes followed by increased activity of non-specific esterases, acid phosphatases and succinodehydrogenases, as well as the changes in the nucleus whose genetic system is of crucial importance in the regulation of biosynthesis in the cytoplasm, we may conclude that the phenomena of synthesis, i. e. secretion, transport and elimination of secrete in the subcommissural organ of epiphysectomized animals, take place with the signs of considerably greater gradation in the activity of some ependymocytes. This indicates that in animals deprived of the pineal gland the reactivity of the subcommissural organ changes under the irradiation stress and according to the functional states of the organism.

The question of the role of the subcommissural organ still remains open. There are hypotheses of its participation in maintenance of the hydro-mineral balance (Gilbert, 1966; Palkovits, 1965; Murphy and Wood, 1966), of its participation in the regulation of aldosterone secretion (Gilbert and Armstrong, 1966; Palkovits, 1968), in the regulation of the contact between cerebrospinal fluid and the parts of neurons immersed in the cavity of the cerebral ventricle (Sterba, 1972). Bearing in mind that under irradiation stress serious metabolical disturbances occur, among which great loss of water and salt is especially distinguished (Betz, 1955; Goetze, 1964), a question arises whether these distrubances are equally manifested in epiphysectomized animals too. Our preliminary investigations, on the same kind of animals, of the correlative behaviours of the supraoptic nucleus, the centre of adiuretine secretion, point to significant reactive changes at the level of the hypothalamus in the irradiated animals of both groups, more shown, however, in those which were pinealectomized. These data, which will receive special treatment, suggest that in epiphysectomized animals increased reaction of some parts of the neuroendocrine system as influenced by the irradiation stressor occurs. They fully agree with the results of our previous investigations on protective activity of the pineal extract against the effect of X rays (Miline, 1970).

RADIVOJ MILIN, VASILIJE DEVEČERSKI, MILIVOJ DEDIĆ,
JOSIF MILIN i MILAN KECMAN

RANO OPHOĐENJE SUBKOMISURALNOG ORGANA U OZRAČENIH EPIFIZEKTOMISANIH PACOVA

KRATAK SADRŽAJ

Proučavane su ultrastrukturne odlike subkomisuralnog organa u epifizektomisanih pacova žrtvovanih 24—72 časa nakon ozračivanja in toto letalnom dozom od 800 r.

U građi ependima ustanovljene su reaktivne promene delimično distrofičnog, a pretežno evolutivnog karaktera. Ustanovljen je pojačan aktivitet kiselih fosfataza i nespecifičnih esteraza. Pojedini svetli ependimociti ispoljavaju citološke odlike involutivnog karaktera, drugi, kao i tamni ependimociti, reaktivne promene progresivnog karaktera. U reagovanju ćelijskih organela ističe se: povećanje broja mitohondrija, njihov polimorfizam i bubrenje; prisustvo mitohondrija sa znacima vakuolizacije kresti kao i mitohondrija u toku fragmentacije; izobilje u ribozomima. Ependimociti tamnog tipa sadrže veće količine sekrecionih granula i cisterni endoplazmatičnog retikuluma, prisutnih u oba ćelijska pola, brojnije ribozome i lizozome.

U građi hipendima ustanovljena je hipertrofija i veći polimorfizam jedara hipendimocita (brojnije prisustvo jedara sa udubljenjima i incizurama), hipertrofija i polimorfizam mitohondrija, proširenje Golgi-eve zone, polimorfizam sekrecionih zrna. U završnim delovima aksona koji inervišu organ ustanovljeno je brojnije prisustvo sinaptičnih mikrovezikula sa osmiofilnim sadržajem.

Dobiveni rezultati kao i njihova konfrontacija sa rezultatima ranijih istraživanja o udelu subkomisuralnog organa u iradijacionom sindromu u pacova sa očuvanom pinelanom žlezdom, govore u prilog pojačanog senzibiletta subkomisuralnog organa prema dejstvu X-zraka u pacova lišenih pinealne žlezde.

REFERENCES

1. Afifi, A. K.: The subcommissural organ of the camel. The Jonural of comparative neurology. 123, 139—136 (1964).
2. Barka, T.: A simple azo-dye method for histochemical demonstration of acid phosphatases. Nature. 187, 248—249 (1960).
3. Betz, E. H.: Contribution à l'étude du syndrome endocrinien provoqué par l'irradiation totale de l'organisme. Georges Thone, Liège, 1955.
4. Bugnon, C., Lenys, R. et Lenys, D.: Quelques aspects particuliers de l'organe sous-commissural du rat blanc et quelques observations sur l'organe sous-commissural du Lapin, du Porc et du Cheval. Annales Scientifiques de l'Université de Besançon. 7, 61—80 (1963).
5. Gilbert, G. J.: The subcommissural organ: a regulation of thirst. The American Journal of Physiology. 191, 243—247 (1957).

6. Gilbert, G. J. and Armstrong, E. P.: The effect of epinephrine upon subcommissural organ secretion in the rat, Neurology. 16, 236—241 (1966).

7. Goetze, E.: Lehrbuch der pathologischen Physiologie. VEB Gustav Fischer Verlag, Jena, 1964.

8. Leatherland, J. F. and Dodd, J. M.: Studies on the structure, ultrastructure and function of the subcommissural organ Reissner's fibre complex of the European Eel Anguilla anguilla L. Zeitschrift für Zellforschung. 89, 533—549 (1968).

9. Lenys, R.: Contribution à l'étude de la structure et du rôle de l'organe sous-commissural. Thèse, Université de Nancy, 1963.

10. Lenys, R.: Données morphologiques et histochimiques récentes sur l'organe sous-commissural. Annales Scientifiques de l'Université de Besançon, 1, 21—29 (1965).

11. Miline, R.: Influence de l'extrait épiphysaire sur la résistance à l'irradiation. Acta Anatomica. 42, 270 (1960).

12. Miline, R.: L'effet protecteur de l'extrait épiphysaire sur la résistance glandotrope de l'hypophyse à l'irradiation. Acta Endocrinologica. Suppl. 51, 303 (1960).

