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CONSIDÉRATIONS SUR LA PRÉSENCE DE L'ESPÈCE *PHORONIS HIPPOCREPIA* WRIGHT (*PHORONIDEA*) DANS LES EAUX ROUMAINES DE LA MER NOIRE*

PAR

V. IACOBESCU

In this paper it is for the first time noticed the presence of the species *Phoronis hippocrepia* Wright in the Romanian littoral waters and its spreading to the Romanian continental platform.
The author presents a concise histological description of the material he collected.

Dans cette note nous mentionnons pour la première fois la présence, dans les eaux roumaines de la mer Noire, de l'espèce *Phoronis hippocrepia* Wright.

HISTORIQUE

Le groupe des Phoronides est représenté par un seul genre : *Phoronis*, signalé pour la première fois par Wright en 1856, dans le canal de Bristol. Dans la mer Noire, ce genre a été signalé par Zernov [8]. En Roumanie, dans des tableaux faunistiques, Băcescu [1] mentionne pour la première fois en 1965 le genre *Phoronis*, dans les eaux du littoral roumain, en indiquant deux stations où il a été trouvé (st. 27, profondeur 28 m et st. 100, profondeur 45 m). A l'heure actuelle, ce groupe est plus ou moins connu, grâce aux contributions de : Masterman (1892, 1902), Longchamps (1907), Cori (1939) qui mentionne que le genre *Phoronis* englobe 16 espèces, Lars (1954) et Forneris (1959).

Les Phoronides sont cosmopolites et les représentants du genre *Phoronis* vivent dans les eaux froides des régions tempérées, aussi bien que dans celles des régions tropicales. Dans les eaux du littoral roumain, la présence de ce groupe a été signalée seulement en tant que genre (Băcescu).

* Article offert en hommage à M. Băcescu pour son 60e anniversaire

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MATÉRIEL ET MÉTHODE

A la suite des recherches systématiques effectuées sur la plate-forme roumaine de la mer Noire, nous avons collecté une série d'échantillons qui nous ont fourni aussi le matériel présenté dans cette note et je tiens à remercier, à cette occasion, M. le Dr M. Băcescu d'avoir mis à ma disposition ce matériel, en même temps que pour les précieux conseils qu'il m'a offerts.

Le matériel dont nous disposons contient des exemplaires complets de *Phoronis hippocrepia* Wright, en bon état, ainsi que des fragments et des tubes séparés, provenant des 9 stations suivantes, emplacées au large du littoral roumain :

N°	N° de la station	Date du collectage	Profondeur	Nombre des individus
1	91	17 sept. 1954	47 m	1
2	452	29 sept. 1956	36 m	fragments
3	482	7 févr. 1957	42 m	1
4	484	7 févr. 1957	51 m	fragments
5	545	20 juillet 1957	30 m	1
6	735	15 juin 1959	29 m	fragments
7	743	15 juin 1959	36 m	1
8	655	15 mai 1967	54 m	2
9	838	30 nov. 1967	40 m	2

Le matériel a été collecté à l'aide de dragues spéciales de type M. Băcescu et Van Veen, à des profondeurs variant entre 28 et 54 m.

Les coupes histologiques que nous présentons ont été exécutées par D. Scripcaru, du Laboratoire d'histologie de la Faculté de Biologie de l'Université de Bucarest, que nous remercions pour l'aide accordée. La fixation du matériel immédiatement après son extraction a été faite dans du formol 4%. La deuxième fixation a été faite dans une solution d'alcool (96°), acide acétique et chlorure de mercure et la coloration dans de l'hématoxyline ferrique, alcène bleu fuchsine, par sections de 5 μ.

DESCRIPTION DU MATÉRIEL

En examinant le matériel, nous avons trouvé 8 exemplaires complets, appartenant à l'espèce *Phoronis hippocrepia* Wright 1856 (= *Ph. kowalevsky* Benham, 1889, *Ph. psammophila* Cori 1889).

Dans la fig. 1 on peut voir un exemplaire de *Phoronis hippocrepia* Wright, dans son tube. L'animal a été trouvé à la station 91, dans un échantillon pris à 47 m de profondeur (v. tableau). Décontracté, il a une longueur de 7 mm (3 mm de la partie antérieure du corps restant hors

du tube). Le tube sécrété par l'animal présente une consistance membraneuse et, collés à lui il y a des grains de sable et de très fins fragments de coquilles, qui lui donnent une certaine rigidité grâce à laquelle il maintient une forme cylindrique, plus ou moins rectiligne ; la longueur du tube est de 4 mm et sa largeur de 1 mm. A l'aide d'une pincette, l'animal peut être facilement enlévé de son tube, étant donné qu'aucune partie de son corps n'est fixée à la paroi intérieure du tube.

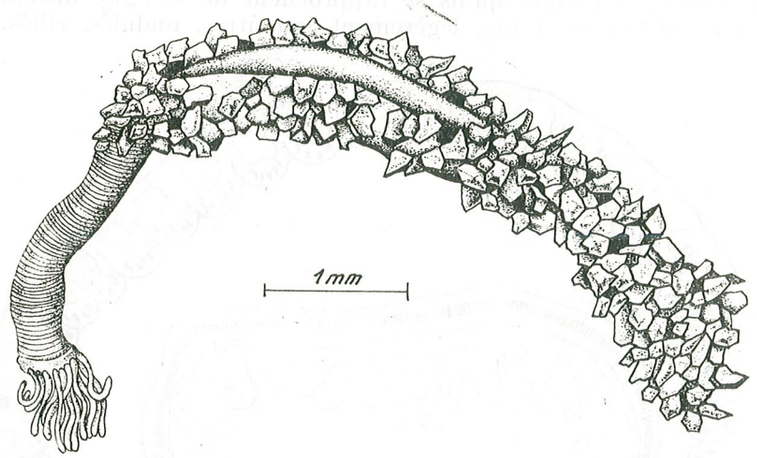

Fig. 1. — *Phoronis hippocrepia* dans son tube (*orig. V. Iacobescu*).

A la station 545 (v. tableau) nous avons trouvé un exemplaire qui avait quitté son tube (fig. 2). Mesuré depuis le bout des tentacules au bout distal du corps, l'animal a 8 mm de longueur ; il est cylindrique, légèrement annelé, translucide, ayant la partie antérieure du corps plus mince que la partie postérieure qui est plus grosse dans la région de l'ampoule. Le coloris est jaunâtre tirant sur le rose, avec, à la base des tentacules, en dessous des lophophores, une portion rétrécie, étranglée, pigmentée en rose vif.

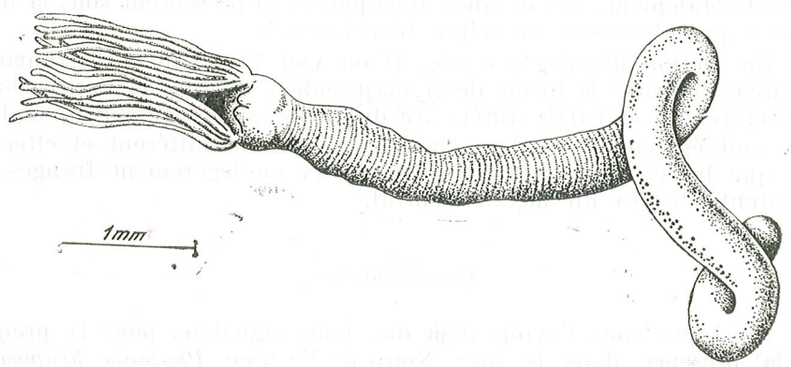

Fig. 2. — *Phoronis hippocrepia* enlevé du tube (*orig. V. Iacobescu*).

A la partie antérieure du corps il y a le lophophore, organe spécifique chez les Phoronides, qui porte une couronne de tentacules. Notre exemplaire présente 57 tentacules, par deux rangées — extérieure et intérieure — ainsi qu'on le voit dans la section histologique faite à la base des tentacules (fig. 3). Les tentacules ne sont pas tous de la même longueur ; les plus longs, 1,5 mm, se trouvent dans la rangée extérieure ou sur la partie ovale, tandis que ceux de la rangée intérieure deviennent de plus en plus courts, à mesure qu'ils se rapprochent de la ligne médiane du corps. Ils sont transparents, légèrement jaunâtres, ondulés, ciliés, plus

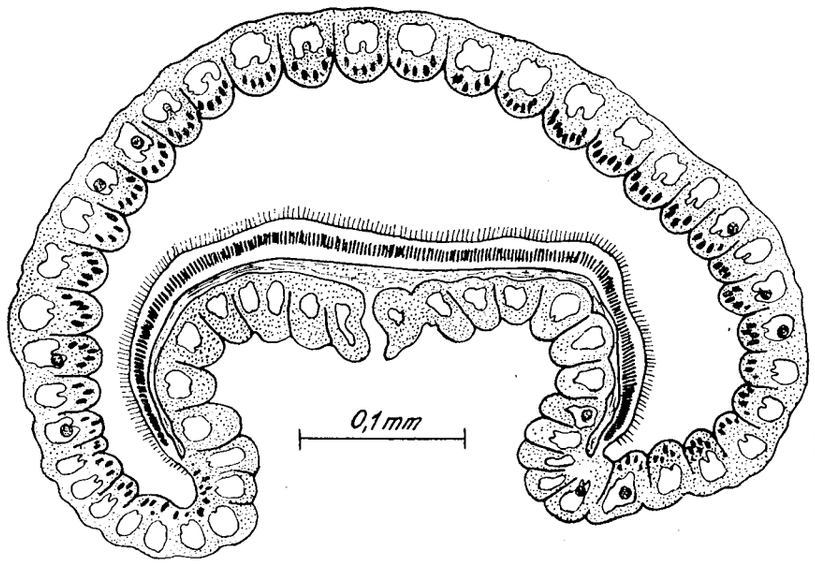

Fig. 3. — Section à la base du lophophore (*orig. V. Iacobescu*).

larges à la base et s'amincissant vers le bout. Chaque tentacule est indépendant, n'étant pas uni par sa base aux autres. Ils sont légèrement comprimés latéralement. Les organes lophophores se présentent sous la forme de deux protubérances de teinte blanchâtre.

En section histologique (fig. 4) on voit l'intestin et l'estomac (le tube digestif ayant la forme de la majuscule U), l'anus et l'orifice bucal, qui s'ouvrent à la partie antérieure du corps au niveau du lophophore. On y voit également les deux vaisseaux sanguins (afférent et efférent), ainsi que les éléments sanguins discoïdaux ou légèrement frangés, qui présentent chacun un noyau central.

CONCLUSIONS

Ainsi que nous l'avons déjà dit, nous signalons pour la première fois la présence dans la mer Noire de l'espèce *Phoronis hippocrepia* Wright.

Le fait d'avoir trouvé des Phoronides seulement dans 7 des 780 stations de la plate-forme continentale du littoral roumain prouve que l'espèce est assez rare dans nos eaux.

Phoronis hippocrepia Wright de la mer Noire est d'origine méditerranéenne, où elle à été trouvée en différents endroits. Dans les eaux du littoral roumain, les Phoronides ont été capturées entre 28 et 51 m de profondeur, tandis que dans la Méditerranée on les trouve plus près du

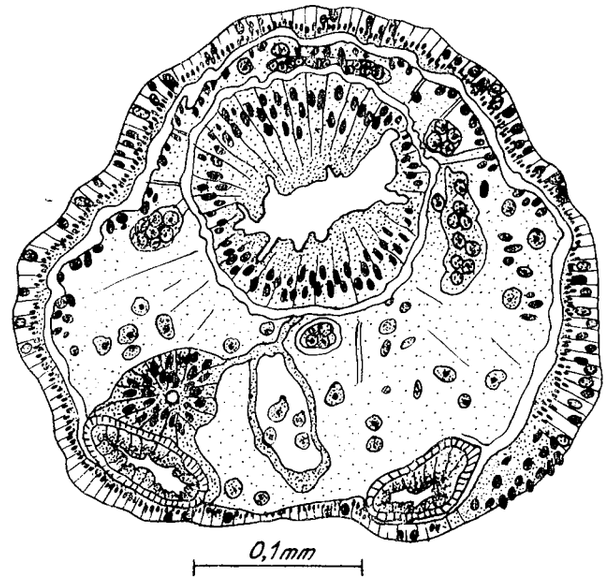

Fig. 4. — Section transversale taillée dans le corps de l'animal.
(*orig. V. Iacobescu*).

littoral. Un problème qui reste à éclaircir est celui de savoir quelles seraient les plus favorables profondeurs pour le développement de la vie de ces animaux par rapport à la latitude et aux conditions spécifiques de chaque endroit.

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CHARACTERISATION OF WORLD FRESHWATER FISH FAUNAS ACCORDING TO MAYR (1965)'S SCHEMA

BY

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The freshwater fish faunas of the main centers of differentiation of the superorder *Ostariophysi* originated through autochthonous adaptive radiation; those of narrow areas with a poorly developed river net through single-origin colonization from larger adjacent areas; those of mainlands whose autochthonous non-ostariophysean fish fauna was submerged by the more successful *Ostariophysi* through a combination of autochthonous adaptive radiation and multiple-origin colonization.

In a recent paper, E. Mayr [3] distinguished five types of faunal origin: autochthonous adaptive radiation, continued single-origin colonization, continued multiple-origin colonization, fusion of two faunas and successive adaptation; he recognized further that "the fauna of any extended area is actually a composite of all five types", but that "only recognition that such types exist will permit their analysis".

It seemed to me interesting to ascribe the freshwater fish faunas of the world to these types. But before doing it, some preliminary remarks are necessary:

1. The higher taxa common to two or more now isolated land masses (Europe and North America, Africa and South America, etc.) originated in one of these land masses and colonized later the other (s). In some such cases (e.g. that of *Percidae* and of *Characoidei*), the original fatherland can be determined (Europe for the first group, South America for the second); in other cases, such as the *Osteoglossidae* (distributed in Australia, South Asia, Africa and South America), the fatherland cannot be determined and, because these taxa are very old ones, I'll consider them autochthonous in every mainland where they occur.

2. The earlier, and even some rather recent, colonists in one fauna often differentiated in distinct, endemic taxa — genera or even families —

some of which are small or monotypic, others on the contrary very speciose. In the last case an adaptive radiation followed an older colonization.

3. Each freshwater fish fauna contains, besides representatives of primary and secondary division freshwater families (either autochthonous or colonists), a certain amount of marine immigrants belonging to peripheral families. These peripheral fishes will not be taken into consideration, except for the faunas consisting mainly or exclusively in such peripheral colonists.

4. Past events, such as the Pleistocene glaciation, destroyed most of the fauna from large areas which were formerly centers of autochtonous adaptive radiation or of single — or multiple — origin colonization. The few survivors of a formerly richer fauna constitute now a depauperated fauna.

The general classification of world freshwater fish faunas here accepted is that of the regions I proposed some eight years ago [1].

The Holarctic fish fauna, considered as a whole, is a composite of an autochthonous adaptive radiation of old Holarctic families and higher taxa (*Percidae*, *Esocoidei*, etc.) and of continued multiple-origin colonization with primary freshwater fishes (*Cyprinidae*, *Catostomidae*, *Cobitidae*, a few *Siluridae* and the ancestors of the *Ictaluridae*) from different subregions of the Oriental region. (A much less important colonization with secondary freshwater *Cyprinodontoidei* of Central American origin occurred in North America.)

Six subdivisons can be recognized within the Holarctic fish fauna.

The present fish fauna of Siberia is a depauperated one, resulting from multiple-origin colonization with East Asian fishes (*Cyprinidae* and *Cobitidae*), a few European (*Perca*, *Acerina*) and a single North American one (*Catostomus catostomus*), besides rather many marine colonists. Yet, up to the Pliocene, Siberia was an important center of adaptive radiation : here developed, from a single or a few East Asian immigrants, one very speciose carp subfamily, the *Leuciscinae*, which spread over Europe and North America ; the penetration of East Asian freshwater fishes (other subfamilies of *Cyprinidae* — *Gobioinae*, *Acheiloghathinae*, *Cyprininae*, etc.) continued during the Tertiary. The upper Pliocene primary division freshwater fish fauna of Siberia was thus mainly a continued single-origin colonization fauna, complicated by an autochthonous adaptive radiation of the offshoots of the older East Asian colonists. The amount of the European, of the eventual North American colonists and even of the peripheral fishes [1] was insignificant compared to the East Asian colonists and their offshoots.

The Baikal Lake has a continued single-origin colonization fish fauna ; all fishes inhabiting the Lake reached it from Siberia, even the peripheral ones, because the Lake has never direct connections with the sea. Both endemic families, the *Comephoridae* and *Cottocomephoridae*, originated through autochthonous adaptive radiation of the offshoots of peripheral ancestors which reach the Lake by continental route.

The very poor West Mongolian fish fauna originated through continued single-(Siberian) origin colonization.

[1] Now Siberia is dominated by the peripheral *Salmonidae*.

The European (or Euro-Mediterranean) freshwater fish fauna is complex, being a combination of autochthonous adaptive radiation and of continued multiple-origin colonization fauna. The Euro-Siberian and East-North American *Percidae*, having more basic groups in Europe than in North America, seem to be autochthonous in Europe and to have radiated from this mainland, reaching eastern North America on the one hand and Siberia on the other. There is no possibility to decide whether the Holarctic *Esocoidei* (*Esocidae* and *Umbridae*) originated in Europe, in Siberia or in North America. But the greatest bulk of the European freshwater fish fauna consists in offshoots of Asiatic taxa (*Cyprinidae*, *Cobitidae*, *Siluridae*) which reached Europe by two routes : through Siberia (many genera of *Leuciscinae*, a subfamily which evolved in Siberia from an earlier East Asian colonist [2], then East Asian genera belonging to other carp subfamilies and to loaches) and through West Asia (*Barbus*, *Varicorhinus*, and perhaps *Silurus*.) The secondary freshwater *Cyprinodontidae* probably reached Europe through the Atlantic and the Mediterranean.

Several subdivisions can be recognized within the Euro-Mediterranean freshwater fish fauna : the Central European (in the acceptance of Banarescu, [1] : Europe from the Atlantic to the Urals, south to the Pyreneans, Alps, etc.) and several Southern faunas. The Central European fauna originated through the fusion of two faunas : an autochthonous one (*Aspro*, *Romanichthys*, *Acerina* and perhaps other genera of *Percidae*) and a Siberian one (most Central European genera and even many species originated in Siberia). Several South European-Mediterranean faunas (the Iberian, Italian and West Balkan fish faunas) are continued single-origin colonization faunas, consisting exclusively in Central European colonists and their offshoots, while the other southern faunas resulted from multiple-origin colonization, consisting in European and African (the North African fish fauna) or European and West Asian colonists (the fish faunas of Anatolia, Caucasus, etc.).

The East-North American fish fauna is as complex as the European one ; it originated through autochthonous adaptive radiation of old North American groups (*Percopsiformes*, *Hyodontidae*, etc.) and multiple-origin colonization by old European immigrants (the *Percidae*) and more recent Siberian (*Cyprinidae*, *Catostomidae*) and Central American immigrants (the secondary freshwater *Cyprinodontidae* and *Poeciliidae*), besides very few South American colonists (*Characidae*, *Cichlidae*) which used the Central American route. Both European and Siberian immigrants have undergone a strong process of speciation and radiation : the *Percidae*, *Leuciscinae* and especially the *Catostomidae* are much better represented in North America than in Europe, Siberia and East Asia, although the *Percidae* and *Leuciscinae* consist in fewer basic groups.

[2] In an earlier (1960) paper, I considered [1] that *Rutilus* and *Chondrostoma*, two European genera of *Leuciscinae*, better represented in southwestern than in southeastern Europe and apparently related to some West-North American genera, spread through an old North Atlantic landbridge. But the family *Cyprinidae* originated in South-East Asia, the subfamily *Leuciscinae* in Siberia. It seems therefore more probable that both genera, as well as their West American representatives, belong to an earlier wave of Siberian immigrants, which reached West Europe on the one hand and western North America on the other and later on were replaced in Siberia and in eastern North America by more modern genera.

The poor West-North American fish fauna is a typical continued single-origin colonization one: all primary-division freshwater fishes (and even the few secondary-division *Cyprinodontidae* and *Poeciliidae*) came across the Rocky Mountains. The fact that this fauna consists in endemic genera with East American affinities, in endemic species belonging to Eastern genera as well as in a few species occurring also eastwards of the Rocky Mountains, clearly indicates that there was a continuous (repeated) colonization with eastern immigrants.

The great Sino-Indian (Oriental) freshwater fish fauna (which includes, according to my opinion, also the East-, High- and West-Asian faunas) is mainly an autochthonous adaptive radiation fauna: South-East Asia was the center of origin and radiation of the most successful primary freshwater group — the *Cyprinoidei* — and of a few other families — *Anabantidae*, *Channidae*, *Mastacembelidae*, *Chaudhuriidae*. Colonization waves with fishes of Holarctic origin reached East and West Asia and one African genus reached Syria, but no primary division freshwater fishes originating from other main faunas of the world occur in Indochina, India or Indonesia.

Four main divisions can be recognized within the Sino-Indian freshwater fish fauna: the Indo-Malayan (South Asian), the East Asian, the High Asian and the West Asian.

The Indo-Malayan primary division freshwater fish fauna originated exclusively through autochthonous adaptive radiation; yet the very few secondary division fishes (two Cichlids in South India and Ceylon, a few Cyprinodonts of the genus *Aplocheilichthys* throughout South Asia) are offshoots of western immigrants. Within the range of the Indo-Malayan fauna, one can easily recognize a center of evolution and radiation — Indochina including Burma — and peripheral regions — India and Ceylon on the one hand, Sumatra, Java and Borneo on the other — populated by a single-origin colonization fauna of Indochinese derivation. According to many palaeogeographers, including Wegener, India was formerly connected to Africa, but none of its fishes [3], except the salt tolerant Cichlids, suggest African origin.

The Philippines Islands can be attached to the Indo-Malayan subregion; the very few primary freshwater fishes living in some of these islands came from Borneo by two routes: from North-Vest Borneo through Palawan to Mindoro and from North-East Borneo through Sulu to Mindanao [2]. The primary freshwater fish faunas of both Palawan-Mindoro and Mindanao are thus independent from another, each of them having originated through single-origin colonization. A remarkable adaptive radiation occurred in Lanao Lake, Mindanao, after its colonization by Borneo immigrants.

The East Asian fish fauna is composite; it originated through adaptive radiation of several autochthonous carp subfamilies (*Gobioinae*, *Acheilognathinae*, etc.) of possible remote South Asian origin and through continued double-colonization with fishes of Holarctic (*Psephurus*, *Esox*, a few genera of *Leuciscinae*) and especially of Indochinese origin (many

[3] The single South Asian representative (*Scleropages formosus*) of the archaic *Osteoglossidae*, whose distribution suggests former direct connections between "Gondwanian" continents lives not in India, but in Southern Indochina and the Malay Archipelago.

genera of *Barbinae* and other carp subfamilies and of *Cobitidae*, then *Homalopteridae*, *Anabantidae*, many families of *Siluroidei*, etc.). The faunas of peripheral East Asian countries (Korea, Japan) originated through multiple single-origin colonization by Chinese fishes. A few endemic genera evolved in Korea and Japan, but most of them are monotypic or nearly so: no adaptive radiation occurred in these countries.

