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74 1469

REVUE ROUMAINE DE
BIOLOGIE

BIOL. INV. 93

—SÉRIE DE ZOOLOGIE—

TOME 14

1969

N° 4

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REVUE ROMAINE DE
BIOLOGIE
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1909

N° 4

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I. ATHANASIU

1909

REV. Roum. Biol. — Zoologie, Tom. II, N° 4, p. 342-354, 1909.



I. ATHANASIU

IOAN ATHANASIU

(1868 — 1926)

Il a été le plus illustre des physiologistes roumains. Il a déployé une riche activité scientifique, a créé une école de physiologie, a dirigé l'Institut de Physiologie générale et comparée pendant plus de deux décennies, a été le recteur de l'Université de Bucarest et a milité activement pour le développement et le perfectionnement de notre enseignement.

Il est né le 20 avril 1868, à Sascut (Putna) et a fait ses études secondaires au lycée de Bacău. Ensuite il s'est fait inscrire à l'École supérieure de Médecine vétérinaire de Bucarest. Dès ses études il s'est fait remarquer par ses aptitudes particulières pour le travail de laboratoire et son intérêt pour les problèmes théoriques. Peu de temps après avoir terminé ses études, il est nommé chef de clinique chirurgicale, ensuite chef de clinique médicale et ultérieurement chef de travaux de physiologie animale à la même Ecole supérieure de Médecine vétérinaire.

A l'âge de 26 ans il part pour l'étranger afin de se spécialiser en physiologie (1894). Il a travaillé pendant quelque temps (1894—1898) dans le laboratoire du professeur Ch. Richet, de la faculté de Médecine de Paris et puis (1899) dans celui du professeur Pflüger, de Bonn, d'où il est revenu à Paris, pour travailler dans le laboratoire de Marey. Jouissant d'une excellente appréciation de la part de ce célèbre savant, il a été nommé à son choix au poste de sous-directeur de l'Institut International de Physiologie de Boulogne-sur-Seine, poste qu'il a gardé jusqu'en 1905, quand il est rentré en Roumanie, ayant été nommé professeur à l'Université de Bucarest et directeur de l'Institut de Physiologie de cette institution.

Au cours des années passées à l'étranger et après son retour en Roumanie, Ioan Athanasiu a déployé une infatigable activité scientifique, concrétisée dans de nombreux travaux publiés dans les périodiques de spé-

cialité les plus importants. Il a travaillé dans les domaines suivants : hématologie, circulation, métabolisme, myophysiologie et neurophysiologie. Ses travaux ont apporté d'importantes contributions originales. Nous pensons qu'une mention spéciale méritent ses travaux des dernières années de sa vie, concernant ce qu'il nommait « l'énergie nerveuse ».

Il est mort le 20 juillet 1926, laissant dans l'histoire de la physiologie roumaine une trace lumineuse, qui a guidé les pas des plus représentatifs de nos physiologistes.

Vu ses mérites concernant le progrès de la physiologie qui ont dépassé les frontières de notre pays, le centenaire de sa naissance a été célébré non seulement chez nous, mais aussi à l'étranger, sous l'égide de l'UNESCO.

Les zoophysiologistes roumains ont honoré sa mémoire, en participant à la commémoration organisée par l'Académie roumaine et le Ministère de l'Enseignement le 25 avril et organisant une session scientifique de communications les 26-27 avril 1968.



D. CĂLUGĂREANU

DIMITRIE CĂLUGĂREANU

(1868 — 1937)

Il a été l'un des brillants fondateurs de la physiologie roumaine. Il a eu le mérite d'avoir déployé une intense activité scientifique originale, d'avoir introduit dans notre pays l'étude de la chimie physiologique (1907), enseignant et rédigeant le premier cours de cette discipline à l'Université de Bucarest, ainsi que celui d'avoir organisé l'enseignement de la physiologie générale et comparée à l'Université de Cluj (1919).

Dimitrie Călugăreanu est né le 6 octobre 1868, à Pomîrla (Dorohoi). Il a fait ses études universitaires à la faculté des sciences de l'Université de Jassy, où il a obtenu le titre de licencié ès sciences naturelles, en 1894. Ensuite, il a étudié aussi la médecine, qu'il a terminée en 1897.