13. Miline, R., Werner, R., Šćepović, M., Devečerski, V. et Krstić R.: Contribution à l'étude de l'influence d'irradiation sur le ganglion de l'habenula et la glande pinéale. Annales d'Endocrinologie. 24, 380—384 (1963).

14. Miline, R., Šćepović, M., Devečerski, V.: Influence d'irradiation sur l'histophysiologie corrélative de la zone glomérulaire des surrénales, de l'épithalamus et de l'hypothalamus chez le rat. In: Major Problems in Neuroendocrinology, edited by E. Bajusz and G. Jasmin, S. Karger, Basel-New York, 393—408, 1964.

15. Miline, R., Devečerski, V., Dedić, M. and Miline, J. Contribution to study on behaviour of the subcommissural organ in irradiation syndrome, 1974, in Press.

16. Mollgaard, K. and Moller, M.: On the innervation of the human fetal pineal gland. Brain Research. 52, 428—432 (1973).

17. Murakami, M., Kusawa, K. und Yamakawa, K.: Feinstruktur des Subkommissuralorgans des Histamin-injizierten Gecko japonicus. Arch. histol. jap. 22, 465—475 (1962).

18. Murphy, G. D., Wood, J. G.: Functional and microscopic studies on the subcommissural organ in the cat. Texas Report of Biology and Medicine. 24, 729—735 (1966).

19. Nachlas, M. M., Seligman, A. M.: The histochemical demonstration of esterase. J. Nat. Cancer Inst. 9, 415—425 (1949).

20. Nachlas, M. M., Tsou, K. C., Souza, E. De Chang, C. S., Seligman A. M.: Cytochemical demonstration of succinic dehydogenase by the use of a new p-nitrophenyl substituent ditrazole. J. Histochem. Cytochem. 5, 420 (1957).

21. Oksche, A.: Funktionelle histologische Untersuchungen über die Organe des Zwischenhirndaches der Chordaten. Anatomischer Anzeiger. 102, 413—419 (1956).

22. Oksche, A.: Vergleichende Untersuchungen über die sekretorische Aktivität des Subkommissuralorgans und den Gliacharakter seiner Zellen. Zeistschrift für Zellforschung. 54, 549—612 (1961).

23. Palkovits, M., Lukacs, Gy.: Karyometric examination of the system subcommissural organ-adrenal cortex in rat. Acta biologica. 13, 361—369 (1963).

24. Palkovits, M.: Morphology and Function of the Subcommissural Organ. Akadémiai Kiadó, Budapest, 1965.

25. Palkovits, M.: Karyometrische Untersuchungen zur Klärung der osmo-bezw. volumenregulatorischen Rolle des Subcommissuralorganes und seiner funktionellen Verbindung mit der Nebennierenrinde. Zeitschrift für Zellforschung. 84, 59—71 (1968).

26. Roussy, G. et Mosinger, M.: Traité de Neuro-endocrinologie. Masson et Cie, Paris, 1946.

27. Šćepović, M.: Korelativna histofiziologija epitalamo-epifiznog kompleksa i nadbubrega. Habilitacioni rad, Medicinski fakultet, Sarajevo, 1963.

28. Sterba, G.: Morphologie und Funktion des Subcommissuralorgans. In: Zirkumventrikuläre Organe und Liquor. Ed. G. Sterba, Gustav Fischer, Jena, 17—36, 1969.

29. Sterba, G.: Subkommissuralorgan und Liquorregulation. Biologische Rundschau. 10, 309—324 (1972).

30. Sterba, G., Kabisch, K., Schneider, B., Hoheisel, G.: Storing of secretory material inside the perinuclear space. Experientia. 28, 934—436 (1972).

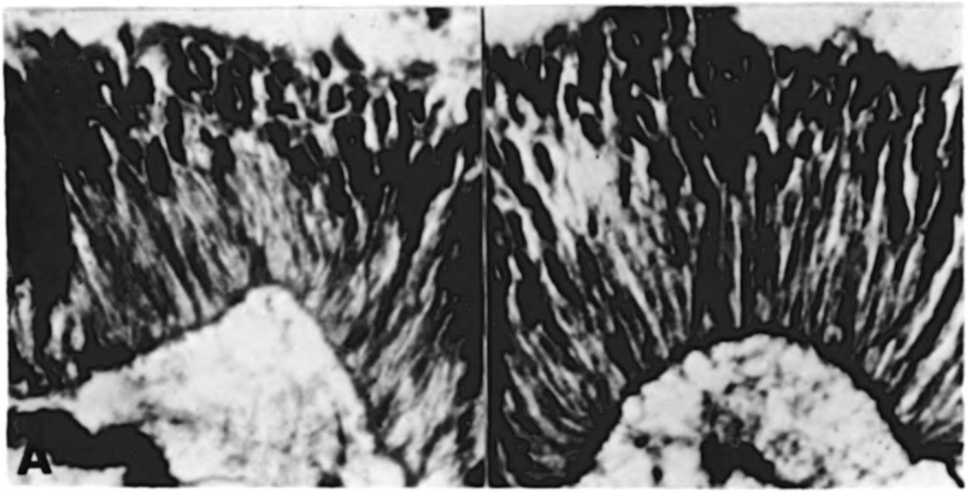

Fig. 1

Subcommissural organ
A. Control rat; B. Rat exposed to irradiation: hypertrophy of the nuclei, accumulated secrete at the apical poles of the ependymocytes (Bouin, Florentin; oc. 12, 5; obj. 63).

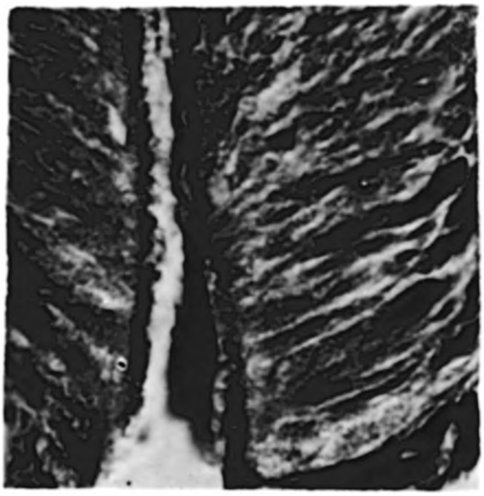

Fig. 2.