The remaining two main divisions of the Sino-Indian fish fauna, both inhabiting arid countries, are typical multiple-origin colonization faunas. The High Asian consists in very few basic groups: the carp subfamily *Schizothoracinae*, the sisorid catfish genus *Glyptosternum* of South Asian origin and many *Noemacheilin* loaches, apparently more closely related to the Chinese than to the South-Asian ones. The double-origin colonization of High Asia with fishes was followed by an active process of adaptive radiation of *Schizothoracinae* and *Noemacheilinae*.

Among the West Asian freshwater fishes one can distinguish genera and species of South Asian origin (many *Barbinae* and other carps, many *Noemacheilin* loaches, then catfishes and even *Mastacembelidae*), of Holarctic, respectively European origin (several genera of *Leuciscinae*, some of them endemic, a few *Cobitis* — this genus has East Asian origin but reached West Asia through Siberia and Europe — and probably one or two *Noemacheilin* loaches) and even of African origin (a few *Cichlidae* and probably a *Clarias*). The fish fauna of West Asia has much more basic groups than that of High Asia but the process of adaptive radiation was much feebler. This fauna is to a certain degree a depauperate one: many genera whose present range is discontinuous — Tropical Asia and Africa — lived, up to the earlier Pleistocene or even to the last Pluvial Age, also in West Asia. A few fishes with quite restricted range — *Barilius mesopotamicus*, recorded but once from the Tigris drainage and the recently described *Cyclocheilichthys kosswigi* from Anatolia — are relicts from the formerly much richer tropical fauna of these countries.

The origin of the African primary freshwater fish fauna is as complex as that of Europe and eastern North America, resulting from the combination of an autochthonous adaptive radiation of several archaic endemic families (many monotypic, only the *Mormyridae* being speciose) and two colonization waves: an older South American one (the *Characidae* and probably the ancestors of the present endemic African families of catfishes) and a more recent Tropical Asiatic one (*Cyprinidae*, *Mastacembelidae*, *Anabantidae*, etc. and probably *Clariidae* and *Schilbeidae* too). Both colonization waves reached Africa only once; there was no "continued multiple-origin colonization", but rather "successive opposite colonizations". Both groups of immigrants, especially the Asiatic one, have undergone an active process of speciation and even of adaptive radiation.

The primary division freshwater fish fauna of South America originated exclusively through autochthonous adaptive radiation of two groups of *Ostariophysi*: the *Characoidei* (with their derivates, the *Gymnotoidei*) and many families of *Siluroidei*. No primary freshwater fishes originating from other mainlands ever reached South America, except perhaps the archaic *Lepidosirenidae*, *Osteoglossidae* and *Nandidae*, common to South America with Africa and even with South Asia, but whose origin cannot be determined. The only fishes which reached South America from other

lands are the salt-tolerant secondary division *Cyprinodontoidei* (*Cyprinodontidae* and *Poeciliidae*) of Central American origin.

One can distinguish, within the South American fish fauna, several subdivisions : a central one, inhabiting the Amazon, Orinoco, La Plata and other Brasilian drainages such as Rio São Francisco, and three much poorer peripheral faunas : one in the Pacific drainage of Colombia, Ecuador and Northern Peru, one in Southern Peru and Chile, the third in the Atlantic drainage of Argentina south of La Plata. These three faunas are single-origin colonization faunas, all their primary freshwater fishes being derivates of the Amazonian fauna. A rather large amount of peripheral (marine) fishes occurs in the South Peru-Chilean and in the South Argentina faunas.

Central America is a transition zone and cannot be considered an ichthiological "region" comparable to the Holarctic, Sino-Indian, African or South American regions; nevertheless, its fish fauna, which was thoroughly analysed by Miller [4] and Myers [5] deserves a special attention. Central America was the center of evolution and radiation of the most important group of secondary freshwater fishes, the *Cyprinodontoidei*, and was colonized rather recently by North American as well as by South American immigrants, while the amount of peripheral fishes is higher than in any continental fish fauna. The Central American freshwater fish fauna has thus a composite origin : autochthonous adaptive radiation and continued multiple-origin colonization. This fauna can be considered also as having originated through fusion of three faunas.

The remaining four freshwater fish faunas consist mainly or exclusively in marine derivates. The most complex of these is that of Australia (including also Tasmania, New Guinea and a few adjacent islands). In Australia live also two primary freshwater fishes common to other continents, *Neoceratodus* and *Scleropages*, but the latter may have reached Australia across the sea. One family, the *Melatotaeniidae*, is restricted to the freshwaters of the Australian Region and can be considered a primary freshwater family having evolved in Australia independently of other freshwater families [4]. The *Melanotaeniidae* are the only speciose Australian freshwater family. The freshwater fish fauna of Australia originated thus through single-origin colonization of an archaic primary division family, through adaptive radiation of an autochthonous family and through continued multiple-origin colonization by peripheral fishes.

The Madagassian, New Zealand and East Indonesian-Polynesian (or Indo-West Pacific [5]) freshwater fish faunas consist exclusively in marine derivates; even the few secondary division freshwater fishes (a few Cychlids and *Cyprinodontoidei* in Madagascar, a few other *Cyprinodontoidei*, including the endemic *Adrianichthyidae* in Celebes) arrived across the sea. Within the New Zealand freshwater fish fauna one can distinguish between fishes of tropical and of south-temperate origin (continued multiple-origin colonization) while all fishes inhabiting the freshwaters of Madagascar and East-Indonesia-Polynesia derived from the adjacent tropical seas (single-origin colonization).

[4] This affirmation is not a paradox, since also other freshwater families of the primary division, such as *Percidae*, *Centrarchidae*, etc. derived from marine ancestors and have nothing to do, phyllogenetically, with orders consisting exclusively in freshwater families.

[5] This term designates a marine fauna but was introduced also for the freshwater fish fauna of East Indonesia and Polynesia by Banarescu [1].

GENERAL CONCLUSIONS

Two large freshwater fish faunas originated through autochthonous adaptive radiation : the South American and the South Asian. Both countries represent the differentiation and radiation centers of the suborders of *Ostariophysi*, the most successful freshwater fishes. The fish faunas of narrow areas closer to larger areas (western North America, South Europe, etc.) and of continental islands (Japan, West Indonesia) originated through single-origin colonization. A double-origin colonization occurred mainly in special situations, when an area was accessible to two distinct branches of the same large fauna (e.g. in High Asia). A combination of autochthonous adaptive radiation and of multiple-origin colonization occurred in mainlands whose autochthonous (non-Ostariophysean) fish fauna was submerged by the more successful and agressive *Ostariophysi* : first of all Africa and North America, then Europe, Siberia (especially if we consider the Siberian fauna prior to the Ice Age) and Central America (whose autochthonous freshwater fish fauna consists in the secondary division *Cyprinodontoidei*).

This agrees with Darlington [2]'s general schema of evolution of world freshwater fish faunas : zonation of non-*Ostariophysi* and radiation of *Ostariophysi*, then evolution of higher and successful taxa in large areas and in tropics (especially Old World tropics) followed by their dispersal in the temperate zone. We remark also that both evolution centers of the *Ostariophysi* (South-East Asia and northern South America) correspond to the "pendulation poles", according to the old theory of Reibisch and Simroth [6].

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L'OVOGENÈSE CHEZ LES POISSONS *ACIPENSERIDAE*. LA FORMATION ET LE RÔLE DE LA ZONE RADIÉE

PAR

MARIA CALOIANU-IORDĂCHEL

The study of the membranes of ovocytes in great sturgeon and sterlet, during ovogenesis permitted the emphasizing of formation and development characteristics of the radiated zone in sturgeons, comparatively with other groups of lower vertebrates. The existence of an appended membrane, outside the radiated zone, resulted as a product of the follicular cells, was rendered likewise evident.

L'étude des membranes des œufs chez les poissons a mené à différentes interprétations quant à leur origine et développement. Aux opinions plus anciennes [23], [6], [15], etc., suivant lesquelles la zone radiée a une origine ovocytaire, les recherches plus récentes [3], [4], ont opposé l'idée que, partiellement ou entièrement, celle-ci est formée par de cellules folliculaires. Ivanov [8] considère, au contraire, que la zone radiée est de nature ovocytaire, mais que ses canalicules sont traversés par les expansions des cellules folliculaires. Sterba [22], Arndt [2] et Stahl et Leray [18], maintiennent l'idée de l'origine exclusive ovocytaire de la zone radiée chez les téléostéens.

Des études récentes effectuées au microscope électronique ont démontré que chez les amphibiens, la zone radiée est traversée également par les expansions des cellules folliculaires et par les microvillosités parties de la surface de l'ovocyte [9], [23]. Des prolongements similaires envoient les cellues folliculaires jusqu'à la surface de l'ovocyte aussi chez les mamifères [14], [20], etc.

Le matériel amorphe qui forme la zone pellucide est, d'après l'opinion de la plupart des auteurs, le produit des cellules folliculaires.

De nombreuses recherches sur les esturgeons, effectuées pour établir et caractériser les étapes du développement et de la maturation des ovocytes [7], [5], [10—13], [19], etc., contiennent des références aux membranes de l'ovocyte. Le problème de la formation et de l'origine de la zone

REV. ROUM. BIOL.—ZOOLOGIE, TOME 14, Nº 1, p. 17–21, BUCAREST, 1969

radiée chez les *Acipenseridae* n'a pourtant pas été abordé, fait qui nous a déterminé d'effectuer la présente étude.

MATÉRIEL ET MÉTHODE DE TRAVAIL

Les recherches ont été effectuées sur des exemplaires de sterlet (*Acipenser ruthenus ruthenus* L.), espèce d'eau douce et rhéophile, et de morue (*Huso huso* L.), espèce marine anadrome, pêchés durant les années 1965—1967, dans la zone des Portes de Fer, de Brăila et du bras Sfîntu-Gheorghe, à partir du mois de mars jusqu'au mois de novembre. Les dimensions des exemplaires analysés ont varié chez le sterlet entre 35—65 cm (longueur absolue) et le poids entre 335—2800 g, et chez la morue entre 180—250 cm et le poids entre 89—170 kg. Les œufs ont été donc prélevés des exemplaires adultes et pendant deux cycles annuels, ce qui nous a assuré un riche matériel.

Les échantillons de gonades prélevés à différents stades de maturation ont été fixés dans du Bouin, du formol neutre 10%, du Carnoy et du Sussa. La coloration des coupes a été exécutée avec de l'hématoxyline ferrique et de l'Azan, d'après Heidenhain, et la coloration Masson. Une série de réactions histochimiques ont été pareillement appliquées : réaction PAS d'après Lillie, vert méthyle-pyronine d'après Brachet et Feulgen, d'après Feulgen et Rosenbeck.

RÉSULTATS

Chez le sterlet et la morue, comme d'ailleurs chez toutes les espèces d'esturgeons, l'ovaire est exempt de cavité interne et présente plusieurs loges à lamelles disposées perpendiculairement sur son axe longitudinal. Chez les exemplaires jeunes ainsi que chez les adultes, dans un stade précoce du développement de la gonade, ces lamelles contiennent de jeunes ovogonies et ovocytes (pl. I, fig. I), qui d'après Moltchianova [8] et Chilov [12] sont définies comme des éléments caractéristiques du second stad e de maturation, ou du stade B, d'après Meien [7].

Aucune des méthodes de coloration n'a mis en évidence la présence de quelque membrane différenciée à la périphérie du très jeune ovocyte. Le cytoplasme des ovocytes légèrement granulaire et coloré en rose avec Azan, est limité à l'extérieur par une fine raie de la même couleur. Ceci représente, d'après nous, la membrane plasmatique de la cellule sexuelle qui ne peut faire ressortir la structure spécifique qu'au niveau du microscope électronique [6], [17].

Simultanément aux modifications du noyau caractéristiques à la prophase méïotique, apparaissent autour de l'ovocyte les premières cellules folliculaires (pl. I, fig. 2). Avec de grands noyaux ovales et riches en matériel chromatique, la réaction de Feulgen positive (pl. I, fig. 3), ces cellules deviennent plus nombreuses et à la fin du stade diplotène de la prophase méïotique de l'ovocyte, elles constituent une membrane folliculaire évidente. Entre les cellules folliculaires et la surface de l'ovocyte on remarque la présence d'une raie, d'une membrane fine, PAS positive. A l'extérieur

des cellules folliculaires se forme une seconde couche homogène, PAS positive, plus développée. Celle-ci limite les cellules folliculaires, du tissu conjonctif environnant (pl. I, fig. 4 ; pl. II, fig. 5), riche en vaisseaux sanguins.

A l'encontre des poissons osseux où la région périphérique du cytoplasme de l'ovocyte forme des stries radiaires [2], [18], chez les esturgeons elle continue de garder un aspect homogène (pl. II, fig. 5, 6). Même après la fixation dans du Bouin, aucune modification n'apparaît. Graduellement, les cellules folliculaires poussent en hauteur, les noyaux devenant presque ronds (pl. II, fig. 6) et présentent un contenu riche en ARN et ADN. Cet aspect reflète un processus métabolique intense à la surface de l'ovocyte, mais au-dessous de la membrane PAS positive — nommée par Stahl et Leray [18], membrane basale — et au-dessous de la couche folliculaire, se forme une zone légèrement striée radiairement (pl. II, fig. 5). Simultanément, dans l'ovocyte, le processus de migration des nucléoles dans le cytoplasme continue, la première zone de vacuoles corticales paraît, ainsi que des granules pigmentaires. Toutes ces caractéristiques de la structure de l'ovocyte marquent le commencement du IV^e stade de maturation (ou E), le début de la période de croissance vitellogénétique.

Nous soulignons qu'il n'est pas correct de considérer le début de cette période, chez les esturgeons, seulement après l'apparition d'une zone de vitellus. De même, il ne faut pas parler que du vitellus. De études histochimiques ont prouvé qu'il s'agit de dépôts lipoprotéiques [21], ou même glyco-lipoprotéiques complexes [1], [24].

Tout comme chez les téléostéens (Yamamoto), chez les esturgeons la zone radiée est fortement PAS positive au début de sa formation. Mais à mesure qu'elle devient plus épaisse, l'intensité de la réaction diminue pour devenir négative à la fin de la vitellogenèse.

La croissance en épaisseur de la zone radiée chez les esturgeons ne se fait pas sous la membrane limitative PAS positive, comme elle a été décrite chez les téléostéens par Sterba [22], Arndt [2] et Stahl et Leray [18]. D'après l'aspect des coupes histologiques (pl. II, fig. 7), entre les microvillies, qui paraissent ici comme de fines stries, émises par la surface de l'ovocyte et les cellules folliculaires il n'y a pas de membrane bien délimitée qui les sépare. On ne distingue qu'une différence en ce qui concerne la densité des stries qui est plus grande dans la portion inférieure de la zone radiée. D'après nous, ici se produit un processus similaire à la formation de la zone radiée chez le crapaud et le triton [23], où les microvillosités de l'ovocyte viennent en contact avec les prolongements émis par les cellules folliculaires. Dans ce cas la membrane PAS positive, située à la limite d'une surface de contact tellement variée, devient difficilement observable au microscope optique.

Vers la fin de la période de vitellogenèse (la fin du IV^e stade de maturation) l'aspect de la zone radiée devient de nouveau homogène. Les expansions du cytoplasme de l'ovocyte persistent encore pour peu de temps dans la portion inférieure de la zone radiée (pl. III, fig. 10), après quoi elles se retirent complètement (pl. III, fig. 11). En même temps la zone radiée se sépare longitudinalement en deux couches (membranes) similaires.

Simultanément avec ces transformation de la zone radiée, entre l'épithélium folliculaire et la membrane radiée, apparaît une nouvelle membrane (pl. II, fig. 8). A l'encontre de la zone radiée qui se colore en rose avec l'Azan, et qui, même à ce stade de développement est aussi PAS négative, cette nouvelle membrane se colore intensément en bleu et est PAS positive. Au stade de son développement définitif, l'épaisseur de cette membrane dépasse celle de la zone radiée.

Arrivé à maturité et apte à féconder, l'ovocyte présente toutes ces membranes à son extérieur (pl. III, fig. 12). Dans le cytoplasme de la zone du pôle animal sont incluses des lacunes intensément colorées en bleu avec Azan, qui libéreront le contenu sous la membrane. Ce caractère distingue les esturgeons des poissons osseux chez qui la substance décrite est répartie sur toute la surface de l'œuf. Ghinsburg et Detlaf [4], étudiant le phénomène de la fécondation et du développement de l'embryon chez *Acipenser stellatus* et autres esturgeons, mentionnent la même répartition et considèrent que cette substance renforce la résistance des membranes.

DISCUSSIONS

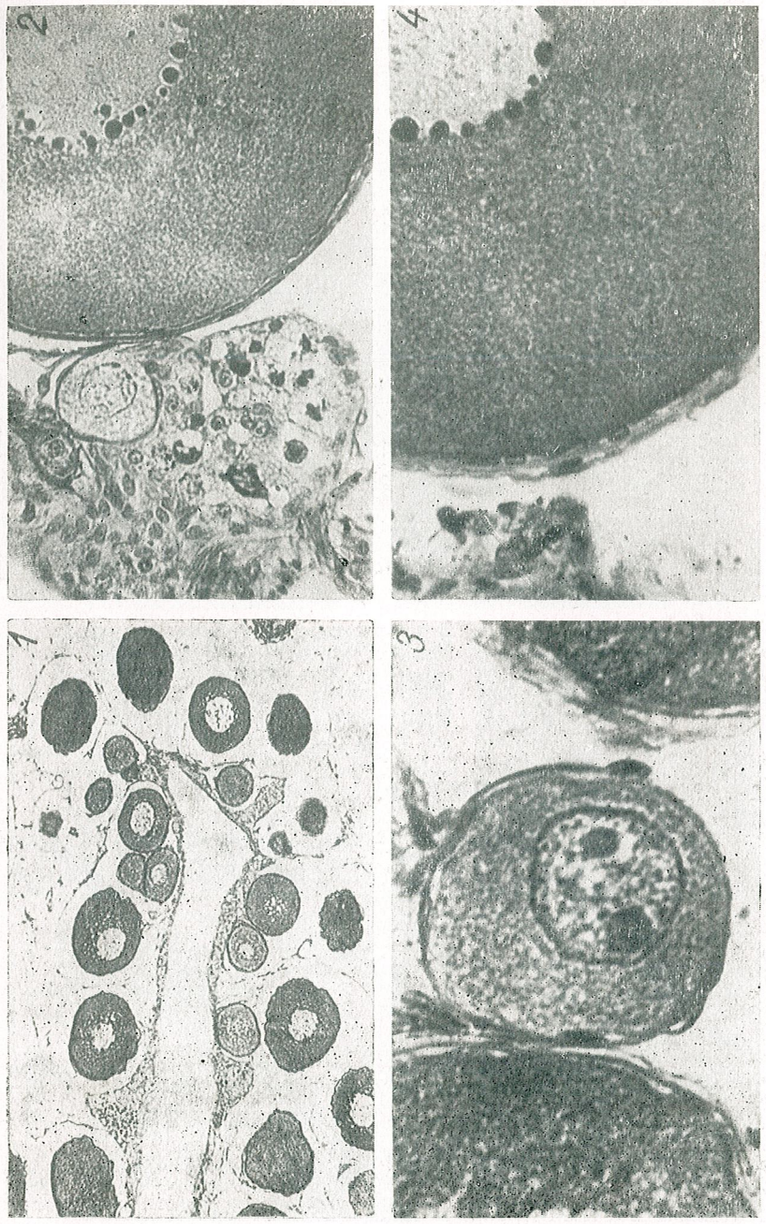
Comparant les données résultées de l'étude des membranes dans les étapes successives de l'ovogenèse chez les esturgeons, avec celles qui existent dans la littérature sur d'autres groupes de vertébrés, l'interprétation du développement et de l'origine de la membrane radiée et de ses annexes, s'impose sous un nouvel angle.

La membrane PAS positive située entre la couche des cellules folliculaires et la surface de l'ovocyte et qui a été nommée par Arndt [2] et Sterba [22], membrane primaire de l'ovocyte ou membrane basale par Stahl et Leray [18] paraît d'une manière évidente aussi chez les esturgeons. Mais, contrairement aux descriptions des téléostéens, ceci ne marque pas une limite permanente entre les radiations (expansions) du cytoplasme de l'ovocyte et les cellules folliculaires. Le rôle fonctionnel de cette membrane selon Yamamoto, est inconnu. D'après Stahl et Leray [18], dû à son contenu glycoprotéique et à sa position dans la zone où les échanges de substances sont les plus actifs, surtout dans la période de la vitellogenèse, cette membrane a un rôle dans le processus de perméabilité sélective, en rapport avec les cellules folliculaires.

Le problème de l'origine de la zone radiée chez les esturgeons est également difficile. A l'encontre des poissons osseux chez lesquels la zone radiée est d'origine strictement ovocytaire [2], [22], [18], et ne se développe que sous la membrane PAS positive, chez les esturgeons elle paraît se développer d'une manière similaire au processus décrit par Wartenberg [23] chez les amphibiens. Dans ce cas, son origine ne peut pas être considérée seulement ovocytaire. Nous soulignons que ce problème ne peut être élucidé que par des recherches au microscope électronique.

Caractéristique pour les *Acipenseridae* est aussi le fait que chez les ovocytes adultes, la zone radiée, devenue homogène comme aspect, devient

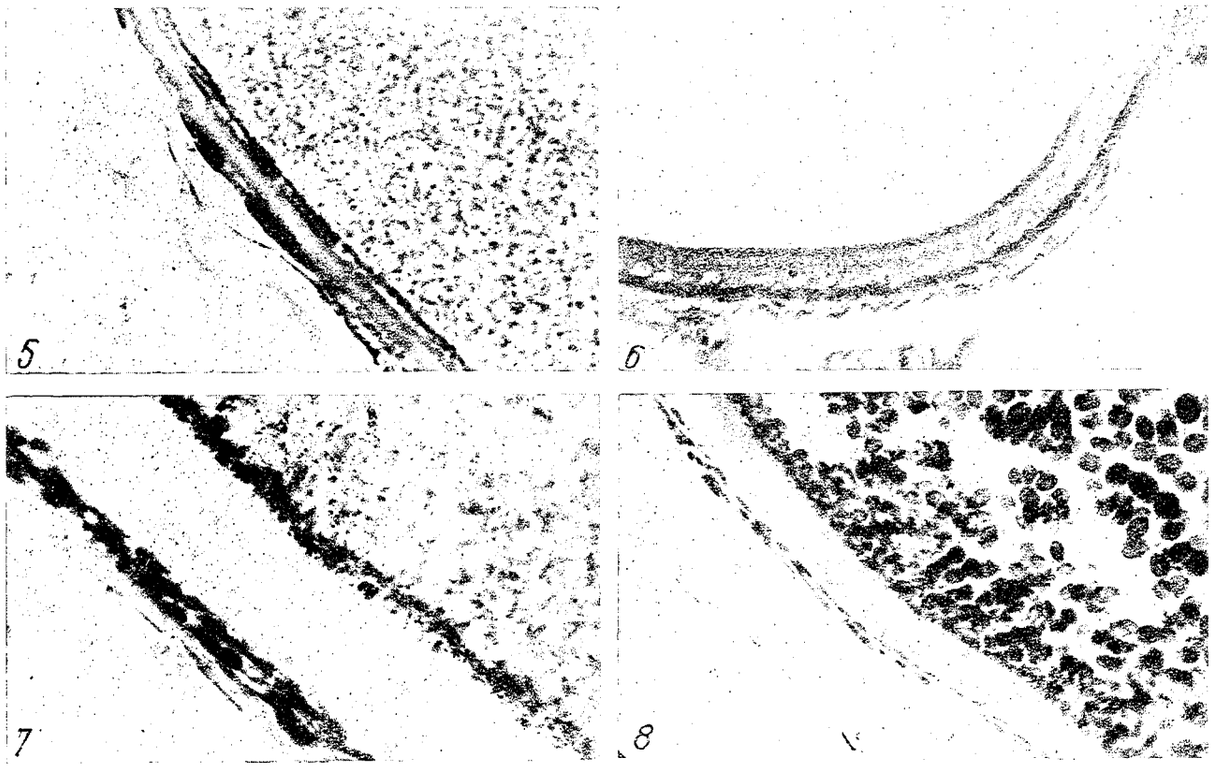
PLANCHE I



Aspect de la gonade et structure des membranes de l'ovocyte dans la période de croissance vitellogénétique, chez le sterlet (Brăila, juin 1966, L = 41 cm ; poids 385 g).