Obtenant une bourse « pour l'étude de la physiologie à une université étrangère », il est parti à Berlin où il a fréquenté les cours d'Engelmann, Munk et König et a travaillé pendant une année dans les laboratoires de l'Institut de Physiologie. L'année suivante (1898), il a été envoyé pour des études à la faculté des sciences de l'Université de Paris, où il a été l'élève du fameux physiologiste A. Dastre, sous la direction duquel il a effectué certaines recherches scientifiques intéressantes et a préparé une thèse de docteur ès sciences naturelles.

Après son retour en Roumanie, il a suppléé pour quelque temps la chaire de physiologie à l'Ecole supérieure de Médecine vétérinaire de Bucarest, et ultérieurement il fut nommé maître de conférences de chimie physiologique à la Faculté des sciences, fonction qu'il a gardée jusqu'en 1919, quand il a été promu professeur de physiologie à l'Université de Cluj. C'est à lui que revient le mérite d'y avoir créé et organisé un laboratoire et une chaire de physiologie animale comparée. Il est resté à Cluj jusqu'en 1926, quand il est revenu à Bucarest pour prendre la direction de l'Institut et de la chaire de Physiologie restée vacante après la mort du professeur Ioan Athanasiu.

Le professeur Dimitrie Călugăreanu a réalisé aussi une importante œuvre scientifique, apportant des contributions originales dans les domaines suivants : neurophysiologie, hématologie, métabolisme minéral, respiration, etc.

De ses travaux, les mieux connus sont ceux qui concernent la respiration intestinale chez *Cobitis fossilis* et sur la fonction de la glande séricigène du ver-à-soie.

Ses travaux, très méthodiques et extrêmement rigoureux, ont joui de bonnes appréciations de la part des spécialistes et sont cités dans les chapitres respectifs des traités les plus renommés de l'époque (par exemple *Winterstein's Handbuch der Physiologie* et le *Traité de Physiologie* de Morat et Doyon).

Dimitrie Călugăreanu est mort le 16 décembre 1937.

Prenant en considération ses mérites multilatéraux, à l'occasion du centenaire de sa naissance, l'Académie roumaine et le Ministère de l'Enseignement ont organisé les 24—25 octobre 1968 une commémoration solennelle, ainsi qu'une session scientifique de communications de zoologie et de physiologie.

UNTERSUCHUNGEN ÜBER DIE METABOLISCHE RATE BEI VIER SEEFISCHARTEN

VON

AL.-G. MARINESCU

The metabolic rate of three marine fish species of three separate phylogenetic groups: sea gudgeon, flounder and stor sturgeon, was investigated.

Following a statistical analysis, a correlation was demonstrated between the weight exponent (oxygen consumption — body weight ratio) and the degree of activity and mobility characterizing the investigated species. Thus, in the stor sturgeon, which is an active fish of a pelagic type, a low regression coefficient was recorded, as against the weight exponents of the sea gudgeon and the flounder, less movable active species, of a benthonic type.

The author discusses this correlation according to the present knowledge about the fish metabolism.

Die Frage der Beziehungen zwischen der Intensität der metabolischen Prozesse und dem Körpergewicht, deren Ausgangspunkt die Untersuchungen Kroghs [7] waren, hat zu zahlreichen Studien geführt, die alle nach genauester Einschätzung der Bedeutung dieser Verhältnisse streben.

Wir erinnern in dieser Hinsicht an die Forschungen über das Verhältnis Stoffwechsel—Körpergewicht unter dem Einfluß der Temperatur [3], [6], [8], [12]—[15], der Temperatur und der Jahreszeiten [2], [11], [20], [21], Marinescu* und der Aktivität [6], [20].

Es seien auch einige Studien erwähnt die charakteristisch verminderte Werte des Gewichtsexponenten für manche Fischarten anführen: Keys [10], Wells [18] für *Fundulus parvipinnis* (0,5—0,6); Barlow [1] und Ruhland [17] für einige Arten der Fam. *Cichlidae* (0,33—0,54).

In der Fachliteratur haben wir keinen Hinweis über eine Korrelation zwischen dem Verhältnis Metabolismus—Körpergewicht einer ge-

* Al. G. MARINESCU — Researches on seasonal oxygen consumption in goldfish (*Carassius auratus gibelio* Bloch). Conf. Fiz. Veg. Anim., 110, Bukarest, 9—11 Okt. 1967.

wissen Art und dem ökophysiologischen Typus der betreffenden Art gefunden.