Subcommissural organ
Rat exposed to irradiation: originating part of Reissner's fibre and its gradual thickening (Bouin, Gomori-Bargmann; oc. 12, 5; obj. imm.).

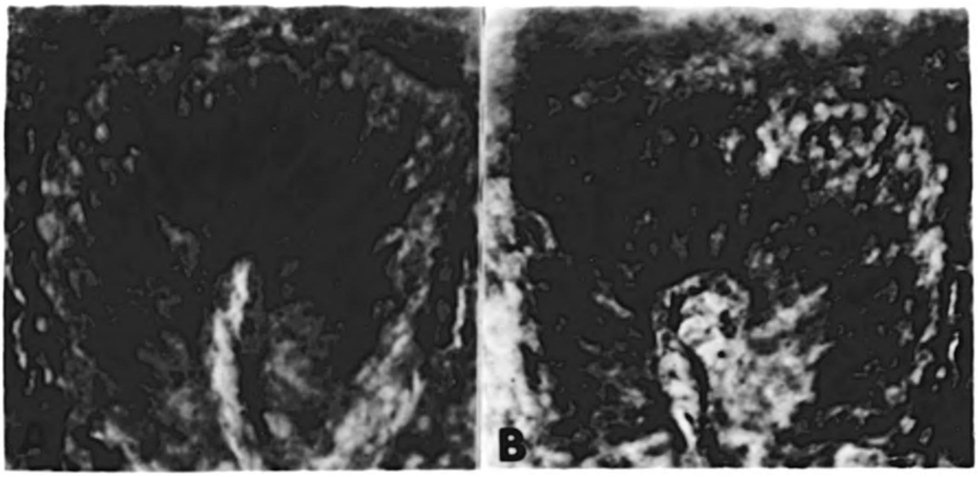

Fig. 3

Subcommissural organ
A. Control rat; B. Rat exposed to irradiation: increased activity of acid phosphatases (oc. 8; obj. 40).

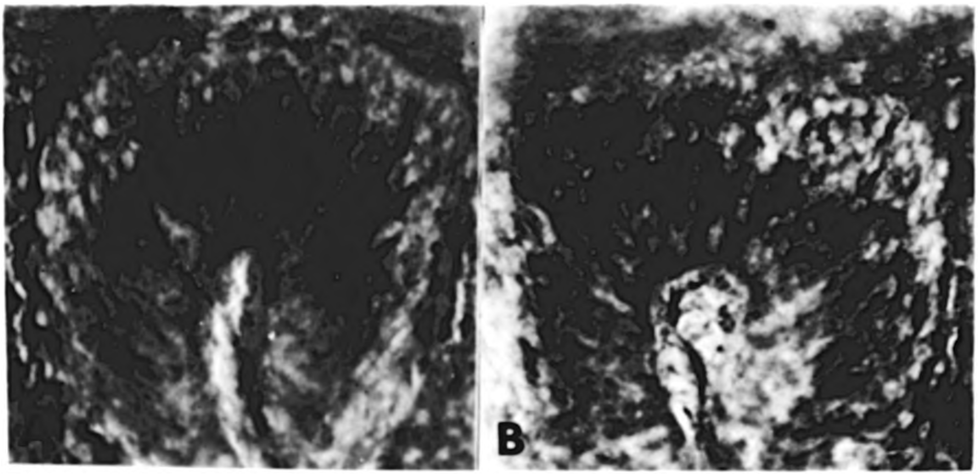

Fig. 4

Subcommissural organ
A. Control rat; B. Rat exposed to irradiation: increased activity of non-specific esterases (oc. 8; obj. 40).