Fig. 1. – Bouin, Azan, oc. 8, ob. 6,3. Fig. 2. – Bouin, Azan, oc. 10, ob. 25. Fig. 3. – Bouin, H.E.V., oc. 8, immersion. Fig. 4. – Bouin, Azan, oc. 10, ob. 40.

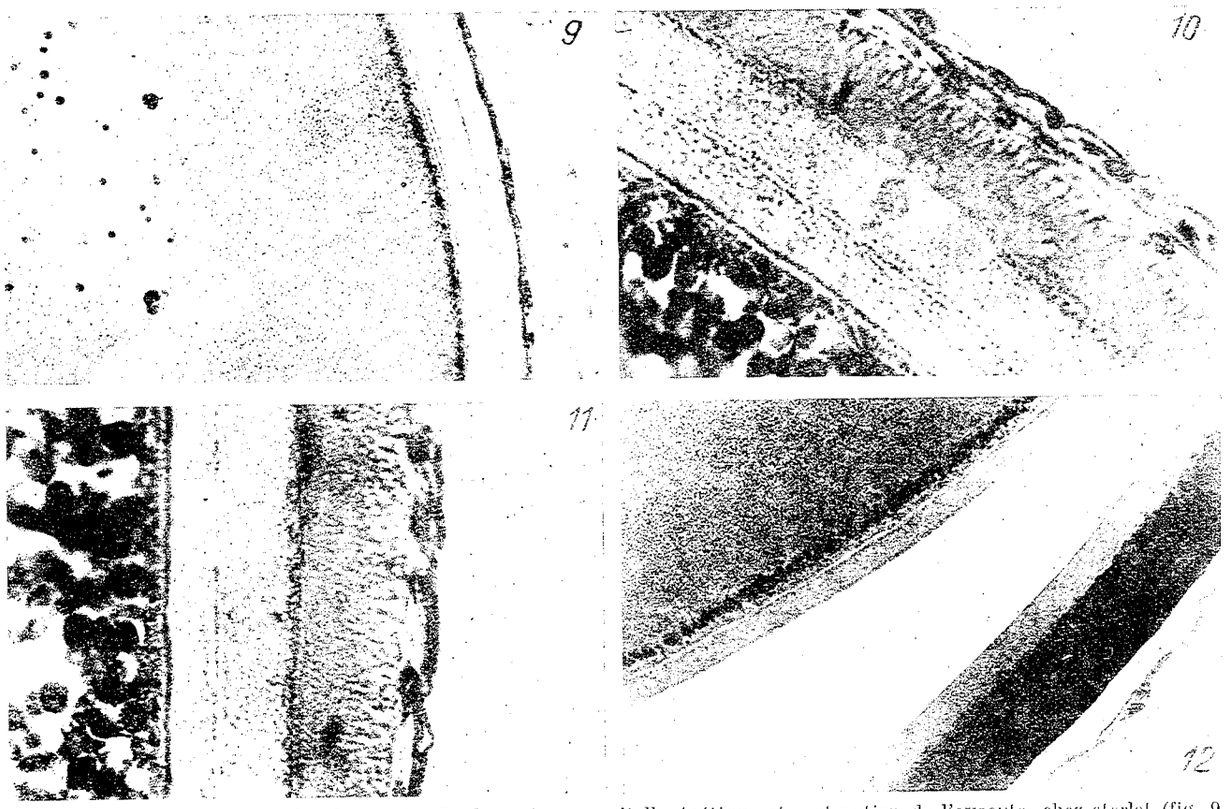
PLANCHE II



Aspect de l'enveloppe de l'ovocyte pendant la croissance vitellogénétique, chez le sterlet.

Fig. 5. — Portes-de-Fer, avril 1966. L = 48,7 cm ; 510 g. Bouin, Azan, oc. 6, immersion. Fig. 6. — Bras Borcea, km 26, juillet 1965. L = 42 cm, 340 g. Bouin, Azan, oc. 6 immersion. Fig. 7. — Bras Borcea, septembre 1965, L = 44 cm, 355 g. Carnoy, V.M.P., oc. 6, immersion. Fig. 8. — Bras Borcea, février 1966, L = 80 cm, 2900 g, Bouin, Azan, oc. 10, ob. 25.

PLANCHE III



Aspect des membranes à la fin de la période de croissance vitellogénétique et maturation de l'ovocyte, chez sterlet (fig. 9, 10, 11) et chez la morue (fig. 12).

Fig. 9. — Portes-de-Fer, avril 1967, L = 52 cm, 750 g. Bouin, Azan, oc. 6, ob. 25. Fig. 10. — Bras Borcea, mars 1966, L = 46 cm, 480 g. Bouin, H.E.V., oc. 6, immersion. Fig. 11. — Le même exemplaire. Bouin, Azan, oc. 6, immersion. Fig. 12. — Sfintu Gheorghe, avril, 1966, L = 280 cm, 172 kg. Azan, oc. 10, ob. 40

double, formant deux membranes dont le rôle sera, en continuation, de protection.

Comme produit seulement des cellules folliculaires, une membrane fortement PAS positive se forme à la surface de la zone radiée et au-dessous de l'épithélium folliculaire.

CONCLUSIONS

1. La surface de l'ovocyte est séparée des cellules folliculaires par une membrane limitative, PAS positive, qui chez les esturgeons n'est pas visible pendant toutes les phases du développement. L'origine et le rôle de cette membrane, considérée par quelques auteurs comme une membrane primaire de l'ovocyte, doivent être revus.

2. Différant des téléostéens, chez les esturgeons la zone radiée se forme avec la participation de l'ovocyte ainsi que des cellules folliculaires.

3. Chez l'ovocyte adulte, la zone radiée est doublée acquérant un aspect amorphe et est PAS négative.

4. A l'extérieur de la zone radiée et comme produit des cellules folliculaires, une nouvelle membrane annexe, intensément PAS positive, se forme entre l'épithélium folliculaire et la membrane radiée.

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REVISION AND REDEFINITION OF THE GENUS *ABLEPHARUS* LICHTENSTEIN, 1823 (*REPTILIA*, *SCINCIDAE*)

BY

ION E. FUHN

The genus *Ablepharus* Lichtenstein, 1823 is restricted including only the Eurasiatic species *bivittatus*, *deserti*, *kitaibelii* and *pannonicus*. A new diagnosis of *Ablepharus* is given, based mainly upon the osteology of the skull. The differences in comparison with the genera *Cryptoblepharus*, *Panaspis*, *Morethia*, *Lerista* — previously considered as congeneric to *Ablepharus* — are emphazised. The systematic revision of *Ablepharus* results in the following new arrangement: *A. b. bivittatus*, *A. b. lindbergi*, *A. b. alaicus*, *A. deserti*, *A. kitaibelii fitzingeri*, *A. k. kitaibelii*, *A. k. stepaneki*, *A. k. fabichi*, *A.k. chernovi*, *A. p. pannonicus*, *A. p. grayanus*.

In an earlier paper (Fuhn, 1969), we discussed and developed the conception advanced first by Smith (1935, 1937) and followed by Parker (1936) and De Witte (1936), that the genus *Ablepharus* Lichtenstein, 1823, including some 32 species, is but an artificial assemblage of polyphyletic origin.

We consider here the genus *Ablepharus* in a restricted extension including but the Eurasiatic species. In Boulenger's conception of that genus some 8 generic levels were lumped together. His diagnosis of the genus (1887) was built upon two characters: "palatine and pterygoid bones in contact mesially" and "no movable eyelids, a transparent disc covering the eye". We are now aware that the osteological character fits to many other genera of *Lygosominae* and the transparent disc shows a series of developmental steps within several genera, being an example of convergence or rather of parallel evolution.

In the actual stage of our knowledge, it is difficult to make definitive statements about the generic affinities of the species artificially included in *Ablepharus*, which most probably should be ascribed to other *Lygosominae* genera.

REV. ROUM. BIOL.—ZOOLOGIE, TOME 14, Nº 1, p. 23—41, BUCAREST, 1969

The osteology of the skull in the Asiatic ablepharine skinks enables us to consider all these species as congeneric. The generotype of *Ablepharus* Lichtenstein, 1823 being *pannonicus* Lichtenstein, 1823, the species *bivittatus*, *deserti*, *kitaibellii* and *pannonicus* belong therefore to *Ablepharus*, restricted in that sense.

Following diagnoses of the genus *Ablepharus* were in use :

1887 G. A. Boulenger : "Palatine and pterygoid bones in contact mesially, the palatal notch not extending forwards to between the centre of the eyes ; pterygoids toothless... No movable eyelids, a transparent disc covering the eye. Ear distinct or hidden. Nostril pierced in the nasal ; supranasal present or absent. Limbs more or less developed". (Cat. Liz. Br. Mus., III : 344)

1935 M. A. Smith : "Palatine and pterygoid bones in contact mesially, the palatal notch not extending forwards to between the centre of the eyes ; pterygoids toothless... Lower eyelid with a large transparent disc, immovable, more or less completely united with the upper. Ear distinct or hidden. Nostril pierced in the nasal ; supranasal present or absent. Scales smooth. Limbs more or less developed, digits 5.5 or reduced in number". (Faun. Brit. Ind. Rept. Amph. II, Sauria : 309).

1952 M. B. Mittleman : "Eyelids immovable, a transparent disc covering the entire eye ; supranasals present or absent ; frontoparietal single or paired, but always distinct from the interparietal ; ear opening absent or if present, quite small ; limbs short but well developed ; digits 5—5 or less ; general habitus lacertiform". (Smiths. Misc. Coll., *117*, 17 : 14).

Our redefinition of *Ablepharus* is based upon combined osteologic and external characters, which differentiate the species maintained in this genus from the many other species considered usually as congeneric.

The most important characters of the 8 generic levels lumped usually together under the genus *Ablepharus* are shown in table 1. It is probable that the Australian *Morethia*, *Menetia* and the *tenuis*-group of species should be congeneric.

Ablepharus (new diagnosis). *Supranasals absent, no movable eyelids, a transparent disc covering the eye* ; *pentadactyle, no posterior projecting process of the palatines separating the pterygoids* ; *palatine processes of the pterygoids not meeting* ; *no recurved process of the pterygoids*.

Consequently, following species of skinks with "ablepharine" eyes were removed from the genus *Ablepharus* and ascribed to different genera as follows :

1. *Cryptoblepharus*, grouping the large *boutonii* — Rassenkreis, differs from *Ablepharus* by having a posterior projecting process of the palatines, by its very long snout, the prefrontals in medial contact, the small frontal, the absence of the interparietal (excepting the subspecies *egeriae*). Many othre features of the lepidosis, the colour-pattern and the biology of *C. boutonii* suggest a different generic level, apparented with *Emoia*.

2. *Panaspis*, including an African group of "ablepharine" skinks, differs in having a very peculiar recurved process of the pterygoids and also a posterior projecting process of the palatines.

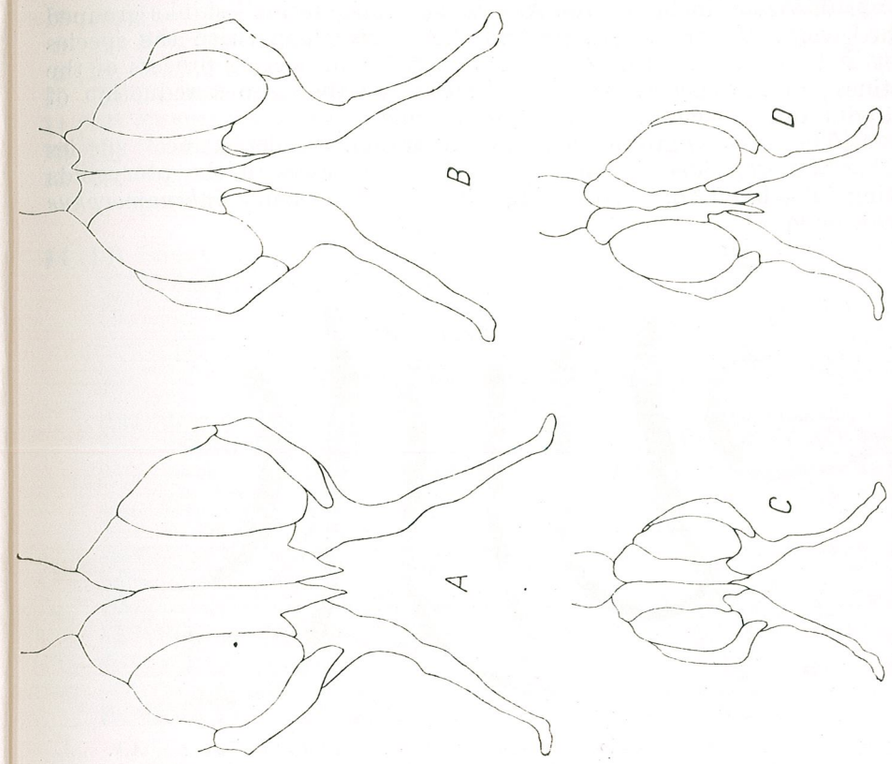


Fig. 2. — Ventral view of the palate of *A*, *Cryptoblepharus boutonii poecilopleurus* (AMNH 29127), New Hebrides, Suwarro ; *B*, *Morethia lineoocellata* WAM R 16895) ; *C*, *Menetia grevi* (WAM R 25348) ; *D*, *"Ablepharus" reginae* (WAM R 29040), Barrow Island, W.A.

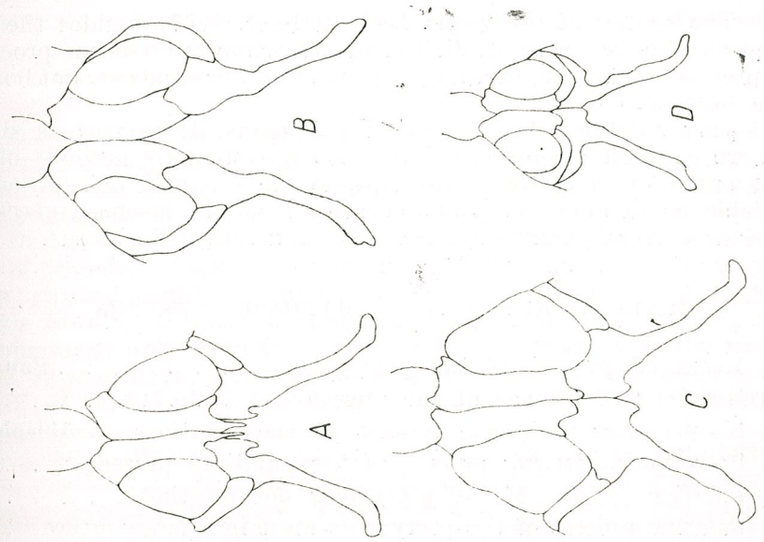


Fig. 1. — Ventral view of the palate of *A*, *Panaspis cabindae* (MCZ) ; *B*, *Ablepharus kitaibelii stepaneki* (IBTS, Bucharest) ; *C*, *Ablepharus wolfjulum* (WAM R 29032), Barrow Island W.A. ; *D*, *Lerista elegans* (WAM R 14498) Wembley near Perth.

3. *Morethia*, including the Australian "ablepharine" skinks grouped in the genera *Morethia*, *Menetia* and the *tenuis*-group (with the species *tenuis* and *reginae*) have in common a posterior projecting process of the palatines; in the species *greyi* and *burnetti* we find also a reduction of the digits and a peculiar lepidosis of the pileus.

4. The *ornatus*-group includes Australian "ablepharine" species (*ornatus* and *wotjulum*) having the palatine processes of the pterygoids meeting in a large suture, showing affinities with some *Sphenomorphus* species.

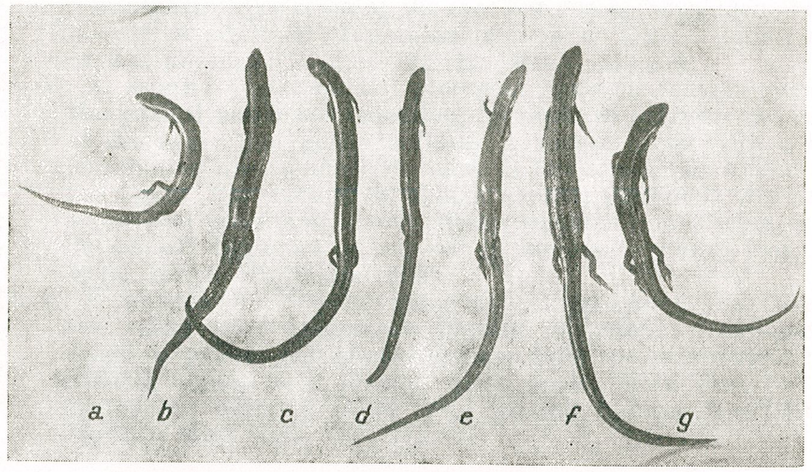


Fig. 3. — *a*, *Ablepharus pannonicus grayanus*; *b*, *A. kitaibelii stepaneki*; *c*, *A.k. chernovi*; *d*, *A.p. pannonicus*; *e*, *A. deserti*; *f*, *A.b. bivittatus*; *g*, *A. b. alaicus*

5. The species of the genus *Lerista* (Greer, 1967), besides the pronounced trend of reduction of digits and toes, have the palatine processes of the pterygoids meeting in a large suture; the pterygoids are not bordering the suborbital fossa.

Having redefined and restricted the genus *Ablepharus* as shown before, we consider as useful to give also a systematic account of the species, as most of the original descriptions are scattered in more or less unavailable publications and, on the other hand, it has been necessary to undertake several changes in the specific and subspecific status.

TENTATIVE KEY OF THE "ABLEPHARINE" GENERA

1 (2) Recurved process of the pterygoids . . . . . **Panaspis**
2 (1) No recurved process of the pterygoids **3**
3 (4) No posterior projecting process of the palatines . . **Ablepharus**
4 (3) Posterior projecting process of the palatines present **5**
5 (6) Palatine process of the pterygoids not meeting **9**
6 (5) Palatine process of the pterygoids meet in a large suture. . . **7**

7 (8) Pterygoids bordering the suborbital fossa . . . **ornatus**-group
8 (7) Pterygoids not bordering the suborbital fossa . . . . **Lerista**
9 (10) Reduction of the digits (tetradactyle) . . . . . **Menetia**
10 (9) No reduction of the digits (pentadactyle) **11**
11 (12) Supranasals absent **13**
12 (13) Supranasals mostly present . . . . . **Morethia**
13 (14) Snout very long, 3 enlarged scales in the periocular circle, interparietal mostly fused with the single frontoparietal . . . . . **Cryptoblepharus**
14 (13) Snout short, no enlarged scales in the periocular circle, paired frontoparietals, interparietal distinct . . . . . **tenuis**-group

SYSTEMATIC ACCOUNT

Ablepharus Lichtenstein

1823 *Ablepharus* Lichtenstein, Verz. Doubl. zool. Mus. Berlin: 103. — Species typica: *Ablepharus pannonicus* Lichtenstein; 1824 Fitzinger, Verh. Ges. naturf. Freunde Berlin *1*: 297, table 14. — Species typica: *A. pannonicus* Fitzinger (= *A. kitaibelii*); 1845 Gray, Cat. Liz.: 63; 1868, Strauch, part., Mel. Biol. Acad. St. Petersb. 6: 553; 1887 Boulenger, Cat. Liz. Brit. Mus. *3*: 344;

1843 *Microblepharis* Fitzinger, Syst. Rept.: 23. — Species typica: *Ablepharus menestriesii* Duméril & Bibron

1872 *Blepharosteres* Stoliczka, Proc. Asiatic Soc. Bengal: 74. — Species typica: *B grayanus* Stoliczka.

Ablepharus bivittatus bivittatus (Ménétriès, 1832)

(Figs 4 and 5)

1832 *Scincus bivittatus* Catal. raisonn. zool. 64, no.218
1839 *Ablepharus Ménétrièsii* Duméril & Bibron, Erpét. géner. *5*: 811
1844 *Ablepharus bivittatus* Gray, Catal. Liz.: 64; 1887 Boulenger Cat. Liz. Brit. Mus. *3*: 353
Type locality: Perimbal, Talysh
Holotype: ?

Diagnosis. 22—25 scales round the midbody; palpebral circle complete, with 3 enlarged granules on the upper border; 3 temporal plates in the first row behind the eye; prefrontals large, forming a median suture; 2 lateral well-marked white stripes.

Description. Sturdy, pentadactyle, eye entirely surrounded by a circle of granules, of which 3 on the upper border are enlarged. No supranasals. Rostral largely in contact with the frontonasal; the large prefrontals forming a broad median suture; frontal large, as long as the frontoparietals and interparietal together, in contact with the first and second supraoculars; frontoparietals paired, interparietal large and distinct. 3—4 supraoculars, first largest; 5 supraciliaries, first largest, 2—3 pairs of nuchals; 4 supralabials anterior to the subocular. External ear opening large, suboval, partially covered by two minute, anteriorly projecting lobules. 22—25 scales round the midbody; limbs well developed, overlapping when adpressed. Tail a little longer than head and body. Bronzy-olive above, with 4 stripes formed of a white central spot bordered

on each side by dark spots. Wettstein (1960) remarked the similitude of this pattern with that of *Chalcides ocellatus*. On each side a dark temporal band, edged with 2 striking white lines (supraocular and supralabial stripes). Lower surface greenish white in preserved specimens, but living ♂♂ show a reddish-orange ventral surface.

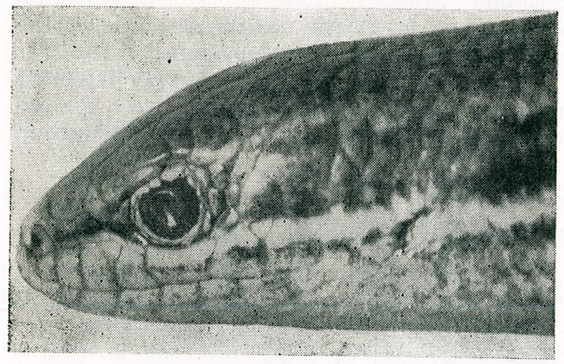


Fig. 4. — *Ablepharus b. bivittatus* (lateral view of the head).