Deswegen haben wir die metabolische Rate einiger Küstenarten erforscht. Die Ergebnisse dieses Studiums sind im folgenden dargelegt.

TIERE UND EXPERIMENTELLE METHODE

Wir haben vier im Küstengebiet des Schwarzen Meeres lebende Seefischarten untersucht u.zw.: die Grundel (*Gobius (Apollonia) melanostomus* Pallas 1811 und *Gobius (Ponticola) cephalarges* Pallas 1831), die Flunder (*Platichthys flesus luscus* (Pallas 1811)) und den Sternhausen (*Acipenser stellatus* Pallas 1771).

Da wir keine bedeutenden Unterschiede zwischen den zwei *Gobius*-Arten betreffs des Sauerstoffverbrauchs feststellten, wurden die experimentellen Angaben zusammen bearbeitet.

Die Analysen wurden bei streng konstanter Temperatur (21,0°, 21,5°, bzw. 21,5°C) mit der Methode der geschlossenen Kammer durchgeführt. Der Sauerstoff wurde mit Winklers chemischer Methode bestimmt.

Die im Laufe der Experimente vorkommenden Variationen des Salzgehaltes, der Sauerstoffkonzentration und des Nykthemismus wurden vermieden. Wir haben nur die Werte berücksichtigt, welche von Exemplaren ohne sichtbar spontaner Aktivität stammen.

Die verwendeten Fischgruppen bestanden aus 11–15 Exemplaren für jede Art, mit einem Körpergewicht zwischen 9 und 180 g.

ERGEBNISSE

Die Versuchsergebnisse samt den Versuchsparametern und den Regressionsgleichungen sind in Tabelle 1 dargestellt.

Tabelle 1
Sauerstoffverbrauch und die Regressionsgleichungen bei drei Seefischarten

Art	Zahl der Individuen	Mittelgewicht g.	Mittlerer Sauerstoffverbrauch ml. O ₂ /kg/h	Temperatur °C	Salzgehalt g %	Sauerstoffmenge ml. O ₂ /l	Stündlicher Zeitabschnitt h	Regressionsgleichung Y	S.E. (±)	F.
<i>Gobius (Apollonia) melanostomus</i> Pallas 1811 und <i>G. (Ponticola) cephalarges</i> Pallas 1831	15	39,45	170,45	21,0	14,11	5,40	16–18	0,744 +0,913 × log. X	0,027	p < 0,001
<i>Platichthys flesus luscus</i> (Pallas 1811)	15	61,60	165,20	21,5	13,90	4,95	19–21	0,776 +0,891 × log. X	0,055	p < 0,001
<i>Acipenser stellatus</i> Pallas 1771	11	100,58	192,85	21,5	13,12	5,16	19–20	1,749 +0,441 × log. X	0,035	p < 0,001

Auf Grund dieser Angaben haben wir eine statistische Berechnung durchgeführt und Diagramme ausgearbeitet, wo die Regressionsgeraden der Beziehung zwischen Sauerstoffverbrauch und Körpergewicht der Flunder (Abb. 1), des Sternhausens (Abb. 2) und der Grundel (Abb. 3) über einem doppellogarithmischen Netz dargestellt sind.

Die drei untersuchten Fischarten (die zwei *Gobius*-Arten wurden als eine einzige berechnet) wiesen eine gut ausgeprägte metabolische Rate auf, die für jede Art charakteristisch war. Der durchschnittliche Sauerstoffverbrauch war 170,45 ml. O₂/kg/Stunde für die Grundel, und 165,20, bzw. 192,85 für die Flunder und den Sternhausen.

Aus der Analyse der Regressionsgleichungen erhellt, daß die Regressionsgeraden der Grundel und der Flunder eine betonte Neigung zeigen, während die Regressionsgeraden des Sternhausens deutlich flach verlaufen (Abb. 4).

Der Gewichtsexponent (*b*) erreicht hohe Werte für die Grundel (0,913 ± 0,027) und die Flunder (0,891 ± 0,055), und sehr niedrige Werte für den Sternhausen (0,441 ± 0,035). Die Wahrscheinlichkeitsanalyse ist für diese Angaben besonders signifikant (*p* < 0,001).