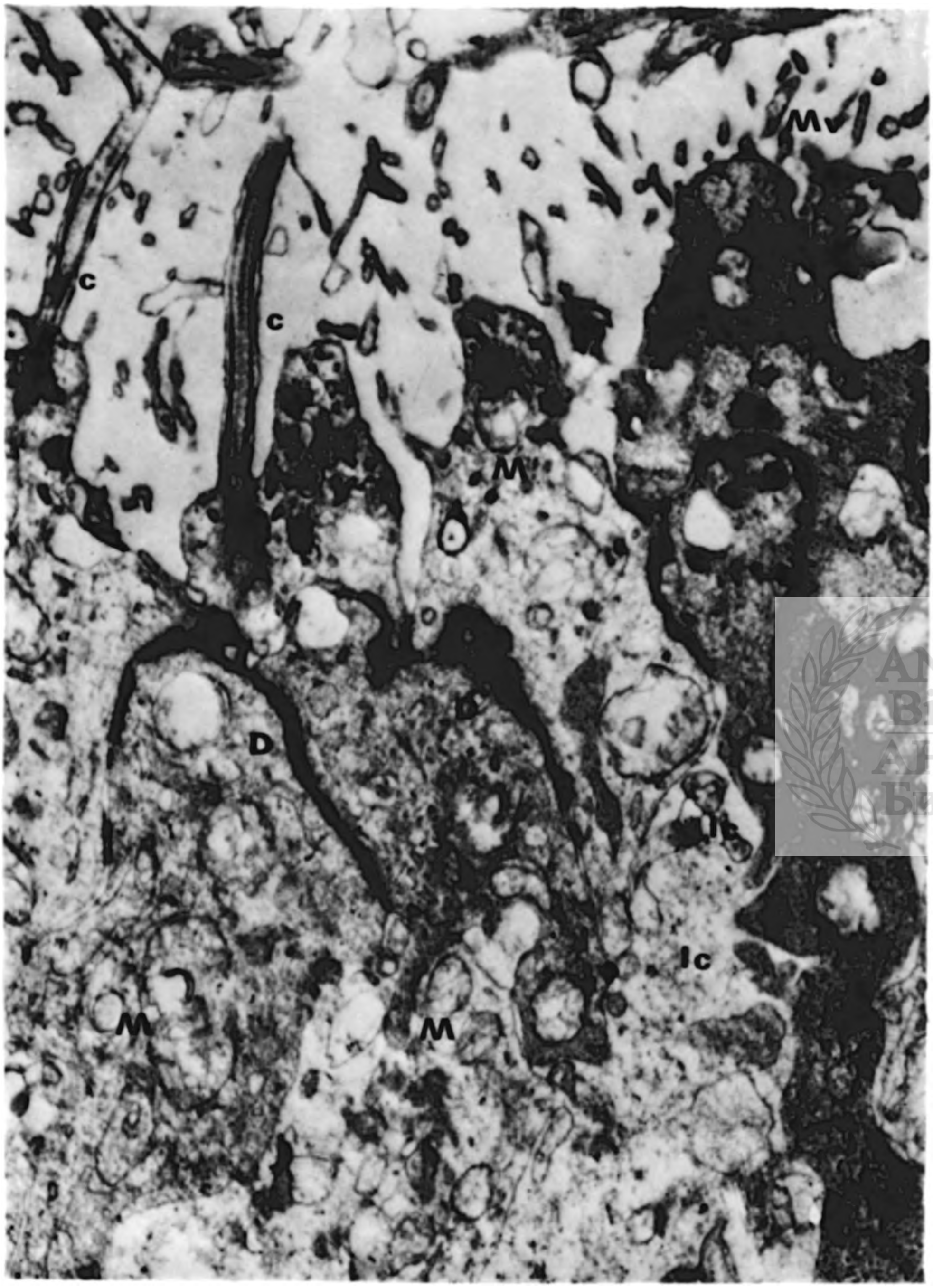

Fig. 5.

Ventricular part of the subcommissural organ: ridge-shaped protrusions of the ependymocytes; lc-light cell; dc-dark cell; D-desmosomes; c-cilia; uv-microvilli; M-mitrochondria; Ic-intercellular space. x 40.000.

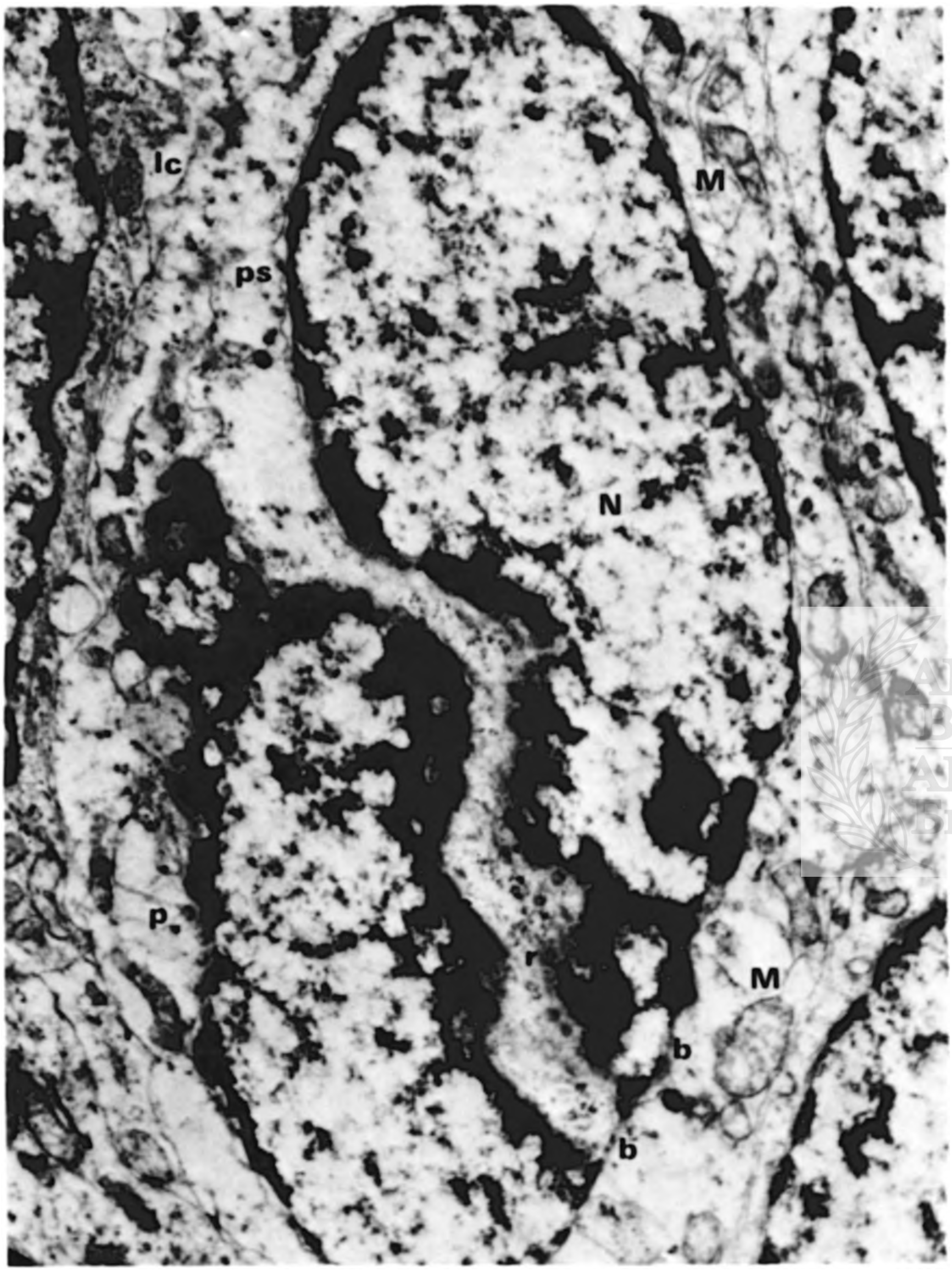

Fig. 6.

Light ependymocytes: N-multilobular nucleus; b-nuclear bridge; p-pores; ps-perinuclear space; M-mitochondria; r-ribosomes; lc-intercellular space. x 20.000.