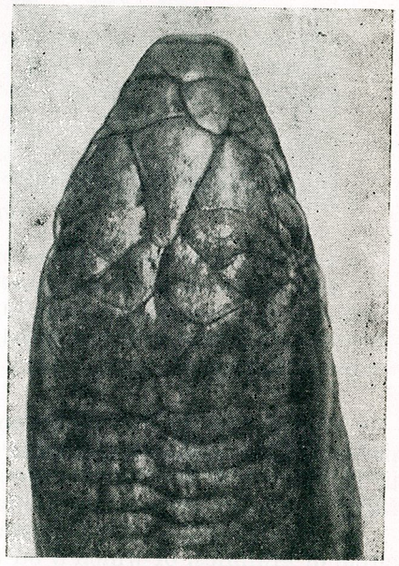


Fig. 5. — *Ablepharus b. bivittatus* (pileus).

Measurements. (mm) Tot. — 115 ; L. — 43 —54 ; Cd. — 72 ; D. — ♀♀ 32 ; Pa. —10 —12 ; Pp. —16 —18.

Distribution. N and N—W Iran, eastern part of Turkey (Dr. M. Başoglu denies its presence, in litt.), Armenian SSR, Azerbaidzhan SSR. Recorded from : Kirovakan, Spitak (Armenia), Bilaj-tschiai River, Rozanov, Zuband, Avash, Dymansk, Mt. Mara-iurt, Kushkizard (between Shiraz and Isfahan), Tabris, Kazwin, Perimbal, Mazanderan, Schahrud, Sagry-Descht, Aju-tur.

Specimens examined : 3 ♀♀ ZIANL Nr. 14255. Lenkoran, Dyman. 25.V.909.A. Kiritchenko leg. ;

Habitat. In the high mountain range of western Lenkoran, between rocks and herbaceous vegetation, avoiding wooded country. In the semi-desertic region S—W of Zuband, among stone boulders with scanty vegetation.

Ablepharus bivittatus lindbergi Wettstein, 1960

1960 *A.b. lindbergi* Lacertilia aus Afghanistan. Contrib. à l'étude de la faune d'Afghan. 3. Zool. Anz. *165*, 1—2 : 61—62
Type locality : "Steppe einige km westlich von Obéh, östlich von Herat, W-Afghan."
Holotype : NMW Nr. 15877

Diagnosis. Concording in all the characters with the typical subspecies *bivittatus*, except that the number of midbody scales is 26—27 instead of 22—24.

Measurements. L. —46-55 mm ; Cd. —68

Distribution. Obéh, east of Herat, W-Afghanistan ; Masdjed-Tchoubi, Chileh Hammam, near the Sabzzak-Pass, 2190 m alt. Oukak ; Mouma ; Ghorat 2300 m alt. ; Lake Bend-Amir ; 2900 m alt. ; Pandjab (Mezaradjat), 2860 m alt.

Habitat. Steppe and mountains.

Remarks. The 3 specimens of the new subspecies were collected in 1957 and 1959 by Dr. Lindberg. Wettstein (1960) emphazises the great eastern extension of the *vittatus*-range consecutive to these new findings and suggests that perhaps "beide nur geographische Rassen einer Art sind und *A. bivittatus lindbergi* eine Verbindungsform darstellt". This assumption is probably true, *vittatus* and *alaicus* with their replacing distribution are conspecific and the *lindbergi*-populations are only intergrades, without subspecific value.

Ablepharus bivittatus alaicus (Elpatjewsky, 1901)

(Figs 6 and 7)

1901 *Ablepharus alaicus* Drevn. Zool. otd. Obsch. liubit. estestv., antropol. i etn. *3*, 2 : 37—39. fig. 2 ; 1906 Elpatjewsky W. und L. Sabanejew. Ergänz. zur herpet. Fauna des Russ. Reichs. Zool. Jb. Syst. *24*, 4 : 247—264, Tabl. 18, fig. 4, 5 ; 1915 Nikolsky A. Fauna Rossii I, Chelonia i Sauria : 492 ; 1935 Chernov, S.A. Iasch. (Sauria) Tadzhikist., Trud. Tadzhik. baz. AHSSSR ; 1959 Fauna Tadzhik. SSR, *18* : 114

1902 *A. kucenkoi* Nikolsky, Ann. Mus. St. Petersb. *7* (Type loc. Issyk-Kul)

1905 *A. deserti* Nikolsky Herp. r ⁊ s., Zap. AN *17*, ser. 8, 1 : 182

1909 *A. saposhnikovi* Kaschtschenk o, Ann. Mus. Zool. St. Petersb. *14* : 126—127. (Type loc. Tian-Shan)

1899 *A. bivittatus* Nikolsky, Presm. i amf. Ejeg. Zool. Mus. AN SSSR *4* : 176
Type locality : "premontaneous region of Pamir, in Kirgizia".
Holotype : ZMMU nr. 2248 (Pamir, 1892) ; Syntypes : ZMMU nr. 2250, 2253 (3 spec.), 2254 (3 spec.)

Diagnosis. 26—28 scales round the midbody ; periocular circle with 2 enlarged granules ; 2 temporal plates in the first row behind the eye ; prefrontals widely separated ; a distinct slit between perioculars

and supraoculars. Dorsal 4 longitudinal stripes, regularly interrupted, each segment with a white centre bordered on both sides with dark brown. The supraciliary white stripe is missing or indistinct.

Description. Pentadactyle, habitus stout, head large, legs well developed, meeting when adpressed, tail rather short. Periocular circle

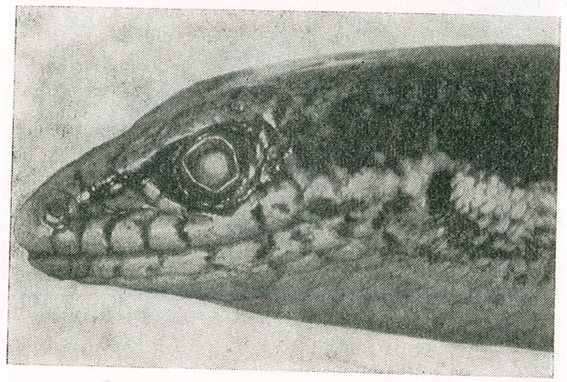


Fig. 6. — *Ablepharus bivittatus alaicus* (lateral view of the head)

Fig. 7. — *Ablepharus bivittatus alaicus* (pileus).

complete, with two enlarged granules (sometimes 3). Prefrontals small, widely separated, frontal kiteshaped, large; paired frontoparietals; interparietal large. No supranasals. Supraoculars 3, preoculars 2, supraciliaries 3, anterior supralabials 4. Tympan large and distinct, oval. Brown above, with 4 longitudinal stripes, formed by white spots, bordered on both sides with dark brown; on the sides a broad dark temporal band mottled with lighter spots and bordered with a white supralabial streak. Ventral light brown-greenish in preserved specimens; living ♂♂ reddish-orange (Andrushko, 1951).

Measurements. Tot. — 88—89; L. — 40—50; Cd. — 45—49; D. — ♂♂ 20—23, ♀♀ 29; Pa. — 10—12; Pp — 14—16.

Distribution. Khirgiz Soviet Republic (south of Lake Balkhash), N—E Tadzhikistan and S—E Kazakhstan ranging to the Ala-Tau and Tian-Shan mountains. Recorded from: Pamir, lake Issyk-Kul, Talas-river, Sukuluk (Semiretchji), Darant-kurgan (Alai); Uzim-Agath (Alma-Ata); Dzhekand-Karategin; Sary-Dshast (Pamir), Lake Jashil-Kul (Pamir, 3000 m alt.).

Habitat. Mountain form, recorded even at 3000 m alt. Lives in rocky valleys with herbaceous vegetation (Tian-Shan) as well in valleys with steppic vegetation, avoiding the wooded regions.

Biology. Ovoviviparous, litter of 2—6 youngs born in VII—VIII. According to Andrushko (1951), in the valleys of the Altai Mt. this skink reaches the sexual maturity in 2 years. Its main food are different insects, spiders and small snails.

Paleontology. Recently, Darevsky and Tschumakov (1962) described on a dental-fragment, a pleistocene skink — *Ablepharus borealis* — closely related to *A. bivittatus*, from Kazakhstan, Altai, 800 km north of the northern limit of the areal of *A. bivittatus alaicus* (50°N lat).

Specimens examined. ZIANL nr. 14068, 2 ♂♂, Aleksandrovski hrebet, pereval Makbal, A. N. Kiritchenko leg. VI—1910; ZIANL nr. 14081 1 ♂, 2 ♀♀, near Przhewalsk, Lake Issyk-Kul shore, Tadzhikistan, 1908, D. Pedashenko leg.; 2 ♀♀, ZIANL nr. 6316, Aram-Kung river, Kazakhstan, 1884, Grum-Grjimailo leg.

Ablepharus deserti Strauch, 1868

(Figs 8 and 9)

1868 Mém. biol. Acad. St. Petersb. *6*: 564; Bull. Acad. St. Petersb. *12*: 366—67; 1905 Nikolsky, Herp. ross.: 182; 1887 Boulenger, Cat. Liz. Brit. Mus. *3*: 351; 1949 Terentiev & Chernov, Opred. Presm. Zemnov.: 172; 1959 Chernov Fauna Tadzhik. SSR, Presm. *17*: 112—114

1915 *A. tenuis* Nikolsky, Faun. Ross. *1*, Chel., Saur.: 503

1925 *A. turkestanicus* Ahl, Zool. Anz. *65*: 20

Type locality: "Sandhügeln von Ustjurt"; "Akmetschet".

Holotype: ZIANL nr. 569: Paratypes: MNHN Paris nr 5697, 5698

Diagnosis. Habitus slender. Eye completely surrounded by a circle of granules, the upper of which is much elongate. Prefrontals separated or in contact in a point; frontoparietals paired; interparietal large. Ear opening distinct. Bronzy-olive above, uniform or with 3 longitudinal dark lines.

Description. No supranasals; frontal large, nearly as long as the frontoparietals and the interparietal together, in contact with the first and second supraoculars; 3—4 supraoculars, first largest; 5 supraciliaries, second largest; 4 supralabials anterior to the subocular; 2—3 pairs of nuchals. Ear opening suboval, small but distinct. Limbs pentadactyle, failing to meet or nearly meeting when adpressed; 2 large preanals. 20—22 midbody scales. Bronzy-olive above, uniform or with 3 longitudinal

dark-brown lines; a dark brown, light edged temporal band on each side; upper surface of tail frequently with dark and light ocelli; lower surfaces greenish white.

Measurements. Tot-88—112; L-39—60; Cd-50—70; Pa-8—10; Pp-11—13; D-♂♂ 21—22, ♀♀ 26—28.

Range. SSSR-South Kazakhstan, Kirgizia, Uzbekistan, northern Tadzhikistan and eastern Turkmenia. Northern limits: northern and

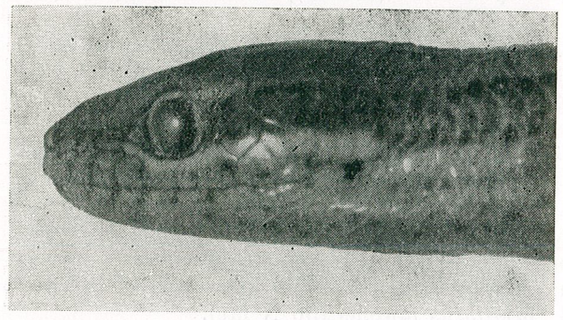


Fig. 8. — *Ablepharus deserti* (lateral view of the head).

Fig. 9. — *Ablepharus deserti* (pileus).

western banks of the Aral-Sea, the Karakum desert near the Aral-Sea, the valley of the Tchu river. Western limits: eastern Ust-Urt and surroundings of the Mary range.

Recorded from: Tschinas, Samarkand, Syddarja (Turkestan), Telekul, 75 miles N-E Perevost (Kazakhstan), Chodsheut, Aralo-Caspian steppe, Mt. Tian-Shan, Mogol-Tau, Chodjent, Andarak, Leninabad, Ura-Tiubinsk, Chavatsk, Artutsch, Kzil-Tam (2080 mt), Pendzhikent, Ust-Urt, Ak-Metschet, Mt. Kara-Tau, A-im-Kischlak (Syr-Daria), Tscha river, Aram-Kunge river, Ar-Tscha-Bulak, Sofiisk-Talgar, Andidshan, Balyktschi, Mt. Alai, Jaschil-Kul, Taldyk river, Tashkent, Fergana,

Bukhara, Kysyl-Beles, Aju-tur river, Aulie-ata, Tokmak, Kukkus (Amu-Daria), Verny (Semirechensk), Iliisk, Zaliisk Alatau.

Habitat. In the surroundings of Leninabad, *A. deserti* occurs in cultivated areas, in vegetable gardens, winyards and cherry-yards; it seems to avoid the proper desertic regions. The skink was recorded at altitudes from 1800 to 2200 m (in the Caucasian *Jenuperus* woods) and even at 3000 m.

Biology. Copula was observed in April-May, at higher altitudes in May, June and even June-July. *A. deserti* is oviparous; 4—7 eggs were found in the oviducts. Youngs of 15—20 mm appear in August.

Specimens examined. 3 ♂♂, 2 ♀♀ ZIANL nr. 14202, Tchinas, 1878, Leg. Russov.

Ablepharus kitaibelii fitzingeri Mertens, 1952

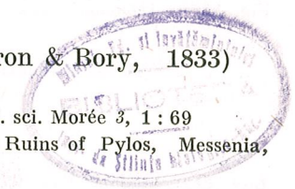
1952 Zool. Anz. *149*, 1/2 : 48 (nom. nov. pro *Ablepharus pannonicus* (Fitzinger, 1824)
Type locality (restr.): Ofen, Budapest, Hungary
Holotype: ZMB (lost)

Diagnosis. Habitus sturdy, head broad (5 mm); 4 supralabials anterior the subocular (sometimes the supralabials 3 and 4 fuse together, forming a double-sized third supralabial). 20—22 scales around the midbody. Distinct dorsal pattern, consisting of fragments of the longitudinal stripes (black and white).

Range. Czechoslovakia (Slovakia), Hungary.

Remarks. Most of the specimens from Czechoslovakia have 4 anterior supralabials (Stepanek, in litt.). Although a great series of Hungarian *ablephari* were not yet studied, our material shows a certain intergradation (individuals with 3 supralabials).

Ablepharus kitaibelii kitaibelii (Bibron & Bory, 1833)



1833 *Ablepharus kitaibelii* Bibron & Bory, in: Bory, Expéd. sci. Morée *3*, 1 : 69
Type locality (restr. Mertens & Müller, 1928): Ruins of Pylos, Messenia, Greece.
Holotype: M N H N Paris nr. 5392

Diagnosis. Body slender, head small and narrow (length 5 mm, width 4 mm). Limbs short and strikingly slim; 3 anterior supralabials; 18—20 scales round the midbody. No dorsal pattern or only faintly indicated by minute points or dots.

Range. Greece and Aegean Islands, Turkey, Cyprus, Rhodes, Syria, Israel, Transjordania, Irak (?), Sinai.

Remarks. It is most probable that intergrades occur in southern Yugoslavia, Albania and Bulgaria.

Ablepharus kitaibelii stepaneki Fuhn, 1969

(Figs 10 and 11)

1969 *Ablepharus kitaibelii stepaneki* Act. Zool. Soc. Bohem. Slov.
1952 *Ablepharus kitaibelii fitzingeri* (part.) Mertens, Zool. Anz. *149*, 1/2 : 48, 1961 Fuhn & Vancea Faun. RPR, *14*, 2 :
Type locality : Cernica Forest, Bucharest, Romania
Holotype : MIN G. Antipa nr. 501

Fig. 10. — *Ablepharus kitaibelii stepaneki* (lateral view of the head).

Fig. 11. — *Ablepharus kitaibelii stepaneki* (pileus).

Diagnosis. Body stout, head broad (5 mm), limbs strong, 3 anterior supralabials ; 20 scales around the midbody ; dorsal pattern with 2—4 lines composed of white and black fragments of the longitudinal lines.

Range. Romania, Bulgaria.

Remarks. The Yugoslavian and Albanian populations, poorly known, are probably related to *stepaneki*.

Ablepharus kitaibelii fabichi Stepanek, 1938

1938 *Ablepharus pannonicus fabichi* Sborn. narodn. Mus. Praha 1B, Zool. : 7
Type locality : Island Mikronisi, Hagios Nikolaos group, eastern coast of Crete and Karpathos-Island.
Holotype : NM Wien Nr. 18426

Diagnosis. Body stout, head large and high (longer and broader than in *A. k. fitzingeri*) ; limbs long and strong (Pa 9 mm, P 12 mm, in comparison with Pa 7, Pp 9.5 mm in *stepaneki*) ; the 4th toe very long and thin (5 mm compared with 2.5—4 mm in the other subspecies) ; 3 anterior supralabials ; 20 scales around the midbody ; colour as in *fitzingeri* and *stepaneki*, but more intensive.

Range. Islands Mikronisi, Karpathos, Kasos, Armathia.

Ablepharus kitaibelii chernovi (Darevsky, 1953)

1953 *Ablepharus chernovi* Bull. mosk. obsch. isp. prir. otd. biol. 58,2, : 39—41
Type locality : Arsakan, Central Armenia, Tzakumiantz-Mt., Arax valley, Zanga river.
Holotype : ZMMU Moscow Nr. 2810 ; Paratypes : ZIANL Leningrad Nr. 16230.

Diagnosis. Body slender, head proportions as in *fitzingeri*, limbs short, ear opening absent (resp. only a small depression) ; 18—19 scales around the midbody ; ventral surface of the males reddish-orange (in all other races blackish-blue-gray) ; dorsal surface brown, with 4 interrupted dark longitudinal lines.

Range. Armenian SSR, Arax-, Zanga- and Razden valleys.

Ablepharus pannonicus pannonicus (Lichtenstein, 1823)

(Figs 12 and 13)

1823 *Scincus pannonicus* in Eversmann, Reise von Orenburg nach Buchara : 145, and Verz. Doub. Zool. Mus. Berlin : 103, type locality : Bokhara.
1868 *A. brandti* Strauch, Mél. Biol. Acad. St. Petersb. *6* : 565 and Bull. Acad. St. Petersb. *12* : 368, type locality : Samarkand, Turkestan ; 1887 Boulenger Cat. Liz. Brit. Mus. *3* : 351
1874 *A. pusillus* Blanford, Ann. Mag. Nat. Hist. *14*, 4 : 33, Type locality : Basra.
1907 *A. brandtii var. brevipes* Nikolsky, Ann. Mus. St. Petersb. (1905), *10* : 283, type locality : Persia
1907 *A. persicus* Nikolsky. Ibid. : 283, tabl. 1, fig. 5
Type locality : "Bokhara"
Holotype : ZIANL (lost, Darevsky, in litt.)
Syntypes : ZMB (lost, Dr. Peters, in litt.) ; BMNH Nr. 1946, 8.18.47

Diagnosis. Body slender; legs not meeting when adpressed; 2 upper scales of the periocular circle much enlarged; a single frontoparietal (exceptionally paired); prefrontals separated; 4 anterior supralabials; small ear opening, generally distinct.

Description. Body slender, pentadactyle. No supranasals. Eye surrounded by a circle of small scales, the two upper of which are much enlarged. Upper eyelid composed of 3—4 scales, hiding the upper margin of the lower, the two united or with a minute palpebral slit. Frontonasal in contact with the frontal; prefrontals middle-sized, separated. Frontal smaller than frontoparietal and interparietal together, in contact with the first and second supraoculars. Frontoparietal single (very rarely paired), subtriangular; interparietal distinct; 2—4 pairs of nuchals; 4 supralabials anterior to the rather high subocular; 6 inframaxillaria; 2 superposed temporals, the upper the largest. Ear opening small but distinct, partly hidden by scales; in few individuals or in the zone of contact with the subspecies *grayanus*, the ear opening is absent. Midbody

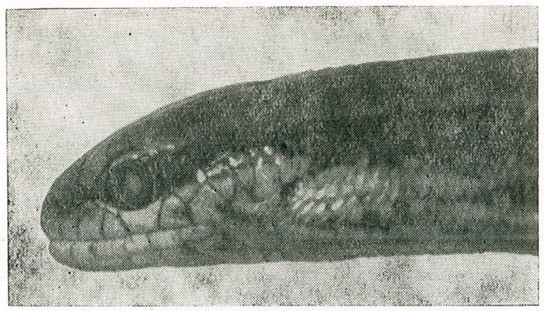


Fig. 12. — *Ablepharus p. pannonicus* (lateral view of the head).

Fig. 13. — *Ablepharus p. pannonicus* (pileus).

scales mostly 20, rarely 22. Limbs short, not meeting when adpressed. Olive or brownish above, with metallic gloss; 6—7 fine dark lines dorsally; a dark lateral band edged above by a light line; on the legs and lateral on the tail, a pattern of longitudinal fine dark lines. Whitish or brownish below; during the breeding season, the inferior part of the tail and hind legs brick or orange coloured.

Measurements. Tot. —95 mm; L-32—38 (50 mm Cernov); Cd-60; D ♀♀—23; Pa-11; Pp-12.

Range. Soviet Union (Kopet-Dagh,ranges of the Pamiro-Altai system and their northern slopes to Leninabad; to the east to Darvaz); Iran, Iraq, Jordania, Syria. The recorded specimens from Afghanistan, Pakistan, N—W India, are possibly intergrades to the ssp. *grayanus*.

Recorded from: Karun-river, Dech-i-Diz, Irak-Adshemi, Tschetchme-rogan, Ziaret, Sarchun, Siga-Mansur (Iran); Amara, Suk ash Shuyak (Iraq); Alep, Tartous (Syria); Oalyk-tau, Bukhara, Samarkand, Bussora, Naksh-i-Mahram (Iran), Mt. Mogol Tau, Mt. Fergana, Fergana-valley, Almatch distr. Havatsk, Zeravschan valley and range, Hisarsk range, Maghiansk-pass near Nadji, Surkhaschiaschma at 2000—2200 m altit., Kvak, Ruidascht (2500 m), Hissar-valley near Stalinabad, Javansk valley, Rengen-tau, Kuibyschewsk, lake Dariakul, Ak-Metchet (Mt. Baba-Tag), Nimitsch-Bole, Sagry-Descht (Tadzhik Republic, USSR); Qual'eh Chabrak/Hezaradjat/, Qual'eh Nou, Obeh Herat, Bamian, Adjaha, Helmand (Afghanistan); Ladha, Kalabagh, Karachi (Pakistan).

Because I consider *A. pannonicus* and *A. grayanus* as conspecific, it is most probable that the populations from Afghanistan and Pakistan are intergrades; this explains the curious fact of the sympatric findings in some localities, as Nimitch-Bole and Karachi, or the records by Procter (1923) of *A. grayanus* included later by M. A. Smith (1935) in the synonymy of *A. pannonicus*. Mertens (1964, in litt.) records also specimens of Afghan *A. pannonicus*-populations with no ear openings (coll. Dr. K. Lindberg).

Habitat. *A. pannonicus* lives (Cernov 1949, 1959) in herbaceous places near the irrigated areas; in the mountains it occurs frequently even at 2500 m altitude, on the high-altitude pastures, hiding under stones and boulders, moving fastly between them. It likes a certain amount of humidity and never ranges far from the water.

Biology. Oviparous; egg deposition between April and May at 800 m, being delayed with 1.1/2—2 month at 2200—2300 m altitude. A clutch numbers usually 3—4 eggs; the eclosion takes place in July (length of the young 20 mm.); the sexual maturity being reached the following year.

Specimens examined. 3 ♀♀ ZIANL Nr. 14213/220, Hissarsk valley, 20 km of Stalinabad, 19.4.1934, leg. Chernov & Gvozdev.

Remarks. The nomenclatoric status of *A. pannonicus* (= *A. brandti*) was established after some polemics (see Mertens 1952). Cernov (1959) uses the synonymous name of *A. brandti* on the argument that Lichtenstein had in his hands specimens of *A. deserti* and not *A. pannonicus* (= *A. brandti*), because this latter species was no more collected since from the Bokhara area and surroundings, meanwhile *A. deserti* is common there. Further, *A. pannonicus* (= *brandti*) occurs actually at 200 km from Bokhara in the mountains, and the biotopes round Bokhara are not con-

venient for the ecological requirements of *A. pannonicus* (= *brandti*). Lichtenstein deposited (1823) 2 cotypes (collected by Eversmann), in the "Zoologisches Museum" Berlin ; unfortunately these are lost (Dr. G. E. Peters, pers. comm.)

Ablepharus pannonicus grayanus (Stoliczka, 1872)

(Figs 14 and 15)

1872 *Blepharosteres grayanus* Proc. asiat. Soc. Bengal : 74—75 ; 1884 Murray Zool. Sind. : 354

1887 *Ablepharus grayanus* Boulenger Cat. Liz. Brit. Mus. *3* : 352 ; 1890 Fauna Brit. India : 214 ; 1935 M. A. Smith Fauna Brit. India : 311—312 ; 1949 Terentiev & Chernov Opred. Presm. Zemnov. : 171 ; 1959 Chernov Fauna Tadzhik. SSR : 112
Type locality : "Waggur district, in the Nort-eastern part of Kachh".
Holotype : NM Wien Nr. 10234

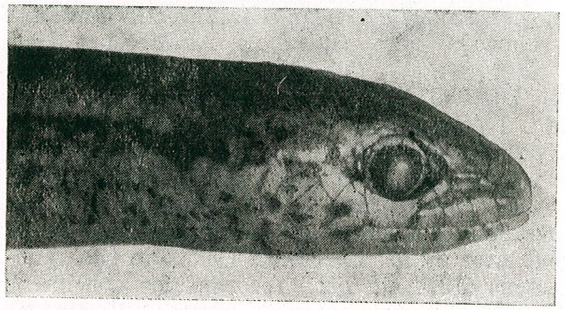


Fig. 14.— *Ablepharus p. grayanus* (lateral view of the head).

Fig. 15.— *Ablepharus p. grayanus* (pileus).

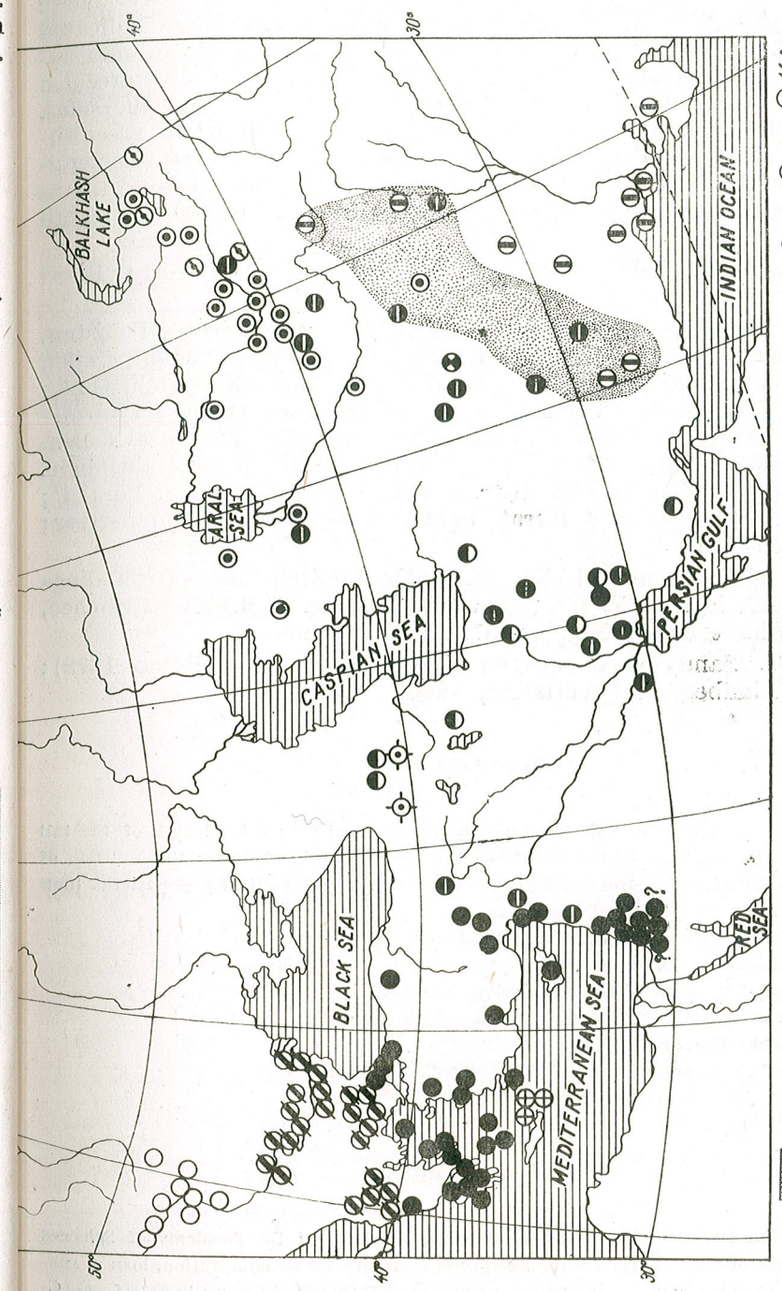


Fig. 16. — Distribution-map of the species of *Ablepharus*.
1. *A. p. pannonicus*; 2. *A. pannonicus grayanus*; 3. *A. k. kitaibelii*; 4. *A. kitaibelii chernovi*; 5. *A. kitaibelii fitzingeri*; 6. *A. kitaibelii stepaneki*; 7. *A. kitaibeli fabichi*; 8. *A. b. bivittatus*; 9. *A. bivittatus lindbergi*; 10. *A. bivittatus alaicus*; 11. *A. deserti*

Diagnosis. Differs from *pannonicus* in the following particulars: ear-opening absent in most specimens, its position sometimes indicated by a depression; 18—20 scales around the midbody; but in the intergradation belt in Baluchistan 20—22 (as in *pannonicus*). Pale olive greenish above, with a very distinct metallic lustre, a little darker at the sides, speckled with black and gradually passing into the uniform greenish-white lower side; a silvery green narrow band passes from the superciliary edge to the base of the tail, it is edged with black below. Limbs marked with rows of white spots or with light longitudinal lines; tail with a pink tinge.

Measurements. Tot-70—80 mm; L-30—36; Cd-55; D-21; Pa-8; Pp-12.

Range. Tadzhikistan (USSR), eastern Iran, Afghanistan, Pakistan. Recorded from: Nimitsch-Bole (Tadzhikistan); Masdjid-Tchoubi, Chileh Hammam, Sabzzak-Pass/2190 m / (Afghanistan); Karachi, Cutch, Queta district Las Bela State; Tatta distr. 4.5 miles west Dabeji; Churma-Island (Cape Monze); 5 miles N Uthal / distr. Las Bela /; 5 miles N Bela /distr. Las Bela /; cannyon of the Sari-river, 23 miles N—E Mahri/distr. Dadu /; 1 mile E Ziarat / Sibi distr./; 9 miles E Ziarat/distr. Loralei/; Tscha-i-divan in Sargoda; Kerat in Choscht-Adano; Bampur-river; Bazman (Pakistan).

Examined specimens. ZIANL Nr. 14075, Nimitch-Bole, surroundings of Garma 1897, leg. A. N. Kaznakov; BMNH Nr. 91.9.14.8 Kurrachee, leg. W. T. Blanford; BMNH Nr. 87.9.22.37 Karachi.

Habitat. "Sandy place between tufts of grass" (Stoliczka, 1872); mountains (Lindberg, in Wettstein, 1960).

ABBREVIATIONS

Tot — length rostrum-tip of the tail; *L* — length rostrum-anal slit; *Cd* — length of the tail (unregenerated) from anal slit to the tip of the tail; *D* — distance between the insertion of the limbs; *Pa* — anterior limb, from axilla to the tip of the longest digit; *Pp* — posterior limb from axilla to the tip of the longest toe.

ZIANL — Zoological Institute of the Academy, Leningrad
NMW — Naturhistorisches Museum Wien
ZMMU — Zoological Museum of the University, Moscow
MNHN — Muséum National d'Histoire Naturelle, Paris
ZMB — Zoologisches Museum Berlin
MINGA — Muzeul de Istorie Naturală "Gr. Antipa", Bucharest
BMNH — British Museum Natural History, London

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LE PRINCIPE DE GEOFFROY SAINT-HILAIRE « L'UNITÉ DU PLAN DE COMPOSITION » DANS LA SYSTÉMATIQUE DES LÉPIDOPTÈRES

PAR

EUGEN V. NICULESCU

In the present work the author shows that the unity principle of the composition plan may likewise be followed in the genitalia of *Lepidoptera*, where good generic characters are present. The characters of four *Nymphalidae* genera are presented in a table, from which it results that each genus has a general organization plan. In conclusion the author shows the usefulness for systematics of establishing the unity of the composition plan of the genera.

Le principe de l'unité du plan de composition, entrevu déjà par Cuvier, a été formulé pour la première fois par Etienne Geoffroy Saint-Hilaire et constitue l'une des preuves anatomiques du transformisme. Conformément à ce principe, tous les animaux composant un même groupe ont un plan général d'organisation identique. Quoiqu'ils se distinguent beaucoup les uns des autres par diverses particularités morphologiques et anatomiques, liées aux adaptations de milieux de vie et régimes alimentaires différents, toutefois ils ont le même plan général de structure. Ainsi, par exemple, le squelette des membres antérieurs chez l'homme, le chat, la chauve-souris et le phoque est constitué, dans ses grands traits, de façon identique : humérus, cubitus et radius, carpe, métacarpe et phalanges — malgré les différences profondes entre ces quatre espèces, leurs membres antérieurs remplissant des fonctions différentes. Ces membres sont des organes homologues par leur structure, ayant un même plan d'organisation. Cette unité de plan peut être retrouvée dans n'importe quel groupe. Nous l'avons constatée dans l'armure génitale des Lépidoptères où elle procure de bons caractères génériques. Chaque genre a un plan général d'organisation précis, un faciès précis, par lequel il se distingue nettement d'un autre genre. Mais il faut préciser dès maintenant que ce plan général

REV. ROUM. BIOL.—ZOOLOGIE, TOME 14, No 1, p. 43—45, BUCAREST, 1969

est évident seulement dans le cas où le genre comprend beaucoup d'espèces. Dans les « petits » genres de 2—3 espèces, résultant de la coupe d'un grand genre (procédé utilisé par les « splitters »), l'unité de plan ne peut plus être retrouvée.

Pour illustrer cette unité de plan dans le monde des Lépidoptères nous choisirons comme exemple quatre genres de Nymphalides : *Apatura*, *Limenitis*, *Melitaea* et *Argynnis*. Chacun de ces quatre genres a un plan général d'organisation de l'armure génitale, comme le montre le tableau ci-joint.

On peut trouver ce plan général d'organisation chez toutes les espèces du genre ; tous les sclérites mentionnés dans le tableau se retrouvent partout, pour chaque genre dans la même position relative et cette position constante contribue à l'unité du plan de composition. Mais chaque sclérite varie dans sa forme d'une espèce à l'autre, seules sa présence et sa position sont constantes au sein du genre. Nulle part n'apparaît quelque sclérite « aberrant » qui rompe l'unité du plan. Il n'y a aucune espèce d'*Apatura* avec harpe ou processus supérieur, comme il n'y a aucune espèce d'*Argynnis* possédant un saccus long et cylindrique. Même à un examen partiel et superficiel de l'armure génitale, on peut immédiatement décider de l'appartenance d'une espèce à l'un des quatre genres, tant est caractéristique la structure de cette armature, et tant est unitaire le plan général de composition.

Cela nous prouve, d'une part, que le genre est une entité réelle, et d'autre part que cette identité de plan est inscrite dans le patrimoine héréditaire de chaque espèce. Chez tous les descendants, le plan général de l'organisme se retrouvera identique, jamais n'apparaîtront des structures aberrantes, mais toujours les mêmes sclérites disposés dans la même situation relative. Nous pourrions mentionner un grand nombre de genres pour illustrer l'unité du plan de composition, mais ceci serait superflu.

L'importance pour la systématique de cette unité de plan est très grande. Nous avons ici un critère de genre de premier ordre, si nécessaire aujourd'hui dans la délimitation des genres. L'on sait que beaucoup de lépidoptéristes ont de grandes difficultés à délimiter correctement les genres, et souvent ils résolvent ces problèmes de systématique en créant de « nouveaux » genres. L'application juste du principe de l'unité du plan de composition contribue hautement à l'élaboration d'un système de classification rationnel. Mais pour cela deux conditions sont nécessaires :

1. L'adoption du point de vue unificateur.
2. La connaissance solide de l'armure génitale du groupe considéré.

Si à tout cela nous ajoutons aussi d'autres principes dont nous devons tenir compte, à savoir le principe de la subordination des caractères, le principe de la discontinuité (pour les genres) et le principe récemment élaboré de l'équivalence des caractères (Niculescu, 1968), nous constatons que le systématicien, armé de ces principes et connaissant en maître le groupe considéré, a des éléments suffisants pour construire la systématique de son groupe sur des bases solides et contribuer ainsi au progrès de la science lépidoptérologique.

TABLEAU MONTRANT LES CARACTÈRES GÉNÉRIQUES DE L'ARMURE GÉNITALE CHEZ QUATRE GENRES DE NYMPHALIDES

	Apatura	*Limenitis*	*Melitaea*	*Argynnis*
Uncus	Horizontal	Horizontal	Double ou absent	Recourbé ventralement
Valve	Etroite distalement, harpe absente	Possédant un sillon longitudinal, harpe présente	Triangulaire ou rectangulaire, harpe présente	Rectangulaire avec processus supérieur, processus inférieur, crista obliqua, clinopus.
Saccus	Très long et cylindrique	Court et large	Large, avec une échancrure médiane.	Large, globuleux, dépourvu d'échancrure médiane,
Pénis	Long, avec fultura inférieure	Court, depourvu de fultura inférieure	Court, entouré d'un fort vallum-pénis	Court, soutenu par la fultura inférieure, cornuti nombreux.

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OBSERVATIONS ON *ARNOLDIA CERRIS* KLLR. (*DIPTERA-CECIDOMYIDAE*)

BY

GR. ELIESCU and M. FALCĂ

The distribution of the galls of *Arnoldia cerris* Kllr. on *Quercus cerris* is studied in a year of mass supermultiplication (1966).
Maximum and minimum average densities on trees and branches at different levels, as well as absolute density, are determined. The influence of the position of trees within the brush on gall density is discussed.
It is shown that gall distribution on a tree with slight infestation is a negative binomial one.

Our investigations on the ecology of *Arnoldia cerris* Kllr., a species harmful to *Quercus cerris* leaves by the galls it induces, have raised the problem of studying the distribution of the populations of this species. As in 1966 *Arnoldia cerris* Kllr. presented a strong mass supermultiplication in the forests around Bucharest we tried to find out certain characteristics of the populations at the moment of their mass multiplication.

In the present work we show part of the results obtained.

MATERIAL AND METHOD

The attacked leaves were collected in the Otopeni-Săftica forest, at 18 km from Bucharest. Seven trees, having different positions within the biotope, were chosen so as to enable certain comparisons.

We chose tree no. 5 on the northern skirt of the brush; tree no. 7 on the eastern skirt; trees no. 1 and 2 on the southern skirt; tree no. 4 within the brush, surrounded by various trees; tree no. 3 isolated in the open field, at a certain distance from the forest; and tree no. 6 on the eastern skirt of another forest portion, protected by a belt of trees.

REV. ROUM. BIOL.–ZOOLOGIE, TOME 14, Nº 1, p. 47–54, BUCAREST, 1969

Fom every tree, three branches from different levels were analysed, in order to see to what extent altitude influences the egg-laying process of the insects. All the leaves were analysed and counted and the number of galls was also determined.

RESULTS

The results of the analysis are shown in Table 1, which records the trees, their height, the levels from which branches were taken, the percentage of attacked leaves and the average density of gall infestation (the number of galls per leaf, taking all leaves into consideration).

Table

Percentages of attacked leaves

Tree	Height m	Percentage of attacked leaves at different height of levels (m)								Total
		1	2	3	3.5	4	5	6	8	
1	3.50	67	56		20					55
2	8			60				65	73	64
3	12		17				33		50	23
4	10		32			100		94		68
5	10		27			26		35		28
6	8		75			58		60		65
7	8		35			58		23		37

1. Total infestation (average density) of a tree ranged between 1.33 and 11.80 galls per leaf. We may consider these values as representative for mass multiplication since 1966 was the year of the greatest abundance for *Arnoldia cerris* Kllr. In 1967 the insect abundance was extinguished in the Otopeni-Săftica forest and the analysis of galls collected in 1966 showed that a very high percentage (over 98%) of the larvae were parasitized. In the laboratory, no adults were obtained. 1967 was thus a year of crisis for the insect abundance of this population. Nevertheless, in some trees infestation had a smaller average density — between 1.33 and 1.70 — while in others infestation was greater — between 6.38 and 8.60 — and even 11.80. Two infestation groups may be discussed.

2. The percentage of attacked leaves for the same trees is found to range between 23 and 68%. These data may likewise be taken as an index for the great infestation intensity. From these data it may also be established that trees may be divided into two infestation groups: in the first the percentage of attacked leaves ranged between 23 and 37%, in the second between 55 and 68%.

3. Though the seven analysed trees grow at a distance of only a few scores of metres from each other, the average density varies fairly

much. The lower infestation in trees 3, 5 and 7, is accounted for by the different microclimate which influenced the layings. Tree no. 3 is isolated and exposed to air currents. Likewise, tree no. 5 has northern exposure and tree no. 7 an eastern one. These exposures are generally avoided by insects for egg laying, also because of air currents. The other trees were more favourably exposed (southern exposure for trees 1 and 2), protected from air currents within the brush (no. 4), or protected by the tree belt (no. 6). This also explains why tree no. 4 had the strongest infestation both as concerns the number of leaves attacked and the density of galls on leaves.

4. As regards the average density of galls on cerris leaves on each level, it is generally established that to an overall low gall density ther

1

and average density of galls

Average densities at different height of levels (m)								Total
1	2	3	3.5	4	5	6	8	
10.89	7.23		3.46					8.60
		2.79				6.01	10.16	6.70
	0.87				3.45		1.38	1.70
	3.35			21.06		16.85		11.80
	1.06			0.90		2.66		1.33
	9.80			4.89		2.78		6.38
	1.15			1.86		1.56		1.51

corresponds a low density on each level, and conversely. Nevertheless, no general law may be inferred as to the possible influence of the height of the analysed level. The complex of weather factors at the moment of flight and egg laying might considerably influence egg laying. These factors are temperature, insolation, atmospheric humidity and air currents, and as extreme factor, rain. Thus the following anomalies are explained:

In tree no. 1 the highest average density was found at the height of 1 m and then it decreased towards 3 m (it should be observed that this tree was the smallest). The same phenomenon was recorded in the case of tree no. 6, with the maximum average density found at 2 m. In tree no. 2, the strongest infestation was recorded at 8 m and the weakest at 3 meters. Tree no. 4 had the highest average density at 4 and 6 m and the lowest at 2 m. These anomalies are recorded in the 4 trees with strong infestations. In trees with slight total infestations, infestations are higher at the 4, 5 or 6 m levels, and lower below (2 m), which shows that most favourable laying conditions are generally from the middle of the tree towards the summit.

The previous observations are approximately reflected in the per centage of attacked leaves by levels. We may also mention that in th studied trees, absolute density was of 180 galls per leaf (one case).

5. From the above it results that the type of gall distribution i closely connected not only to the atmospheric condition during the fligh of the insect but also to the number of egg-laying females. That is wh we studied the simplest case of distribution, with slight infestation, i order to find out to which distribution type it belongs. It is the gal distribution on tree no. 7 that we shall analyse below according to th statistical method.

Tree no. 7. Distribùtion analysis. The results of counting the gall on the leaves of this tree are shown in Table 2, which presents the dis

Table 2

Leaves frequency, average and variants by levels

Number of galls on leaves x_i	Number of leaves f_i				2 m level		4 m level		6 m level		Total	
	2 m level	4m level	6m level	Total	$\overline{x}$	S^2	$\overline{x}$	S^2	$\overline{x}$	S^2	$\overline{x}$	S^2
0	39	23	41	103								
1	7	11	3	21								
2	6	7	2	15								
3	3	3	2	8								
4	0	0	0	0								
5	1	2	2	5								
6	0	0	0	0								
7	1	0	2	3								
8	1	0	0	1								
9	0	2	1	3								
10	1	2	0	3								
11	1	0	0	1								
12	0	0	0	0								
13	0	1	0	1								
	60	51	53	164	1.150	5.722	1.862	9.402	0.867	4.077	1.28	6.46

tribution of galls by levels and on the whole tree. The mean and the variance for each level and for the whole tree are also computed.

The working method was as follows :

We attempted to put into agreement experimental distribution and Poisson's distribution. From the values of the mean and of the variance, both by levels and for the entire tree, it resulted however that means are generally much smaller than the respective variances, which shows from the very first that we are not confronted with a Poisson distribution model. It is not a positive binomial distribution either, as variances are not smaller than means. As in our case the variance is about 5 times greater than the mean, it results that our distribution is a negative bino mial one.

In literature it is shown that certain *Cecidomyidae* populations are distributed according to the negative binomial distribution curve. Thus, Legay J. M. (1963) [2] showed that *Mikiola fagi* presents a similar distribution for a 0.53 infestation.

Definition of negative binomial distribution. This distribution is characterized by two parameters : the mean ($\overline{x}$) and the exponent (k) ; the generative function of probabilities is :

$$(q - p)^{-k} \tag{1}$$

where

$$p = \frac{\overline{x}}{k} \qquad q - p = 1 \qquad q = 1 + \frac{\overline{x}}{k}$$

Probability that an event should occur m times — at a great number of trials, n — is equal to :

$$P_{m \cdot n \cdot} = \frac{k + m - 1}{m} p^m q^{-(m+k)} = \frac{(k + m - 1)! \frac{m}{p}}{m!\,(k-1)!\,\frac{k}{q}} \tag{2}$$

From equality (2) it follows that for $m = 0$,

$$P_o = \frac{1}{q^k}$$

The computed distribution values (H_1) will be obtained by the multiplication of probabilities (P_i) $i = 0, 1, 2, 3, \ldots 13$, by the number of leaves (n).

For x, equal to :

$$x_0 \qquad H_0 = n P_0$$

$$x_1 \qquad H_1 = k \frac{p}{q} H_0$$

$$x_2 \qquad H_2 = \frac{k + 1}{2} H_1$$

$$x_3 \qquad H_3 = \frac{k + 2}{3} H_2.$$

Computation of negative binomial distribution and results obtained. The main problem in computing a negative binomial distribution consists in estimating coefficient k. We shall chose the coefficient which permits the equality or closest approximation of experimental data to the computed ones. The assay of the distribution for the entire tree was taken into account.