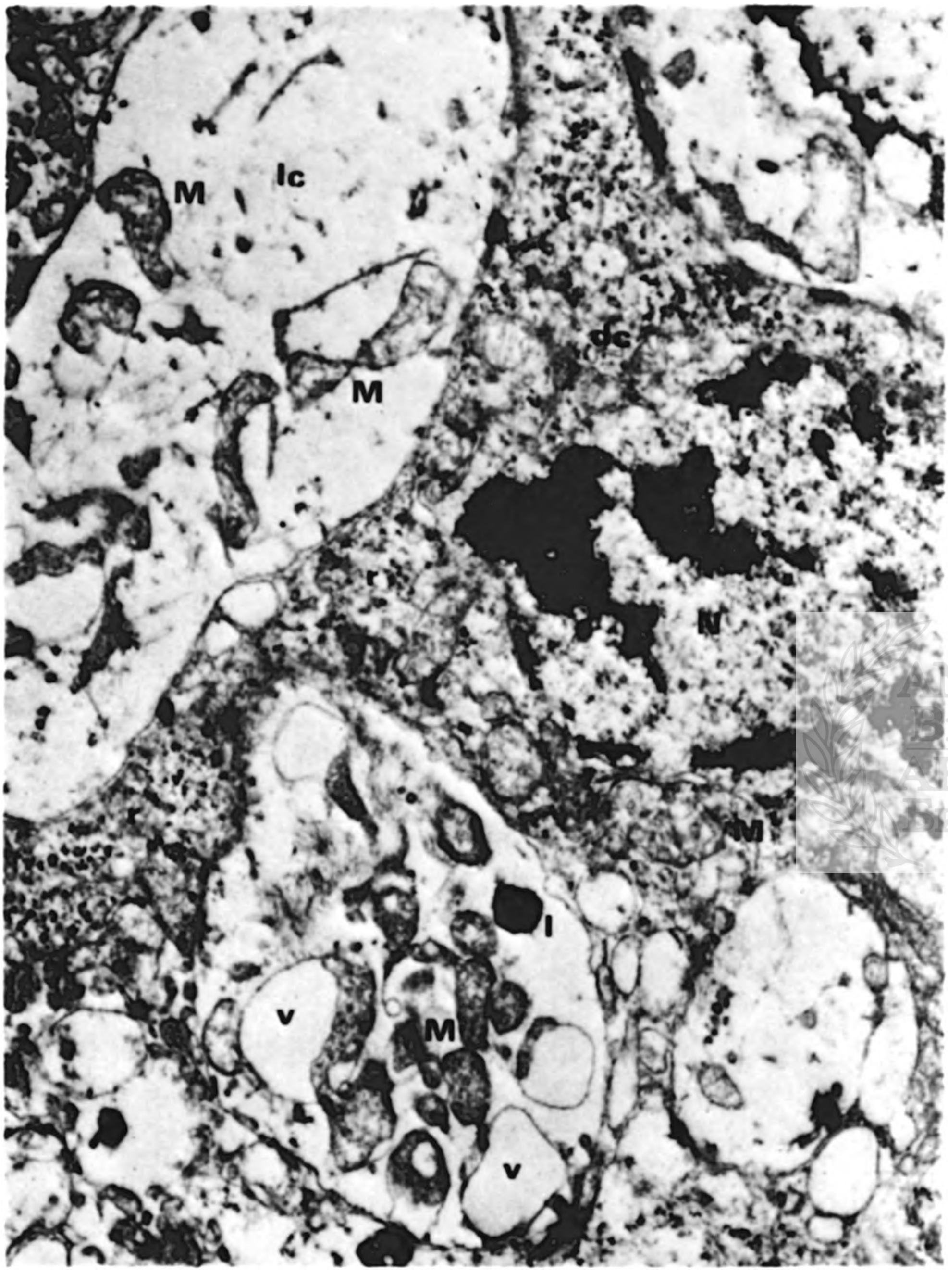

Fig. 7.

Dark and light cells: lc-light cell; dc-dark cell; N-nucleus of the dark cell; r-ribosomes; M-mitochondria; v-vacuole; l-lysosome. x 20.000.