For estimating coefficient k, there are 3 possibilities :

a. A first possible estimation of k is $k_1 = \frac{\bar{x}^2}{S^2 - \bar{x}}$.

According to this method, the value of coefficient k in our distribution is 0.316.

Thus estimated, the value of k is convenient (Anscombe-1949) only :

— for the small values of $\bar{x}$, when $\frac{k}{\bar{x}} > 6$

— for the large values of $\bar{x}$, when $k > 13$

— for the average values of $\bar{x}$, when $\frac{(k + \bar{x})(k + 2)}{\bar{x}} \geqslant 15$.

The value of $k = 0.316$ corresponds to no one of the 3 situations, and therefore we give up this value.

b. A second estimation of k is k_2 whose values must satisfy the following equality :

$$k_2 \lg\left(1 + \frac{\bar{x}}{k_2}\right) = \lg \frac{N}{f_0} \quad . \tag{3}$$

This estimation is convenient if it satisfies the following inequality :

$$(\bar{x} + 0.17)(P_0 - 0.32) > 0.20 \tag{4}$$

Replacing the inequality terms with the corresponding values we obtain : 0.446 and therefore k_2 will be utilizable.

The second equality term (3) $\lg \frac{N}{f_0} = 0.20194$.

The value of coefficient k_2 is that which gives the expression $k_2 \lg\left(1 + \frac{\bar{x}}{k_2}\right)$ a value equal or closest possible to 0.20194. This value will be arrived at by successive approximations stopping at the value comprised between the greatest and the smallest value of the constant factor of the right side of equality :

$k_2 \lg\left(1 + \frac{\bar{x}}{k_2}\right)$	k=0.24	k=0.25	k=0.26	k=0.27	k=0.2619
	0.19238	0.19668	0.20086	0.20490	0.20163

We chose the value $k_2 = 0.2619$ and compute the corresponding frequencies (table 3).

By means of the conformity test, we verify the "agreement" quality between experimental and theoretical data. The degrees of liberty are 2. $n = 5-3 = 2$; 3 = number of individuals N plus the 2 parameters $\bar{x}$ and k. χ^2 value = 2.116, which corresponds to a probability comprised between 30% and 50%, shows that the "agreement" is good, inducing to accept the nought hypothesis, according to which between the two (experimental and computed) distributions, there are no significant differences, that is, greater than those generated by hazard in our sample.

c. A third method, by which the value of coefficient k may be estimated, is the maximum probability method (Fisher, Bliss and Fisher 1953).

Table 3

Number of galls on leaves x_i	Observed frequency f_i	Calculated frequency	χ^2
0	103	107.329	0.103
1	21	22.543	0.105
2	15	11.406	1.447
3	8	6.896	0.176
4	0	4.509	
5	5	3.082	
6	0	2.167	
7	3	1.554	
8	1	1.131	
9	3	0.823	
10	3	0.611	0.285
11	1	0.457	
12	0	0.343	
13	1	0.259	
			2.116

By successive approximations value k_3 is obtained, which must give the smallest possible value to expression :

$$\frac{A_x}{k_3 + x} - N \ln\left(1 + \frac{x}{k_3}\right)$$

	k = 0.26	k = 0,266	k = 0.263	k = 0.2655
$\frac{A_x}{k_3 + x}$	293.94036	288.44764	289.34555	288.89528
$-N \ln\left(1 + \frac{x}{k_3}\right)$	291.72896	288.62867	289.13469	288.88168
	2.21140	−0.18103	0.21086	−0.01360

Table 4

Number of galls on leaves x_i	Observed frequency f_i	Calculated frequency	χ^2
	103	106.770	0.133
0	21	22.734	0.173
1	15	11.535	1.040
2	8	6.985	0.147
3	0	4.573	
4	5	3.128	
5	0	2.201	
6	3	1.579	
7	1	1.148	
8	3	0.845	0.215
9	3	0.628	
10	1	0.470	
11	0	0.353	
12	1	0.267	
13			
			1.708

Value 0.01360 is the smallest difference between the two terms and we compute the corresponding frequencies with $k = 0.2655$ (Table 4).

$\chi^2 = 1.708$ shows a probability ranging between 30% and 50%; therefore in this case too the "agreement" quality is good.

6. Table 1 shows that the infestation density on the 3 levels of tree no. 7 are different (1.15—1.86—1.56). Computing distributions of populations for each level, as was done for the entire tree, it was found that these distributions follow the theoretical type of negative binomial distribution, just like that of the total tree.

CONCLUSIONS

1. In 1966 *Arnoldia cerris* Kllr. presented a mass supermultiplication which enabled the determination of gall density on leaves. The average maximum density recorded on one tree (of the 7 studied) was 11.80 and the average minimum density 1.33.

2. The average density of galls at different levels and at different heights ranged between 0.87 and 21.06.

3. The trees with northern and eastern exposure and the isolated ones presented the lowest average densities.

4. The trees presenting the highest average densities were those with southern exposure and those within the brush.

5. Trees presenting the highest average densities have at the same time high average densities on branches of different heights and conversely, trees with low average densities present low average densities also on branches from different heights.

6. The variation of average densities at different levels (heights) is not a well established law. Generally, in trees with slight average densities, density is higher in the upper part of the tree.

7. The tree with the slightest infestation presented a gall distribution on leaves, (experimental distribution) close to the theoretical negative binomial distribution.

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VARIATION OF SOME METABOLIC INDEXES DURING THE RECOVERY AFTER EFFORT, IN THE ISOLATED FROG MUSCLE

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with the technical assistance of Șt. Illyés

There exists a great deal of data on the phenomena of the muscle metabolism connected with the contraction and relaxation processes, with the states of fatigue and exhaustion. On the contrary, the metabolic aspect of the recovery, of the post-effort rest phase of muscle activity is much less studied.

The metabolic recovery of the fatigued muscle is an aspect of the tissue homeostasis; the ability of the isolated muscle to recover is an index of the degree of metabolic autonomy of the muscle tissue. This paper is devoted to the study of this ability on the isolated frog gastrocnemius.

MATERIAL AND METHODS

The experiments were made on *Rana esculenta* weighing 70—100 g. After decapitation of the animal, the gastrocnemii were quickly isolated and moistened with Ringer's saline. Then, one was attached to a myograph the clamps of which served also as electrodes. Stimulation was performed with rectangular impulses of 2 V, with 10 msec duration and a frequency of 1 per sec; the myograph was loaded with 100 g. Stimulation was continued until the muscle did not answer any longer to the 2 V stimulus. During this time, the other (control) gastrocnemius was maintained on a filter paper moistened with Ringer's saline. When the stimulation was stopped, the two muscles were cut along in two pieces, one being used to measure the oxygen consumption, and the other for biochemical determinations.

REV. ROUM. BIOL.—ZOOLOGIE, TOME 14, N° 1, p. 55—61, BUCAREST, 1969

The oxygen consumption was measured in a Warburg apparatus, on 150—200 mg tissue slices, in 3 cm^3 Ringer's solution, at 22 ± 0.1° C, the gaseous phase being air. Calculations were performed on the basis of the 10, 30 and 60 minutes readings.

The tissue for analyses was frozen at —75° and weighed in this state at a torsion balance. The contents of glycogen [11], pyruvic acid [12] and lactic acid [3] were determined in two variants: I. the tissue was frozen immediately when the stimulation was stopped; II. the tissue was maintained in the air during 20 minutes after the stimulation — on a filter paper moistened with Ringer's solution, — and frozen thereafter.

The experiments were performed from November to March. The frogs have been collected and brought to laboratory in October, and maintained without nutrition in tanks with running water at 8—10°C.

RESULTS

The modifications induced by effort, as well as the metabolic recovery processes, exhibit seasonal differences. The change of the metabolic behaviour occurred — in two successive years — in the first half of December. Therefore, we give the results grouped in two periods: autumn and winter.

Table 1 contains the values obtained for the control muscles[1]. These values are not "absolute control" (normal) ones, reflecting not exactly the state of the muscle when removed from organism, as they were obtained on muscles after several minutes of stay in the air.

Table 1

Values in control muscles

	Autumn series	Winter series	Difference	P
Oxygen consumption $mm^3/g/h$	234 ± 11 (13)	174 ± 22 (9)	−26%	<0.02
Glycogen mg/g	6.9 ± 0.54 (9)	10.0 ± 0.80 (16)	+45%	<0.02
Pyruvic acid μg/g	10.0 ± 1.67 (6)	10.9 ± 2.51 (8)	+ 9%	>0.05
Lactic acid μg/g	558 ±65 (8)	459 ±122 (7)	−18%	>0.05

As regards the oxygen consumption and the glycogen content, significant differences between the muscles of autumn and winter frogs were obtained. It is noteworthy that the dispersion of the values is much greater in winter frogs. We give here the values of the coefficient of variability for the two series of experiments:

	Autumn	Winter
Oxygen consumption	16%	38%
Glycogen content	24%	32%
Pyruvic acid content	41%	65%
Lactic acid content	33%	71%

[1] In this paper, all the results are given in the form: mean ± standard error, in brackets the number of animals. Means were calculated after elimination of aberrant values, using Chauvenet's criterium.

In tables 2 and 3 the modifications induced by effort and by the following rest are given. The data are expressed as percentage differences between the value of the stimulated muscle and that of the control one. The oxygen consumption is given for different intervals in the Warburg apparatus; to these intervals 20 min are to be added, representing the time necessary to prepare the slices and equilibrate the temperature. Thus, the value given as for "10 min" expresses in fact the oxygen consumption in the interval from 20 to 30 min from stopping the stimulation.

Table 2

Modification of the oxygen consumption after effort

	10 min	30 min	60 min
Autumn series			
Percentage difference against control	+9.0 ± 7.2 (13)	+0.9 ± 2.8 (13)	−12.4 ± 2.2 (10)
P	← = 0.02 →		
Winter series			
Percentage difference against control	−22.7 ± 5.0 (7)	−11.7 ± 7.8 (6)	−2.8 ± 7.9 (6)
P	← = 0.05 →		
Degree of significance of the difference between the two series (P)	< 0.01	≅ 0.05	> 0.05

Table 3

Percentage modifications of the composition of the gastrocnemius, during the effort and the subsequent rest

	I Variant	II Variant	Difference	P
Autumn series				
Glycogen	− 20.1± 5.8 (9)	−40.0 ± 5.4 (7)	−100%	<0.05
Pyruvic acid	+131 ± 7.5 (5)	−1.4 ± 12.6 (8)	−101%	<0.001
Lactic acid	+352 ± 76 (8)	+161 ± 23 (7)	− 54%	<0.05
Winter series				
Glycogen	− 23.7 ± 3.1 (15)	− 7.5 ± 4.0 (15)	+ 68%	<0.01
Pyruvic acid	+ 32 ± 28 (6)	+ 9.3 ± 14.0 (7)	− 71%	>0.05
Lactic acid	+270 ± 86 (6)	+93 ± 64 (8)	− 66%	>0.05

In autumn frogs, the oxygen consumption of the exhausted muscle decreases more rapidly than that of the control one. In winter frogs, the initial differences are of opposite direction and their variation is also inverse (fig. 1). Extrapolating the curves of figure 1 we observe that at the cessation of stimulation (at zero time) the difference between the two series was still greater.

The values of the "excess lactate" [6] were calculated, in view of an estimation of the degree of anaerobiosis of the tissue[2]. These are given in Table 4.

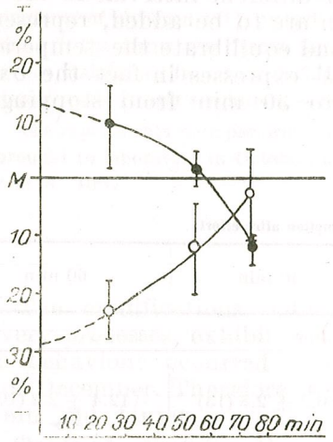

Fig. 1. — Difference between the oxygen consumption of stimulated and control muscles, at different time intervals from the stopping of the effort. ● = autumn frogs; ○ = winter frogs.

Table 4

Values of the excess lactate (mg/g) appeared during the effort and the subsequent rest

	I Variant	II Variant	Difference	P
Autumn series	1.2 ± 0.3 (6)	1.7 ± 0.3 (8)	+43 %	> 0.05
Winter series	0.6 ± 0.1 (6)	0.5 ± 0.2 (8)	−15 %	> 0.05
Difference	−50 %	−70 %		
P	> 0.05	< 0.01		

DISCUSSION

It is well known that an intense glycolysis occurs in muscles during the effort and thereafter, and leads to an at least partial resynthesis of the high energy phosphates consumed in effort. The breakdown o tho glycogen is thus to be considered as a step of the recovery process. On the other hand, the subsequent restoration of the diminished glycogen stock is also a recovery process.

Cori and his coworkers have shown that in isolated frog muscle, the normalisation of the glycolysis after an effort occurs in a few minutes [5]. However, it seems that this is true only if the effort has

[2] Huckabee gives the following expression for the calculus of the excess lactate: $XL = (L_n - L_0) - (P_n - P_0)\ (L_0/P_0)$, where L is the concentration of lactate, and P that of pyruvate, before the effort (0) and after them (n). We used an algebraically equivalent expression, that involves a smaller number of operations: $XL = L_n - P_n\ (L_0/P_0)$. One may use also the expression: $XL = P_n\ (L_n/P_n - L_0/P_0)$, that is advantageous when one needs also the values of the lactate/pyruvate ratio in the two states of the muscle.

been elicited by a rather low frequency of stimulation. Indeed, several authors emphasise a prolongation of the intensified glycolysis in the post-effort rest period; this was studied generally by lactate determinations from muscles and from blood [8], [9]. Our results obtained in autumn frogs by determination of the tissue glycogen are in agreement with the last cited data.

There are data in literature concerning the differences in chemical composition of the muscles, between the autumn frogs and the winter ones. Thus, during hibernation, the glycogen content increases, reaching its maximum in February [2], [10]; meanwhile the ATP content decreases, reaching its minimum at the end of the winter [1]. We have also established an increase of the glycogen content and at the same time a decrease of the oxygen consumption. It was suggested, as an explanation for the glycogen increase, in heterothermic mammals, that during the winter an intense gluconeogenesis takes place in the liver [7].

As far as the modification of the glycogen content during the recovery is concerned, we established a clear difference between the muscles of the two sets of frogs. Though the decrease of the glycogen content during the effort is the same in the two series, the metabolic behaviour of the muscles during recovery is quite different. In the winter frogs, after the 20 min of rest, no significant difference of glycogen contents is observed between the exhausted and the rested muscles. Thus, in these animals, not only there is no prolongation of the intensified glycolysis *after* the effort, but even a restoration of the glycogen stock of the fatigued muscle seems to take place. We cannot state exactly the way through which this restoration occurs. Perhaps, we have to do with a polymerization of the oses from the pool of the muscle tissue. The increase of the glycogen content seems to be about 1.5 mg per g of muscle.

Thus, metabolic recovery processes occur in the isolated muscles in both autumn and winter frogs, but these processes are of a different nature. In the muscles of autumn frogs the recovery develops on the way of restoration of the high energy phosphate pool through glycolysis, a process that has begun still during the effort; we have to do here with a kind of "metabolic inertia" of the muscle. In the gastrocnemii of the winter frogs this "inertia" does not appear, the metabolic processes being directed in a quite different way during the recovery period, as compared with the effort one.

As far as the seasonal variations of the time course of the oxygen consumption are concerned, we cannot give any interpretation.

In muscles of autumn frog, the great surplus of lactate and pyruvate that appeared during the effort decreases during the rest period. Of course, this does not imply an actual decrease of the *amount* of lactate: in isolated muscle the lactate concentration increases both in the stimulated and in the control one, during the whole period of maintenance in the air. What gets decreasing is the *percentage difference* between the lactate content of both muscles (see table 3). This shows that a part of the lactate surplus disappeared. A rough calculus may give the approximate value of this disappeared amount of lactate: in the first experimental variant, the quantity of glycogen of the stimulated muscle is

with about 1.5 mg/g less than that of the control muscle, and the quantity of lactate is higher with the same value; in the second variant, the difference is 2.5 mg/g for glycogen, but only 1.7 mg/g for lactate; it results that about 0.8 mg lactate per gram of muscle (i.e. about 9 μmoles) disappeared. This cannot be attributed to an oxidation of the lactate, since the plus oxygen consumption of the stimulated muscle in the first 20 min is only about 0.5 μmoles[3]; moreover, intoxication of the muscle with KCN does not prevent the disappearance of lactate. On the other hand, control experiments showed that neither lactate, nor glycogen, dextrine or glucose has diffused during the 20 min in the filter paper. Thus, we cannot state the way of disappearance of lactate.

It is noteworthy that, in spite of the disappearance of an appreciable amount of lactate, the "excess lactate" does not decrease during the rest. This fact leads us to the assumption that a great part of the oxygen debt is due to another substrate of the hydrogen ions than the lactic acid and this "alactacid" fraction [8] of the oxygen debt maintains the excess lactate at a high level.

In the muscles of winter frogs, the excessively great variability of the results for lactate and pyruvate does not allow a more detailed discussion of the values obtained.

Our results show that the seasonal differences between the autumn and the winter frogs are not restricted to the chemical composition of the tissues, but refer also to the nature and the degree of their homeostatic ability. The influence of the annual cycle is manifested not only on the regulatory functions of the organism as a whole, but also on the cellular or tissular regulatory phenomena, which determine the direction and intensity of the homeostatic processes of the tissues.

CONCLUSIONS

1. There are differences between the gastrocnemius of the autumn and winter frog, concerning both the chemical composition (less glycogen content in autumn), and the metabolic behaviour in rest (greater oxygen consumption), in effort (more excess lactate; opposite modification of the oxygen consumption), and in recovery (intense prolonged glycolysis in the muscle of the autumn frog, partial restoration of the glycogen pool in that of the winter one).

2. The lactate which is accumulated during the effort in the isolated muscle disappears partially during the subsequent rest period, without involving a decrease of the excess lactate value. This indicates that in the fatigued muscle there exists an accumulation of hydrogen ions also on another substrate than the lactic acid.

3. The recovery processes of the metabolism of fatigued isolated muscle are directed on different (even opposite) ways, depending on

[3] The lack of a quantitative concordance of the plus oxygen consumption with the accumulation of lactate in fatigued muscle was shown by Fenn [4].

season. This shows that there exist seasonal differences in the metabolic control not only at the level of the organism, but also at that of the tissular homeostatic processes.

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THE ACTION OF INSULIN AND ADRENALIN ON TISSUE GLYCOGEN IN *RANA RIDIBUNDA* *

BY

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Modifications in glycogen concentration in liver and muscles under the influence of adrenalin and insulin were investigated „in vivo" in *Rana ridibunda*.
Adrenalin (500 μg/kg) induced an evident diminution in the quantity of glycogen from both tissues particularly in the first 3 hours after administration.
At 12—18 hours after a dose of 50 IU insulin, as well as after 4 repeated daily 10 IU/kg doses, a diminution in hepatic and muscular glycogen concentration was recorded. This is probably due to some secondary influences of insulin, such as: stimulation of lipogenesis from glucides, or the entering into action of compensatory contrainsulin mechanisms as a response to the decrease in glycemia and the occurrence of convulsions.

The study of the influence of insulin and adrenalin on tissue glycogen concentration in amphibians was made especially by "in vitro" researches. To this purpose the liberation or absorption of glucose by isolated frog liver [4], [5], [7] — [9], [13], [20] or by slices of tissues, liver, muscles and urinary bladder was examined under the influence of the two hormones.

Modifications in hepatic and muscular glycogen concentration under the action of insulin and adrenalin "in vivo", have been little investigated [2] [6] [17] [18], some results being obtained, different from those recorded by the study of the effects of the two hormones "in vitro".

Proceeding from this fact, we undertook several series of experiments on *Rana ridibunda*, in which we examined modifications in the quantities of glycogen in liver and muscles, after insulin (alone or in combination with glucose) and adrenalin administration.

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MATERIAL AND METHOD

Experiments were undertaken on 95 adult, male and female specimens of *Rana ridibunda*, collected in the neighbourhood of Bucharest. The weight of the animals varied between 50 and 80 g. During experiments the animals were kept in a state of inanition in aquaria with a little running water.

The dosing of glycogen from liver and symmetrical gastrocnemian muscles was made by the Kemp method (1954) which permitted the use of small quantities of tissue (about 25 mg liver and 100 mg muscle).

In order to exclude individual variability and to be able to grasp modifications induced by the administration of a single dose of hormones, comparative dosings were made in the same lots of animals, 24 hours prior to injecting the hormone, and after a certain time interval from injection (1, 3, 6, 12, 18 or 24 hours in the case of insulin, and 3, 6, 12 or 24 hours in that of adrenalin).

The values obtained after the administration of repeated daily doses were compared however to those of a control lot.

"Biofarm" (1‰) adrenalin and (40 IU/ml) insulin solutions were used, which were injected into the dorsal lymphatic sacs after dilution with saline solution.

The investigated adrenalin dose was of 500 μg/kg, the experiments being carried out in the months of March-April, at a temperature of 17°—20°C.

Insulin was administered in a single dose (50 IU/kg) or repeated daily (10 IU/kg), alone (for 4 days) or simultaneously with glucose, 1 g/kg (for 5 days). The experiments were carried out in June-July at the temperature of 21°—24°C.

RESULTS

Influence of adrenalin

Results are presented in table 1.

The glycogenolytic effect of adrenalin is very visible in both tissues. The maximum decrease in glycogen concentration in liver and muscles occurs in the first three hours. A smaller quantity of glycogen than before injection was likewise recorded after 6, 12 and even 24 hours, though the difference was smaller and statistically less significant.

Influence of insulin

The data obtained after the administration of the dose of 50 IU insulin/kg b.w. are presented in table 2.

The analysis of these data shows an evident diminution in glycogen concentration both in liver and in muscles. This diminution sets in with greater difficulty and statistically is less significant in liver (18 hours, $p < 0.05$) than in muscles (12 hours, $p < 0.01$).

In the case of repeated daily administrations of 10 IU insulin/kg b.w., frogs frequently presented convulsions, which after 3—4 days resulted in death. We therefore could not continue the treatment beyond a

Table 1

Modifications of hepatic and muscular glycogen concentration under the influence of adrenalin in *Rana ridibunda*. Average differences are presented between values recorded 24 hours prior to the administration of adrenalin, and those ascertained in the same lots of animals after 3, 6, 12 or 24 hours from injecting the hormone

Average difference ± SE $SE = \sqrt{\frac{\varepsilon(\bar{x} - x_1)^2}{n(n-1)}}$

No	Hepatic glycogen									
	0		3		6		12		24 hours	
1	5.84	6.69	10.40	9.40	8.70	5.20	18.35	15.53	13.35	9.50
2	9.20	8.00	3.30	0.96	5.53	5.07	4.30	6.00	12.76	8.00
3	7.61	7.14	10.36	6.08	4.25	2.46	16.46	13.83	5.00	5.75
4	12.20	12.60	13.53	10.00	13.41	11.00	1.56	1.50	13.00	11.80
5	—	—	10.40	6.00	—	—	11.27	9.30	—	—
AD ± SE	−0.10±0.43		−3.11±0.65		−2.04±0.64		−1.13±0.88		−2.26±1.02	
p	p>0.1		p<0.01		0.02<p<0.05		p>0.1		p>0.1	

No	Muscular glycogen %									
	0		3		6		12		24 hours	
1	0.70	0.62	1.09	0.75	1.28	0.85	0.70	0.52	0.62	0.48
2	0.84	0.76	1.02	0.36	0.77	0.71	0.45	0.10	0.35	0.34
3	1.14	1.05	0.45	0.12	0.12	0.50	0.50	0.22	0.48	0.43
4	0.15	0.19	1.60	1.25	0.10	0.07	1.00	0.81	0.23	0.11
5	—	—	—	—			1.15	1.10	—	—
AD ±SE	−0.05±0.03		−0.42±0.08		−0.16±0.09		−0.27±0.73		−0.08±0.024	
p	p > 0.1		0.01<p<0.02		p>0.1		p = 0.02		p > 0.02	

few days. The quantity of glycogen found in the liver and the gastrocnemian muscle of animals which resisted to 4 daily injections was smaller than in control animals (table 3). Statistically the diminution was of little significance in liver ($p = 0.1$) and highly significant in muscles ($p < 0.01$).

In animals treated merely with glucose, we found more glycogen in liver and muscles than in those treated simultaneously with insulin and glucose (Table 3).

DISCUSSION

The results obtained "in vitro" [4], [7], [19], as well as "in vivo" [2], [6] prove beyond doubt that in amphibians adrenalin has, as in the other vertebrates, a stimulative effect on glycogenolysis.

Our experiments offer particulars concerning the evolution in time of this effect, which may give indications as to how adrenalin intervenes in regulating glycemia of amphibians. Thus the maximum intensity of adrenalinic glycogenolysis in the first 3 hours after administration

Table 3

Influence of repeated insulin and glucose administration, separate or in combination, upon glycogen concentration in liver and muscles in *Rana ridibunda*

No	Mode of determination	Control animals	10 UI insulin/kg daily for 3—4 days	1 g glucose/kg daily for 5 days	10 IU insulin/kg and 1 g glucose/kg daily for 5 days
1	Hepatic glycogen % M ± SE (extr. values) %	4.92 ± 0.76 (1.52 — 12) 100	2.70 ± 0.41 (1.48 — 4.06) 55.00	13.02 ± 0.62 (10.41 — 18.68) 264.60	6.89 ± 0.80 (3.00 — 9.24) 140.00
	p to control values		p = 0.1	p < 0.01	p > 0.1
	p (to the values of the lot with glucose)				p < 0.01
2	Muscular glycogen % M ± SE (extr. values) %	0.48 ± 0.055 (0.19 — 0.96) 100	0.28 ± 0.04 (0.19 — 0.37) 58.33	1.04 ± 0.10 (0.53 — 1.63) 216.66	0.34±0.083 (0.18 — 0.47) 79.20
	p to control values		p < 0.01	p < 0.01	p > 0.1
	p to the values of the lot with glucose				p < 0.01

likewise accounts for the great amplitude of adrenalinic hyperglycemia in the first hours.

The persistency of glycogenolysis induced by adrenalin may contribute, beside other factors (a slow metabolization of glucose freed by glycogenolysis, a certain inertia of compensating insulin system, peculiar to frog organism, which does not react rapidly to glycemia modification), to the preservation of adrenalin hyperglycemia for a long time in amphibians [10].

The phenomenon was likewise recorded by Plisetskaia in cartilaginous [14] and osseous [15] fishes and was connected to a slower inactivation of the hormone by the organism of fishes.

If the glycogenolytic action of adrenalin is a well established phenomenon in amphibians, as regards the action mechanism of insulin on carbohydrate metabolism in these animals, there are some contradictory results.

In "in vitro" experiments it was recorded that by adding insulin to perfusion fluid [7], [8], [13], or by injecting frogs with insulin, prior to liver extirpation [9], [19], a diminution in spontaneous liberation of glucose is induced, and then an inhibition of glycogenolysis. At the same time it was recorded that adrenalin mobilizes glucose from the liver of control animals to a greater extent than in animals treated with insulin [9].

Nevertheless, "in vivo" there appears a diminution in glycogen concentration in the liver and muscles of animals treated with insulin, not an increase, as might have been expected (Smith [18] in *Rana temporaria*, our experiments on *Rana ridibunda*). Yanni (cit. [15]) and Plisetskaia [15] recorded the same thing in fishes.

The phenomenon is difficult to be accounted for, particularly as more recent investigations show that insulin diminishes visibly the hepatic

Table 2

Influence of the dose of 50 IU insulin/kg body weight on glycogen concentration in liver and muscles, in *Rana ridibunda*

No	Hepatic glycogen %													
	0		1		3		6		12		18		24 hrs after insulin administration	
1	2.00	2.17	5.37	6.07	4.25	4.82	3.22	2.05	3.77	3.66	8.65	3.33		
2	8.30	7.84	7.64	8.10	3.24	2.74	2.00	2.68	5.27	4.79	4.41	4.32		
3	5.20	5.64	6.51	7.00	4.65	4.60	3.50	3.40	1.50	1.27	4.85	1.30		
4	6.24	5.61	4.00	3.33	4.00	4.34	2.66	2.23	3.30	3.20	7.61	3.35		
5	—	—	—	—	5.44	3.65	—	—	—	—	—	—		
AD ± SE	−0.21 ± 0.38		+0.24 ± 0.30		−0.28 ± 0.50		−0.25 ± 0.36		−0.23 ± 0.08		−3.33±1.08			
p	p > 0.1		p > 0.1		p > 0.1		p > 0.1		p > 0.1		p < 0.05			
No	Muscular glycogen													
	0		1		3		6		12		18		24	
1	0.33	0.30	0.60	0.66	0.61	0.82	0.19	0.05	0.69	0.32	0.76	0.63*	0.18+	0.02
2	0.61	0.53	0.50	0.46	0.52	0.24	0.79	0.70	0.39	0.21	1.14	0.46*	0.28	0.10
3	0.17	0.18	0.27	0.21	0.61	0.37	0.15	0.11	0.42	0.24	0.40	0.19*	0.25	0.03
4	0.40	0.30	0.43	0.34	0.64	0.24	0.29	0.05	0.40	0.29	0.90	0.88*	0.40	0.08
5	—	—	—	—	0.19	0.05	—	—	—	—	0.91	0.37*	—	—
AD ± SE	−0.05 ± 0.025		−0.032 ± 0.032		−0.176 ± 0.103		−0.126 ± 0.042		−0.21 ± 0.060		−0.312±0.128		−0.22± 0.035	
p	p > 0.1		p > 0.1		p > 0.1		0.05 < p < 0.1		0.02 < p < 0.05		0.05 <p<0.1		p <0.01	

* Animals which underwent convulsions. Determinations were made after convulsions.

glucose-6-phosphatase activity in fishes and frogs, favouring in this way the glycogen synthesis in the liver [16]. It could be the result of some secondary influences, such as the stimulation by insulin of lipogenesis from glucides, or the entering into action of compensatory contrainsulinic mechanisms, as a response to the decrease in glycemia and the occurrence of convulsions.

The dose of 10 IU insulin/kg b.w. repeatedly administered to *Rana ridibunda* being convulsive, it was likewise accompanied by the decrease in glycogen concentration in liver and muscles.

As regards the influence of insulin on glucose tissue absorption in amphibians, Candela et coll. [3] failed to record an accelerating effect of insulin on muscles "in vitro", while Narahara and Özand [11] recorded an increase in the permeability for glucose of the membrane of muscular cells under the action of insulin (researches with 3-methyl glucose H^3).

In liver, insulin increases glucose retention particularly for low hexose concentrations in perfusion fluid. In the case of high concentrations, the difference between the quantity of glucose retained by the liver of animals treated with insulin and that of control animals is insignificant [14].

In our experiments we found a smaller quantity of glycogen in the liver and muscles of animals injected for five days with insulin and glucose than in animals which only received glucose. It is possible that animals may have used part of the exogenous glucose for surviving during the chronic insulin treatment. It is thus that lethality induced by insulin administered alone was twice as high (60%) as that caused by insulin and glucose administered simultaneously (30%).

Table 4

Influence of repeated insulin administration upon glycogen concentration in liver and mucles in *Triturus vulgaris*

No	Mode of determination	Normal animals	5 IU insulin /kg daily for 5 days (21 hrs from last inject)	1 g glucose/ kg daily for 7 days (24 hrs from last inject.)	5 IU insulin/kg and 1 g glucose/kg daily for 7 days
1	Hepatic glycogen %	3.97	3.33	5.25	10.55
2		9.47	3.25	5.90	8.95
3	(June 25—26°C)	2.32	6.94	4.46	8.74
4		2.72	3.41	5.00	7.90
5		4.16	4.65	5.13	8.81
6		5.79	4.29	5.15	7.55
	M ± SE	4.74±1.07	4.31±0.57	5.13±0.19	8.75±0.43
	%	100	90.92	108.20	184.80
	p		p > 0.1	p > 0.1	p < 0.01
1	Muscular glycogen %	0.62	0.22	0.10	0.66
2		0.61	0.67	0.49	0.85
3		0.58	0.40	0.51	0.99
4		0.42	0.58	1.29	0.83
5		0.43	0.54	0.62	0.79
6		0.27	0.48	—	0.82
	M ± SE	0.49±0.05	0.48±0.06	0.60±0.15	0.82±0.01
	p		p > 0.1	p > 0.1	p < 0.01
	%	100	97.96	122.45	167.34

In some of our experiments on *Triturus vulgaris* with a smaller dose of insulin (5 IU/kg), animals did not undergo convulsions, and deposited a larger quantity of the administered glucose under the form of glycogen, both in liver and muscles, than animals which were treated only with glucose (table 4).

CONCLUSIONS

1. Adrenalin stimulates hepatic and muscular glycogenolysis in *Rana ridibunda*. This action is manifested more intensively in the first 3 hours, but is continued, though with lesser intensity, for more than 6 hours, which partially explains the persistence of adrenalinic hyperglycemia for a longer period of time.

2. The administration of insulin to *Rana ridibunda* is accompanied, at 12—18 hours after injection, by a decrease in hepatic and muscular glycogen concentration.

3. By injecting glucose and insulin, an intensification of glycogen stores in liver and muscles may be obtained, only if such a relationship between the two substances is ensured, that the insulin dose is not convulsive.

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THERMOREGULATION AND GLYCEMIA IN ONTOGENESIS OF *MESOCRICETUS AURATUS* WATERH.*

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The authors have recorded that in hamsters in the process of the occurrence and stabilization of chemical thermoregulation, four well-defined stages are discerned. In the first days the young ones are quasi-poikilothermic, while the transition towards the homeothermic type takes place between 3 and 7 days. The great metabolic oscillations, as well as the body temperature ones, in hamsters during ontogenesis evolution are due to the incomplete development of regulating mechanisms.

In heterotherms thermoregulating mechanisms present specific particularities during ontogenetic development. Thus, according to the few data existing in literature, it is recorded that in the first days after birth, young hedgehogs [11], ground squirrels [8] and marmots are characterized by total poikilothermy. Unlike these animals, the hamsters (according o data obtained by us [12] on young animals born in the period October—November) are not completely poikilothermic, while thermoregulation presents a phasic character. The period of occurrence and stabilization of thermoregulation in heterotherms is influenced by the temperature of the environment [5], [10]. In this sense the knowledge of thermoregulation particularities, as well as that of certain energetic sources necessary to the development of these processes in ontogenesis (glycemic level), in hamsters, constitutes the object of our investigations.

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REV. ROUM. BIOL.—ZOOLOGIE, TOME 14, Nº 1, p. 71—77, BUCAREST, 1969

MATERIAL AND METHOD

Researches were undertaken on 40 young specimens between 1—30 days old, issued from 5 females, in the period May-June 1967. Environment temperature 28—30°C.

Oxygen consumption was recorded by means of a thermostat installation within temperature limits of 10—38°C (with 5°C intervals). The average duration of each determination was of 25 min., in order to exclude the possibility of animals catching cold or of their being starved for a long time, which influences thermoregulation.

Glycemia was determined on a number of 49 specimens by the Hagedorn-Jensen method. Blood taking was always done in the first hours of the morning.

Data were computed statistically.

RESULTS

In figures 1 and 2 the results obtained in ontogenesis on thermogenesis evolution in the hamster are presented.

By examining these data, it is found that in the first 24 hours after birth, the reaction of the organism to low temperatures is slight, oxygen consumption not exceeding 0.0024 cu.cm/g/min within the temperature limits of 10—25° C; a slight increase in metabolism can be recorded after 48 hours, which is maintained at about the same level up to 5 days. At high temperatures of 30—38°C, the values of the metabolism are at their maximum during this time interval. Thus, the reaction of the organism to modifications of environment temperature of 10—25°C, is little differentiated between 3 and 5 days.

Between 7 and 13 days, an intensification of the metabolism is produced, its level thus recording maximum values between 10 and 25°C. Frequent, irregular oscillations are then recorded, metabolism gradually diminishes, while between 21—28 days its basal level, characterizing a homeothermic condition, approaches that of adult animals.

It is to be observed that at high temperatures of 35—38°C, the metabolism remains almost constant, with slight variations, for 1 to 10 days, after which a gradual diminution follows, up to 28 days. If for the first fortnight the temperature of 30—38°C represents for the young animal a thermic optimum, i.e. nest temperature, after this period it is gradually transformed into critical temperatures (30°C).

Body temperature stabilization is produced slowly and generally later than chemical thermoregulation.

Body temperature in the young hamsters

Age	Temperature	Observations
1 day	25°C	hairless, blind
7 days	28.5°C	hair is noticed on abdomen and back
14 days	29.8°C	It is being slightly covered with hair, eyes partially open
21 days	30.2°C	Completely covered with hair, eyes open
30 days	33°C	idem

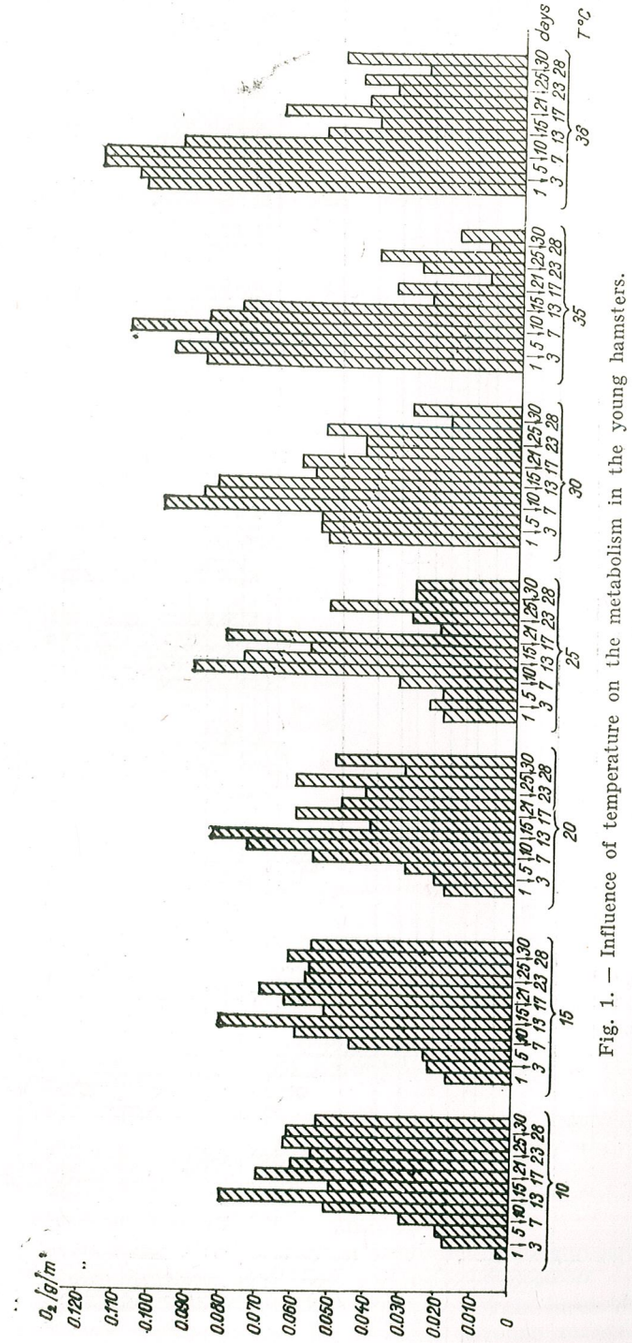

Fig. 1. — Influence of temperature on the metabolism in the young hamsters.

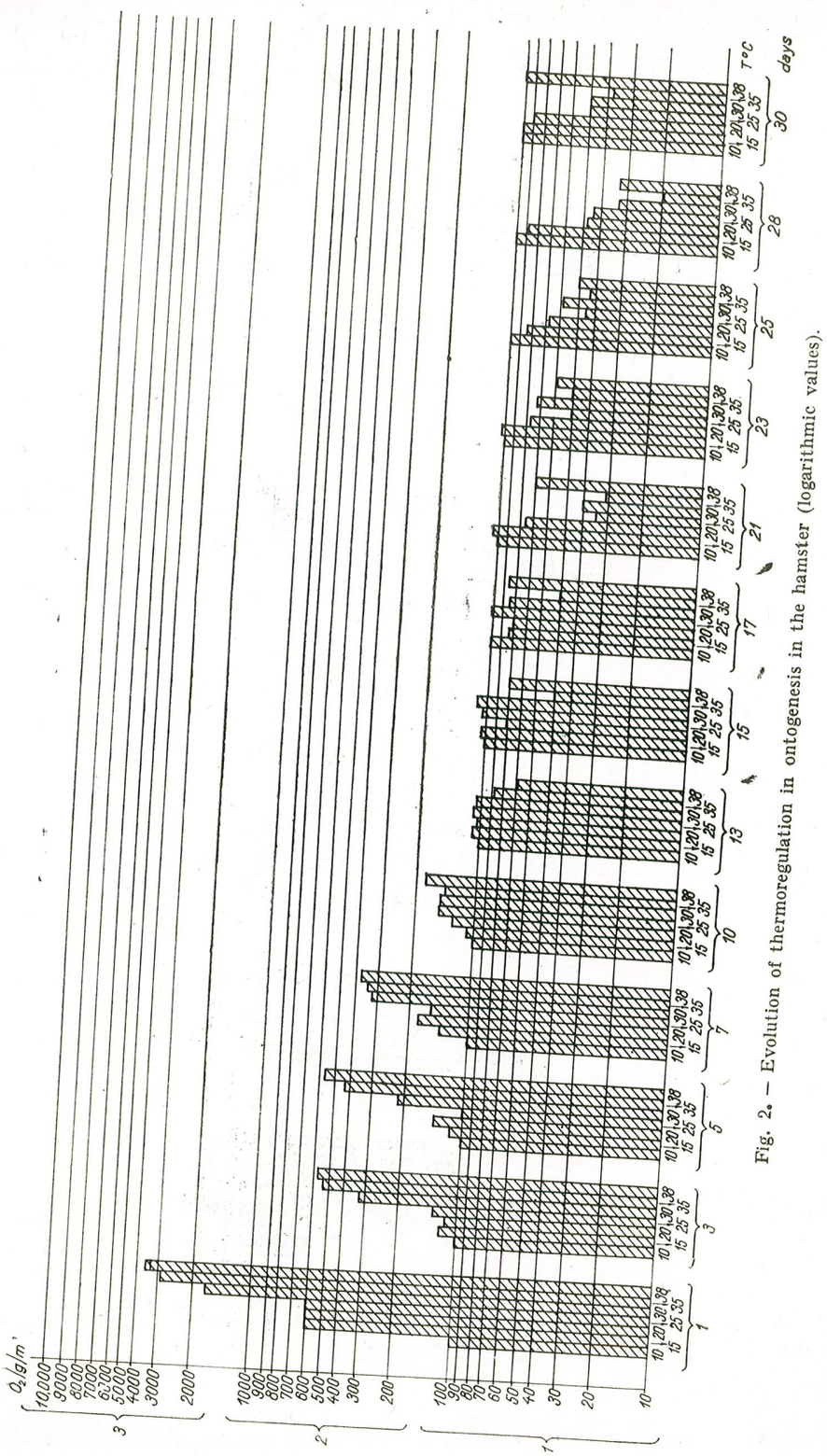

Fig. 2. — Evolution of thermoregulation in ontogenesis in the hamster (logarithmic values).

Glycemia in the young hamsters is relatively low in the first three days, representing 65 mg% glucose. Between 5—7 days, the glycemic level reaches 127 mg % glucose, in order to record, after three weeks, 257 mg/100 ml blood. After this period a gradual decrease is produced; at 28 days, glycemic values are of 176 mg % glucose. The glycemic level is probably stabilized after 30 days. Investigating this index in adult animals, an average value of 117 mg % glucose is ascertained, a certain difference according to sex being rendered evident. Thus females have a basal glycemic level by 23% higher than that of males.

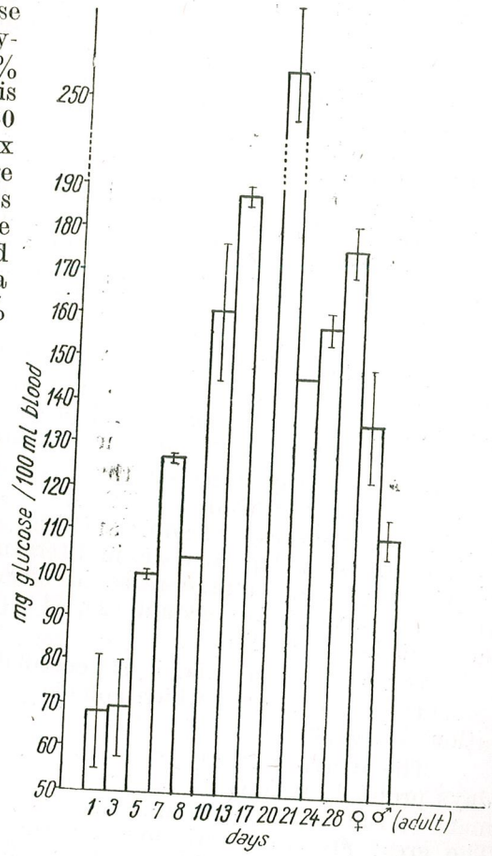

Fig. 3. — Glycemic values in ontogenesis in the hamster.

DISCUSSION

The results shown in the present paper agree to the data previously obtained by us, namely that in the first few days the young hamsters differ from certain heterothermic and homeothermic animals (hedgehogs, dormice) by their being very sensitive to environmental temperature oscillations. The decrease or increase of environmental temperature induces sudden modifications of metabolism and body temperature.

In the occurrence and stabilization process of chemical thermoregulation 4 stages are recorded in hamsters:

1. quasipoikilothermy (in the first 48—50 hours from birth) characterized by a small oxygen consumption at low temperatures;
2. transition towards the homeothermic type, between 5 and 7 days, oxygen consumption being intensified and body temperature on the increase;
3. actual homeothermy from 10 to 17 days. Metabolism oscillations are characteristic of homeothermic animals;
4. at 17—30 days stabilization of chemical thermoregulation and of basal metabolic level.

Unlike hamsters, the young of ground squirrels have during ontogenesis three stages characterized by a more intense metabolism [11],

those of rats two, while guinea pigs are homeothermic immediately after birth.

Unlike other research workers [4], Baric has shown that rats are homeothermic the first day after birth, but only after being fed. The degree of development of chemical thermoregulation is conditioned, on the one hand by nest temperature, and on the other by that of the surrounding environment. The young of hamsters born in the period May-June, and kept at a lower environmental temperature (25—26°C) than the autumn one (30°) had a more intense metabolism, and thermoregulation better expressed.