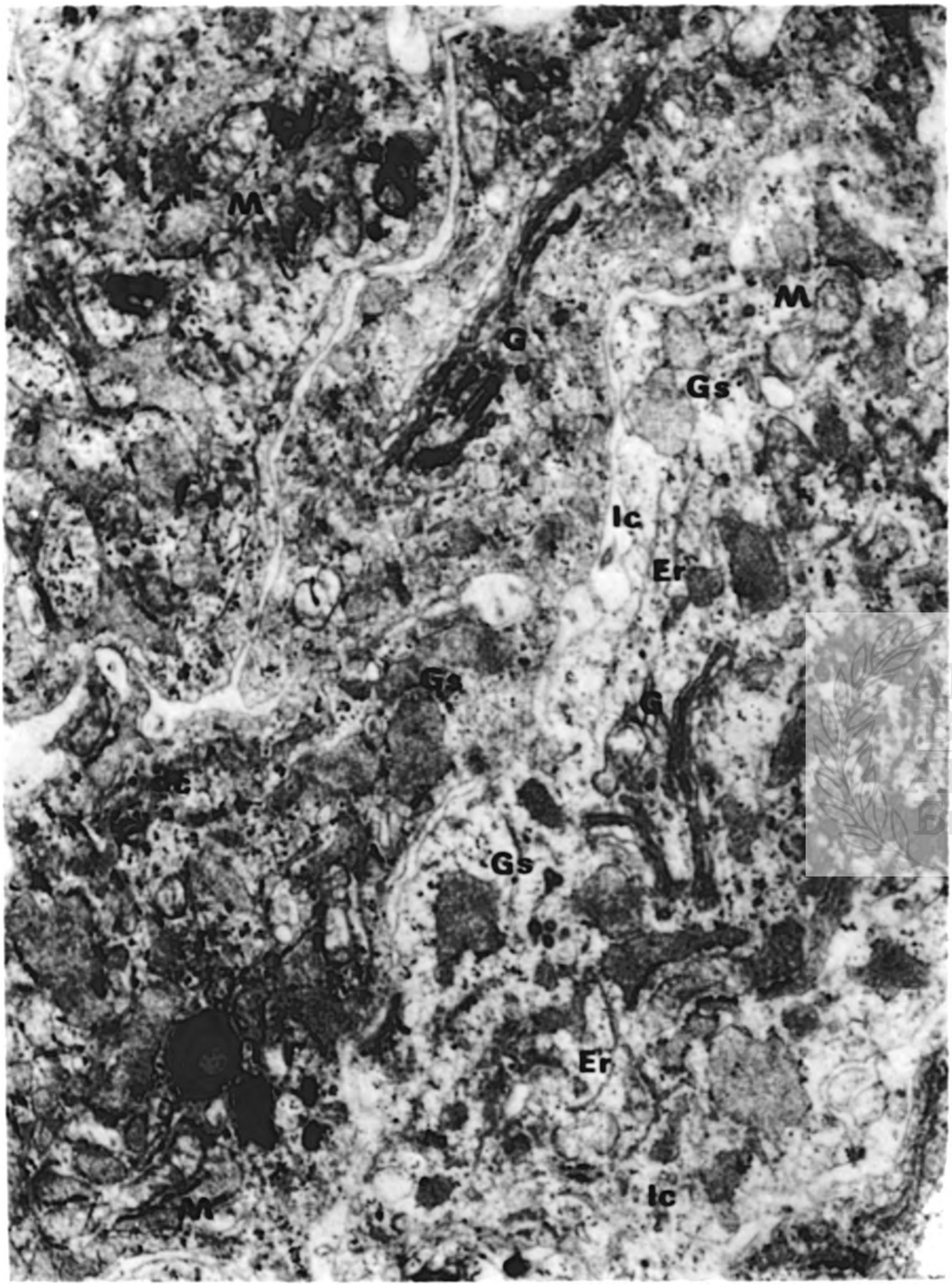

Fig. 8

Dark and light cells: dc-dark cell; lc-light cell; G-Golgi zone; Gs-secrete granules; l-lysosomes; Er-endoplasmic reticulum; M-mitochondria; Ic-intrecellular space. x 20.000.

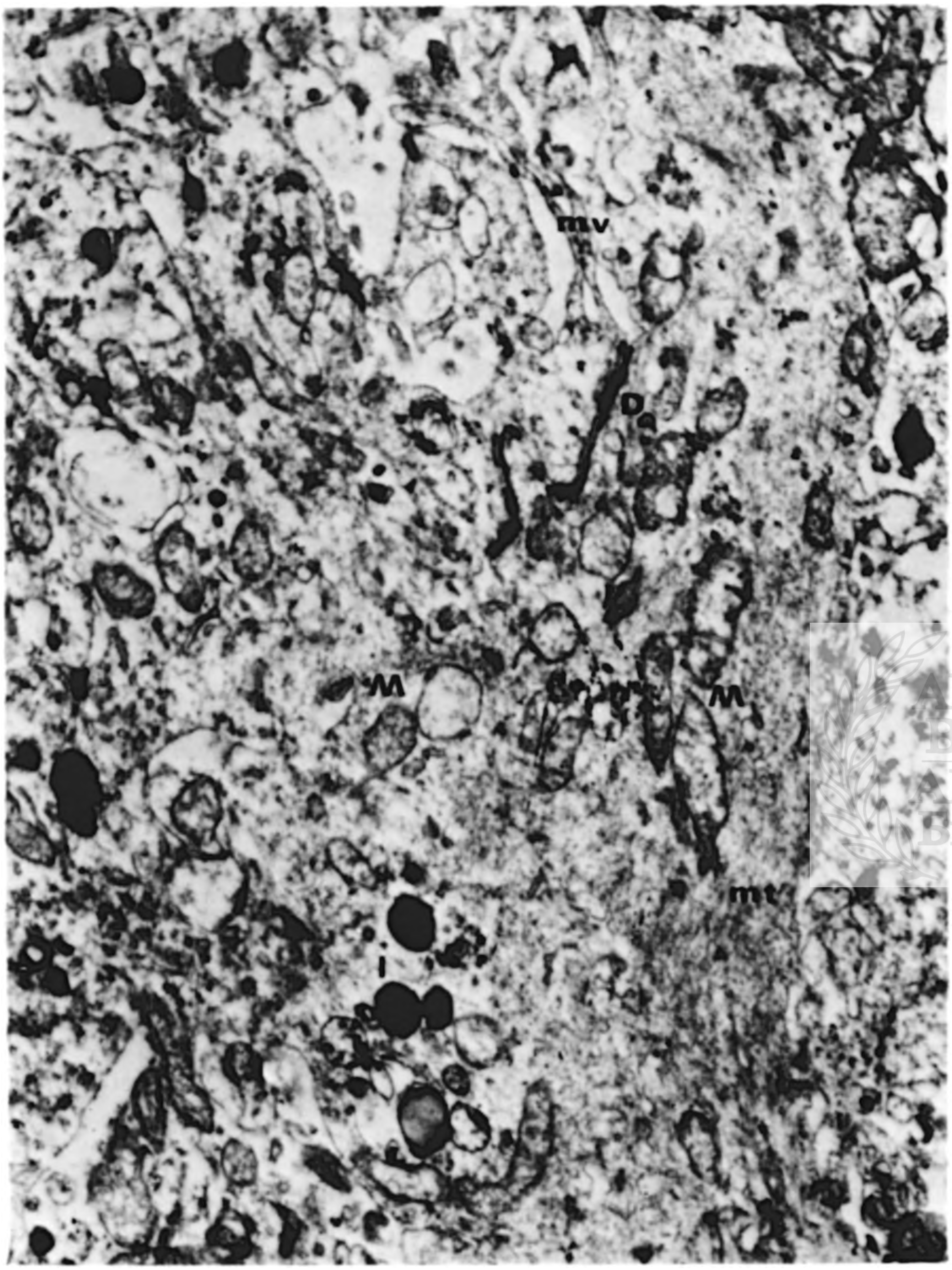

Fig. 9

Ependymocytes: D-desmosomes; M-mitrochondria; mv-microvilli; mt-microtubules; l-lysosomes x 20.000.