Djelineo [4] has shown that in conditions of a low temperature, of +10 to +12°C, chemical thermoregulation in rats sets in at the end of the first week, while at temperatures of +23 to +25°C, at 10 days. As a consequence, low temperature and, particularly, its oscillation constitute an important factor which stimulates thermoregulation in ontogenesis.

Low rectal temperature, as well as its oscillations during ontogenetical development are not due to a condition of hypothermy or hyperthermy, but by their being normal processes of organism in the first few days of life, when regulating mechanisms are insufficiently developed.

It is generally observed that in ontogenesis, physical thermoregulation in mammals and particularly in hamsters covers a longer way to the level characteristic of adult animals, as compared to chemical thermoregulation. According to data in literature, most mammals present great variations of body temperature in ontogenesis, excepting guinea pigs, whose temperature is constant [2], [4], [5], [7], [10], [11] already from the first hours of life.

As regards glycemia, it is recorded that in ontogenesis this index presents several stages, which coincide, up to 21 days, with thermoregulation development level.

The increase in glycemic level to a maximum between 5 and 20 days probably represents the energetic support necessary to the development of the nervous system, and particularly of the intermediary brain. The great glycemic variations existing between 1—3 days, as well as between 10—20 days, show that glycemic homeostasis is produced later than the thermic one.

CONCLUSIONS

By analysing the data obtained, the following conclusions may be drawn:

1. In ontogenesis, thermoregulation in hamsters covers four well expressed stages: quasipoikilothermy, transition towards homeothermic type, actual homeothermy and stabilization period of chemical thermoregulation.

2. In the young born in spring periods and reared at low temperatures, thermoregulation occurs earlier and is well expressed.

3. Stabilization of chemical thermoregulation takes place between 17 and 30 days.

4. In ontogenesis, glycemia in hamsters presents maximum values between 10 and 28 days. An evident parallelism is ascertained between the evolution of glycemia and that of the function of thermoregulation.

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INFLUENCE OF THE MAGNETIC FIELD (MF) ON GLYCEMIA, PYRUVIC ACID (PA) AND LACTIC ACID (LA) IN WHITE RAT BLOOD*

BY

V. HEFCO, ELENA HEFCO and CONSTANȚA BÎRCĂ

The variations of LA, PA and glycemia in white rat blood following treatment with MF daily during 5 minutes over periods of 5, 10, 15 and 20 days were investigated. MF intensity is presented in figure 1.

A significant decrease of PA and LA occurs after 5 and 10 treatments, the maximum effect appearing after 5 treatments. After this period the values revert to normal or are even higher than normal.

Glycemia decreases significantly after 10 treatments.

Different possibilities of action of MF on living organisms are discussed.

Some correlations with changes of other parameters appearing in the same conditions are presented.

A problem more and more intensely investigated during the last years is the existence or non-existence of certain influences of MF on animal and plant organisms. In this regard the magnetic properties of biological material and the influence of MF on various vital parameters are investigated, but the last research direction prevails quantitatively.

This work tries to enhance the possibilities of knowing MF effect, following the variations of glycemia, PA and LA in white rat blood.

MATERIALS AND METHODS

The experiments were carried out in male white rats divided into lots according to the number of MF treatments. For each lot there were corresponding controls with a body weight very close to that of the treated animals. The weight of the animals is indicated in table 3.

* This work was communicated at the National Session of Physiology, Bucharest, 1967.

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The treatment was effected with MF generated by a system of coils connected in series but with inverted poles thus increasing the field gradient. They were supplied by a periodical rectangular current with one-second interruption at every 3 seconds, and a frequency of 50. Hz. The MF intensity is given in figure 1. The various lots were daily submitted to

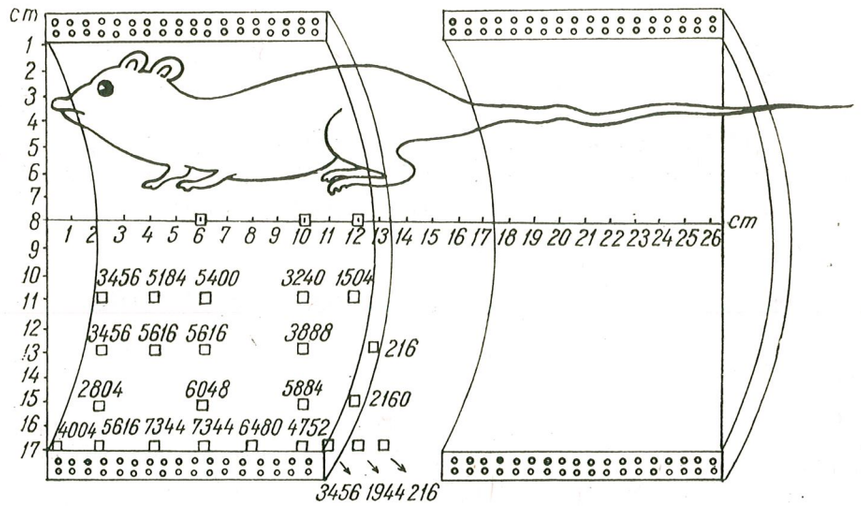

Fig. 1.—A cross section through coils with MF plotted, in Ampers/m.

MF treatment during 5 minutes for periods of 5, 10, 15 and 20 days. The animals were oriented paralelly to the direction of force lines. Twenty hours after the last treatment, the animals were killed by decapitation and parameters were determined. In order to avoid the effect of animal manipulations during the treatment upon the test values, which could, according to our observations produce significant variations, the control animals are submitted to the same kind of operations by introducing them in a dummy solenoid.

Before the experiment the animals were starved for 18 hours.

PA was determined according to Friedemann and Haugen's method [5].

LA was assayed by Barker and Summerson's colorimetric method [1] by photometry at 560 mμ and glucose was determined by Nelson's method [13].

RESULTS AND DISCUSSION

The results are given in tables 1—4.

We have not calculated for all indices an average of control animals of different series, because the weight of the animals was different and the tests were run in several periods of time (January, May-June). When the average of different lots was the same, the overall results were calculated.

From the presented tables it results that PA in the treated lot compared with that in the corresponding control lot, significantly decreased after 5 and 10 treatments, the maximum effect occurring after 5 treatments. After 15 treatments there appears an insignificant decrease and after 20 treatments an insignificant increase of PA values is noticed in treated animals, when compared to controls. The same situation is observed also for LA: a maximum of decrease occurs after 5 treatments, at 10 days the decrease is still significant, at 15 days it is insignificant and after 20 treatments an insignificant increase of 6% may be observed.

MF with a similar intensity supplied by sinusoidal currents was used by us to obtain variations in PA and LA in the same sense and approximately of the same intensity in lots of adult guinea pigs. It results that increased shock in the case of rectangular current seems to present no importance.

A significant decrease in blood sugar level is to be noticed only after 10 treatments; it tends to revert to normal values after 15 treat-

Table 1

The level of PA in mg/100 ml blood in white rats. The per cent differences and p are calculated against the corresponding control lots

Lot		Average ± SE[a]	Difference (per cent)	p[b]	Number of animals
Control for 5, 10 and 15 treatments		2.00 ±0.04	—	—	34
Treated during 5 days		1.66 ±0.09	−17	<0.001	12
Treated during 10 days		1.84 ±0.06	− 8	<0.05	14
Treated during 15 days		1.90 ±0.05	− 5	insignificant	9
20 days	Control	2.368±0.09	—	—	7
	Treated	2.43 ±0.1	+ 2	insignificant	9

Table 2

LA level in mg/100 ml white rats blood. The per cent differences and p are calculated against the corresponding control lots

Lot		Average ± SE[a]	Difference (per cent)	p[b]	Number of animals
Control for 5, 10 treatments		9.03±0.34			23
Treated during 5 days		7.05±0.51	−22	<0.01	12
Treated during 10 days		7.77±0.59	−14	<0.05	14
15 days	Control	8.30±0.34	—	—	8
	Treated	7.90±0.45	− 5	insignificant	9
20 days	Control	6.79±0.52			7
	Treated	7.20±0.50	+ 6	insignificant	9

Table 3

The influence of MF on white rats glycemia (mg per cent)

Lot		Average ± SE[a]	Difference (per cent)	p[b]	Number of animals	Weight of animals
5 days	Control	80.4±3.9			12	193+6
	Treated	73 ±3.7	−10	< 0.5	11	192+6
10 days	Control	81 ±2.24	—	—	15	166+10
	Treated	73 ±1.41	−10	< 0.01	14	165+5
15 days	Control	68 ±2.53	—	—	8	155+5
	Treated	66 ±3.1	− 3	insignificant	9	159+4
20 days	Control					170+7
	Treated					168+8

a = Standard error
b = Probability of this difference

Table 4

The ratio LA/PA variation in white rats submitted to MF treatment

Control (C)	Treated, days (T5d)	T10d	C15d	T15d	C20d	T20d
4.51	4.2	4.2	4.15	4.15	2.86	2.96
Difference (per cent)	−7%	−7%	—	0%		+3%

ments. After 5 treatments the variations still remain insignificant; in several experimental lots the level of glycemia remains unchanged or even higher than normal.

The data presented here point out that — in general — the variations arising after MF treatments are highly dependent on treatment duration, which must be considered in the case of generalization of the effects induced by MF. Sometimes these kinds of modifications have a phase feature. Naturally in PA, LA as well as in other cases [6] the most evident effect arises after 5 days of treatment; in the case of glycemia an evident effect is noticed only after 10 days of treatment. Hence, referring to this period we cannot speak of the appearance of an adaptation phenomenon to the action of this factor.

Exploring MF we must have in view its different possibilities of action on living organisms:

1. The action of MF on biocurrents, on living organisms in motion, or only on different parts in motion, considering that they may be non-neutral from an electrical point of view [6].

2. The MF action on tissues, structural elements, or the whole living organism, which leads to magnetical polarizations and the appearance of motion overimposed phenomena. Our researches have demonstrated that MF produces more evident effects when it acts on the whole

organism than when its action is directed over an isolated organ or an enzyme *in vitro* [7].

3. The MF action on excitable structures may be related to the change of Na and K gradient according to the fluctuations of the water molecule which hydrates the ions and protein molecules in the upper layer of the cellular membrane [15].

4. The action of MF on various molecules consists mainly in two effects: orientation of particles in MF [4] and their displacement in the weaker or stronger zone. Our observations show that the effect produced by the nonuniform MF is stronger than that obtained in a MF having the same intensity but a much greater uniformity.

MF interruptions are highly important in arising biological effects of MF. The application of the former leads to an enhancement of phenomena and even to the appearance of opposite effects.

Most of the substances which enter the general composition of living organisms are diamagnetic. The biocurrents are of reduced size. Hence we can expect that MF generally exhibits a weak action on living organism. An exception is presented by such phenomena of living matter in which the substance metabolism is most intense; in other words in those parts where the macromolecules can interact, displace each other and be oriented, and also in the processes in which the biocurrents represent the essential element. In fact the data presented in literature [14], [16] and from our observations reported in 1965 and later [7] showed us that the young organisms, where the mitotic phenomena are more intense, are highly reactive. This type of response of the young organisms in our experimental conditions supports once more the affirmation that MF with the given characteristics does not constitute a stressing factor [17]. Otherwise the modifications observed in young animals ought to be diminished comparatively to those in adult animals [3].

As we stated, in order to obtain reproducible results, the investigation of living animals in MF requires adoption of several measures for preventing the intervention of various additional factors in the experiment. It is necessary to have as far as possible a quite exact knowledge of the configuration of utilized MF and to take into consideration and avoid the dispersion fields against the environmental ferromagnetic objects. The maintenance of a constant temperature inside the coil is another essential factor for reproducible results. It is known that at 39.5°C surrounding temperature the effect of a 6200 gauss MF is identical with that of a decrease of temperature with 1.5°C. To all this, we must add the fact, observed by us, that "the magnetic sensitivity" of various individuals is not the same [7].

The results agree with other results obtained in identical conditions. Investigating the influence of MF on oxidative phosphorylations we have noted an increase of inorganic phosphate esterification, so that the P/O ratio increases with 20 per cent. This increased ATP content at mitochondrial level indicates an enhanced degradation of metabolites by tricarboxylic cycle pathway, ATP acting at the same time as a regulator of glycolytic processes [8], [12], [18]. This agrees with PA and LA variations in the first days of treatment, when a decrease of their values occurs. Because the level of the investigated acids tends to return to normal,

or even to increase, it may be presumed that after a great number of treatments the level of cellular oxidation coupled with phosphorylations will decrease. The intensification of oxidative processes during the first days of treatment also results from the LA/PA ratio, when the latter decreases in the first 10 days. After 15 days of treatment the ratio remains unchanged, and after 20 days of treatment a slight increase of glycolytic processes is observed.

It is possible that the pronounced decrease of pyruvate and lactate, after the first treatments, may be due to the intensification of some other degradation pathways of endogenous pyruvate. Thus, by correlation with other results, we can admit an intensification of pyruvate transformation to amino acids [10]. The increase of nucleic acids content would advocate for our suggestion that the increase on pathway degradation occurs through the pentose phosphate cycle [6]. It is possible, as it results from the presented data, that the more intensive degradation of pyruvate may be effected by several pathways.

The increase of PA and LA levels, after the first 5 days of treatment, exhibiting the tendency to return to normal or even to exceed the normal values, is probably due to a more intense glucose consumption. At the same time an increase of hepatic glycogen may be observed (unpublished data). The results that point to a decrease of K^+ level in blood, as well as the increased level of the same ions in cells [6], [2], confirm the decrease of glycemia observed by us.

Data referring to the intensification of pyruvate degradation in different ways, the hypoglycemia, the increase of hepatic glycogen and of animals weight, lead to the conclusion that MF influences neurohormonal systems involved in different levels of glucidic metabolism. This will be the object of further studies.

CONCLUSIONS

1. PA, LA and glycemia of white rats blood vary under the influence of MF.

2. The character of these variations depends on the duration of the treatment. Maximum variations appear after 5 days of treatment in the case of LA and PA and in the case of glycemia after 10 treatments.

3. Variations are due to changes occurring under the influence of MF in systems of metabolic neurohormonal regulation.

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N. BOTNARIUC, **Principii de biologie generală** (Principes de Biologie Générale) 242 pp., 10 figs., Editura Academiei, Bucarest, 1967.

Ce livre n'est ni un manuel, ni un précis de Biologie générale mais bien un essai de présenter de manière synthétique les principaux problèmes de la Biologie, en adoptant la théorie des systèmes formulée par L. von Bertalanffy, seule théorie qui permet d'expliquer un certain nombre de phénomènes, apparemment contradictoires.

Le premier chapitre, « Organisation systémique de la matière vivante », explique la notion de système et donne des indications sommaires sur la théorie de l'information dans les systèmes biologiques ; ces systèmes sont caractérisés par l'intégralité (un système complexe n'est pas seulement la somme des parties composantes), le programme (modification future possible du système, déterminée par sa structure), l'équilibre dynamique, l'autoréglage. L'auteur admet trois niveaux biologiques fondamentaux : l'individu, l'espèce (la population) et la biocénose.

Le second chapitre traite des phénomènes caractérisant les systèmes biologiques au niveau de l'individu. L'intégralité de l'individu est plus forte que celle de l'espèce et de la biocénose ; l'intégralité individuelle s'accentue au cours de l'embryogenèse et de l'évolution phylétique. Le problème de l'hérédité est traité selon les dernières données de la génétique moléculaire ; l'auteur adopte l'opinion selon laquelle on n'hérite pas des gènes isolés, mais des systèmes génétiques intégrés ; on discute l'autoréglage des processus métaboliques, son principal effet — le caractère adéquat de la variabilité des organismes — et la variabilité biochimique. Le chapitre finit par la constatation que les réactions individuelles ont un caractère adéquat pour l'individu, mais se font « au hasard » du point de vue des intérêts de l'espèce ; c'est la sélection qui décide de leur sort.

Le troisième chapitre traite de l'organisation et du fonctionnement des systèmes au niveau de la population (de l'espèce). On démontre l'intégralité de l'espèce : relations réciproques entre différents groupes d'âge, entre sexes, etc. à l'intérieur d'une population, le caractère adaptatif de l'amplitude de la variabilité individuelle, l'autoréglage des populations. La sélection naturelle agit en premier lieu sur les populations, pas sur des individus isolés. Les facteurs déterminant les formes et la direction d'action de la sélection sont : la nature de l'espèce, le nombre d'individus composant une population, le mode de reproduction. (Tout en insistant sur les différences entre espèces à sexes séparés et agames, l'auteur considère que ces dernières sont, grâce au jeu de la sélection naturelle, tout aussi réelles que celles bisexuelles). On insiste sur le fait que l'adaptation est un phénomène propre au niveau spécifique.

Le chapitre suivant traite du niveau de la biocénose. L'autoréglage dans la biocénose dépend des relations interspécifiques qui sont multiples (pas seulement trophiques). Tout en considérant la sélection comme loi caractéristique des systèmes au niveau de la population,

l'auteur montre que les formes et la direction de la sélection sont déterminées en grande mesure par la biocénose. On discute ensuite l'influence de certains facteurs abiotiques sur la biocénose et l'évolution des biocénoses, en donnant comme exemple des phénomènes ayant lieu dans la zone inondable du Danube et constatés par l'auteur lui-même.

Le dernier chapitre est consacré aux relations entre systèmes biologiques de différents niveaux : individu-espèce (des phénomènes nuisibles à l'individu — hypertélie, aphagie, cannibalisme — peuvent être utiles à l'espèce) et population-biocénose, ensuite au circuit de la matière et de l'énergie dans divers systèmes biologiques.

Les principales idées originales émises se rapportent au problème de la variabilité, à l'intégralité et à la réalité objective des espèces agames, aux problèmes généraux des relations interspécifiques, aux relations entre les systèmes biologiques appartenant à différents niveaux, au problème des niveaux d'organisation de la matière vivante. C'est peut-être le premier essai d'aborder par la perspective des mêmes principes les problèmes posés par les systèmes biologiques à tous les niveaux d'organisation.

Les principales conclusions sont présentées dans un résumé anglais de 8 pages. Selon notre avis, le livre entier devrait être traduit dans une langue à large circulation.

Petru Bănărescu

V. PREDA, **Determinarea și diferențierea sexuală la vertebrate** (La détermination et la différenciation du sexe chez les Vertébrés.) Editura Academiei Republicii Socialiste România, Bucarest, 1968, 260 pages.

Il s'agit d'un travail à caractère monographique concernant la détermination et la différenciation du sexe chez les Vertébrés, travail qui contient l'opinion de l'auteur sur le processus sexuel — fondée aussi sur des recherches expérimentales personnelles.

C'est en abordant d'un point de vue complexe le problème du processus sexuel, que le professeur V. Preda fait dans son livre des considérations d'ordre morphologique, évolutif et causal en ce qui concerne la reproduction, « la grande loi de la nature ».

L'auteur nous a déjà habitués non seulement à ses recherches expérimentales intéressantes, mais aussi à ses larges synthèses, à ses profondes considérations critiques, concernant les grands mécanismes de la vie. La richesse en données d'ordre morphologique, biochimique, embryologique et génétique permet à cette monographie d'être en réalité un ouvrage synthétique. C'est un travail moderne dans lequel les données analytiques sont intégrées dans une précieuse synthèse, un travail dans lequel les données classiques et les données modernes s'imbriquent harmonieusement, un travail où l'étude des aspects phénoménologiques conduit à la découverte de l'essentiel.

Quelques chapitres introductifs présentent les données classiques concernant la morphologie, la genèse, la différenciation et l'évolution des gonades, des voies génitales et des organes de la reproduction, ainsi que les types de sexualité chez les animaux. Une grande partie du travail est consacrée à l'étude du déterminisme du sexe chez les animaux gonochoriques. L'auteur présente les grandes théories du déterminisme sexuel : la théorie métabolique et la théorie chromosomique, dans une lumière critique, indiquant leurs aspects positifs, leurs lacunes et leurs limites. C'est dans le même sens que l'auteur présente les conceptions et les expériences

modernes concernant la détermination de la différenciation sexuelle des gonades, des voies génitales et des organes de la reproduction, ainsi que le problème de l'inversion expérimentale du sexe.

Dans son ensemble, le travail reflète l'opinion de l'auteur, opinion selon laquelle la possibilité d'utiliser les facteurs du milieu en vue d'influencer la réalisation du sexe, conduit à la conclusion que le sexe est le résultat du jeu des facteurs héréditaires et des facteurs du milieu, fait qui permettrait à l'homme de diriger le processus sexuel.

L'illustration du livre est riche et en partie originale. On regrette seulement que cette illustration, si démonstrative, ne soit pas — du point de vue de la reproduction graphique — à la hauteur désirée.

Le travail est parfaitement systématisé, étant écrit dans une langue claire et accessible. L'auteur a un style élégant et concis. Contenant une abondante bibliographie (plus de 900 titres) où l'on trouve presque tous les travaux classiques et modernes concernant le sujet traité, ce travail devient une excellente source d'information pour ceux qui s'intéressent au problème respectif.

C'est un livre qui nous manquait, car il est tout aussi indispensable au théoricien, qu'à l'expérimentateur et au praticien. Les inconnues du processus sexuel nous sont présentées en partant d'un point de vue optimiste, celui du chercheur plein de confiance dans la valeur de l'expérience et de la pensée logique.

Nous recommandons la lecture du livre d'autant plus qu'il est facile à lire, quoique ce soit un ouvrage de science. L'étudiant en biologie, en médecine ou en agronomie, le chercheur débutant ou bien le chercheur averti, trouveront dans le livre du professeur Preda, non seulement les données nouvelles concernant le problème du déterminisme du sexe, mais aussi une incitation à l'application des données théoriques dans la pratique, ainsi qu'une incitation à la recherche et à la connaissance.

Octaviana Crăciun

AVIS AUX AUTEURS

La « Revue Roumaine de Biologie — Série de Zoologie » publie des articles originaux d'un haut niveau scientifique de tous les domaines de la biologie animale : morphologie, physiologie, génétique, écologie, taxonomie, etc. Les sommaires des revues sont complétés par d'autres rubriques comme : 1. La vie scientifique, qui traite des manifestations scientifiques du domaine de la biologie : symposiums, conseils, etc. 2. Comptes rendus des travaux de spécialité parus en Roumanie.

Les auteurs sont priés d'envoyer leurs articles, notes et comptes rendus dactylographiés à double intervalle (31 lignes par page), en quatre exemplaires.

Les tableaux et l'explication des figures seront dactylographiés sur pages séparées et les diagrammes exécutés à l'encre de Chine noire, sur du papier calque.

Les tableaux et les illustrations seront numérotés avec des chiffres arabes. La répétition des mêmes données dans le texte, les tableaux et les graphiques sera évitée. Les références bibliographiques citées par ordre alphabétique des auteurs comporteront le nom de l'auteur, l'initiale, le titre de la revue, abrégé conformément aux usances internationales, l'année, le tome, le numéro, la page. Les travaux seront accompagnés d'un court résumé, de maximum 10 lignes. Les textes des travaux ne doivent pas dépasser 15 pages dactylographiées (y compris les tableaux, la bibliographie et l'explication des figures).

Les auteurs ont droit à 50 tirés à part gratuits.

La responsabilité concernant le contenu des articles revient exclusivement aux auteurs.

La correspondance relative aux manuscrits, à l'échange de publications, etc. sera adressée au Comité de rédaction, 296, Splaiul Independenţei, Bucarest.

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