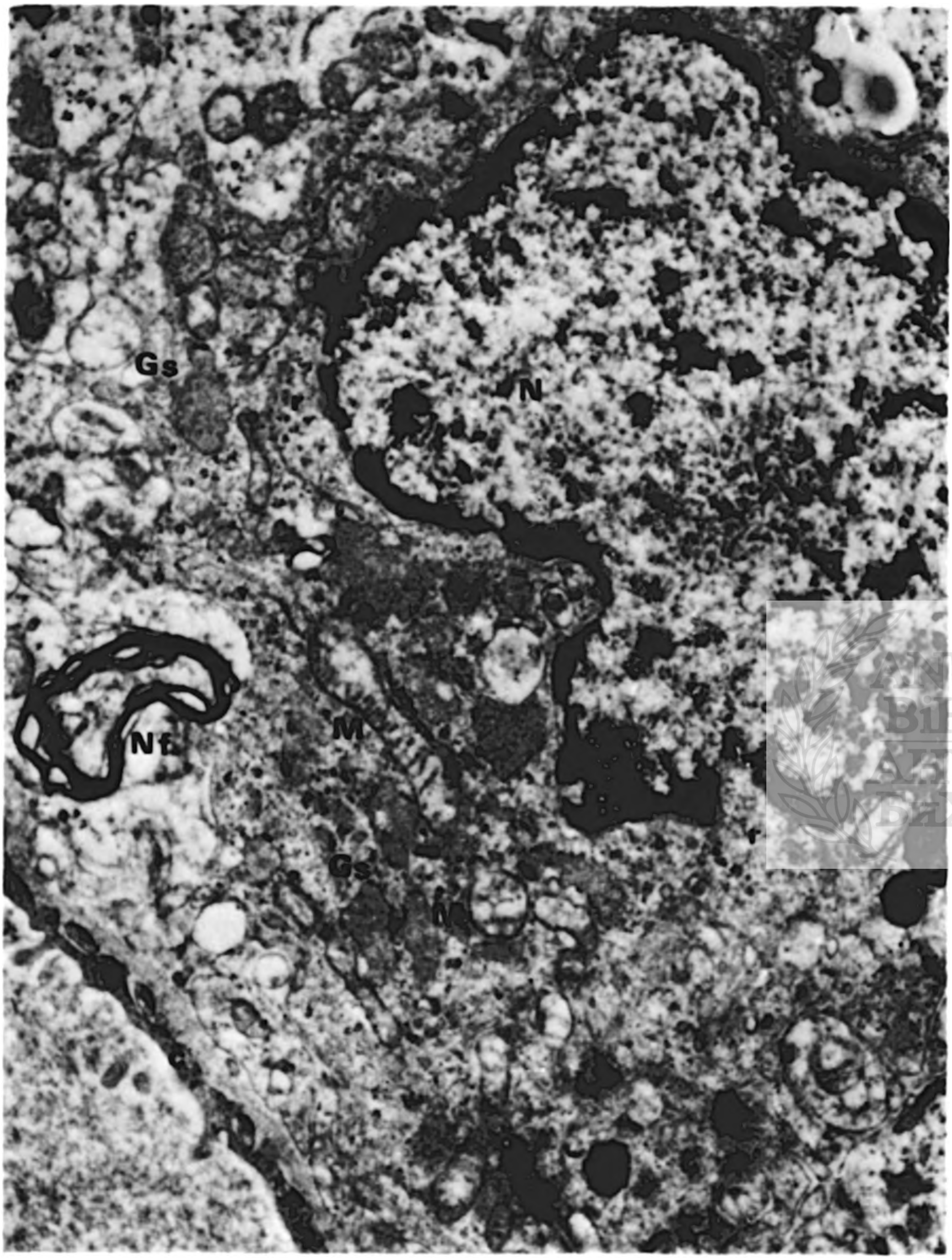

Fig. 10

Hypendymocyte: N-nucleus; M-mitochondria; Gs-secrete granules; r-ribosomes; v-vacuole; c-capillary wall with microvilli; Nf-myelinic nerve fibre. x 20,000.

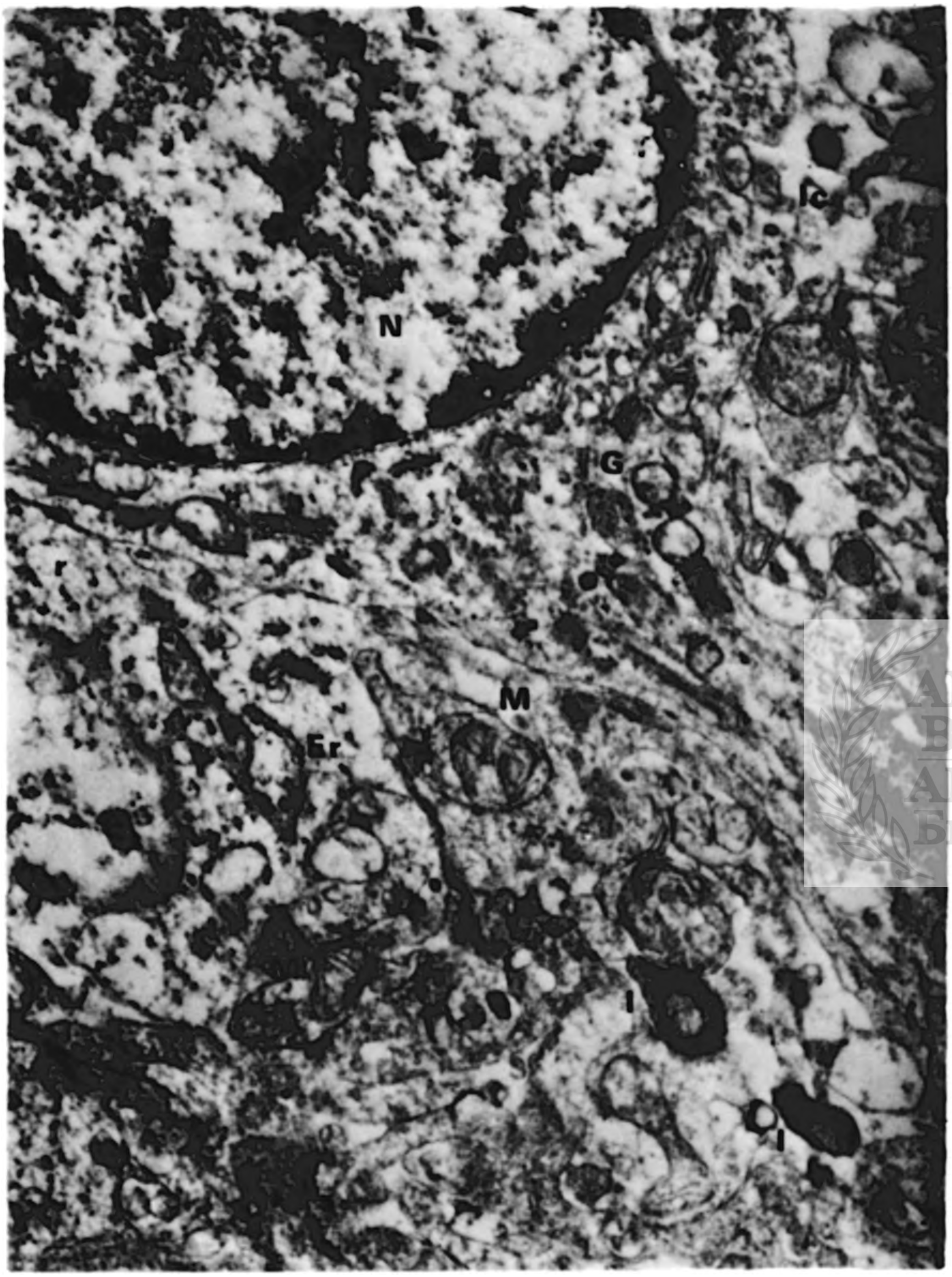

Fig. 11

Hypendymocyte: N-nucleus, outer leaf of the nuclear membrane with ribosomes; M-mitochondria; Er-endoplasmic reticulum; r-ribosomes; G-Golgi zone; l-lysosomes; Ic-intercellular space. x 20.000.

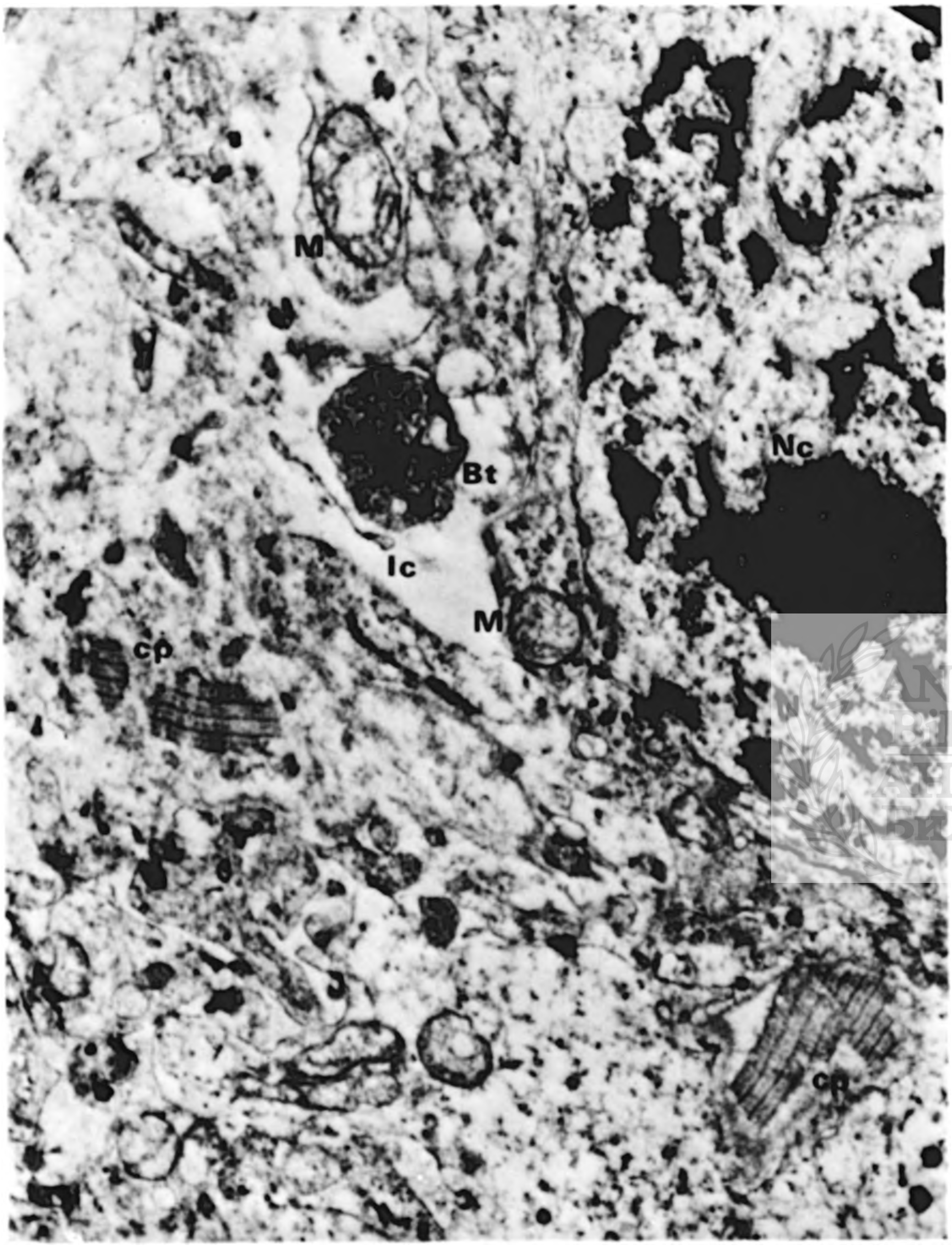

Fig. 12.

Hypendymocytes: N-nucleus; Nc-nucleolus; M-mitrochondria; cp-bodies with periodical structure; Ic-intercellular space; Bt-axon terminal part. x 20.000.