DISKUSSION

Wir haben im Laufe unseren Experimente nur solche Werte eingetragen, die von der direkten und dauernden Beobachtung der ganz ruhigen Exemplare entstammten. Die so erhaltenen Ergebnisse sollten als zu dem Typus der gewöhnlichen metabolischen Rate (*routine rate*) gehörig betrachtet werden [5]. Diese Begrenzung ermöglicht einen Vergleich der Variabilität des Gewichtsexponenten in Abhängigkeit von dem für eine gewisse Art kennzeichnenden Aktivitätsgrad. Der Sternhausen hat eine aktive (pelagische) Lebensweise und seine ihm charakteristischen Wanderungen benötigen einen beträchtlichen Energieverbrauch, im Vergleich zu der Grundel und der Flunder, die typische benthonische Arten sind.

Die drei untersuchten Arten gehören zu verschiedenen, phylogenetisch sehr entfernten Familien, und diese Tatsache widersteht in einem beträchtlichen Maße der physiologischen Tätigkeit dieser Arten. Die Grundel und die Flunder zeigen nahestehende Werte der Regressionskoeffizienten, im Vergleich zu den Werten die bei den Sternhausen beobachtet wurden.

Die ökologische und besonders die physiologische Bedeutung der Unterschiede zwischen den Gewichtsexponenten dieser Seearten zu erläutern ist ein schwieriger, aber sehr interessanter Versuch. Da wir in unseren vergleichenden Untersuchungen über eine nur beschränkte Artenanzahl verfügten, muß die Signifikanz der experimentellen Angaben natürlich mit gewissem Vorbehalt betrachtet werden.

Die durch einen geringen Mobilitätsgrad und eine beschränkte Aktivität gekennzeichneten Arten (in unserem Falle die Grundel und die Flunder), erreichen eine metabolische Stufe die in einem höheren Maße von ihrem Körpergewicht abhängig ist. Ihre Gewichtsexponenten sind vergleichsweise von derselben Klasse mit jenen die bei niedrigen Temperaturen beobachtet wurden. In Gegenteil zu diesen Arten, besitzen

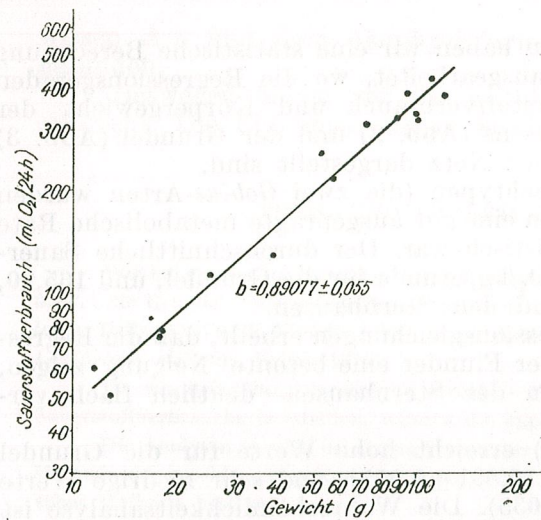


Abb. 1. — Das Verhältnis zwischen dem Sauerstoffverbrauch und dem Körpergewicht bei der Flunder (*Platichthys flesus luscus* Pallas 1811), bei 21,5°C. (Jeder Punkt stellt die Angaben für ein Exemplar dar.)

Abb. 2. — Das Verhältnis zwischen dem Sauerstoffverbrauch und dem Körpergewicht beim Sternhausen (*Acipenser stellatus* Pallas 1771), bei 21,5°C. (Jeder Punkt stellt die Angaben für ein Exemplar dar.)

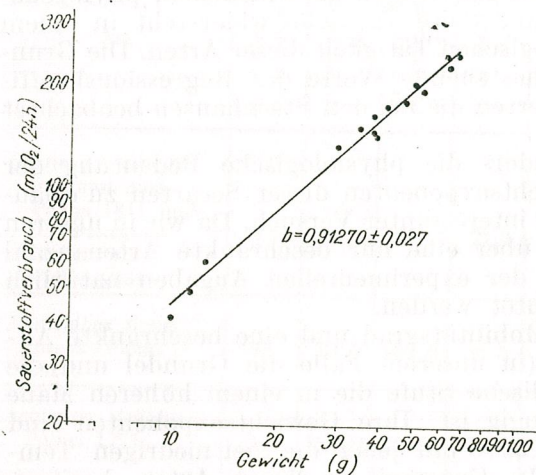
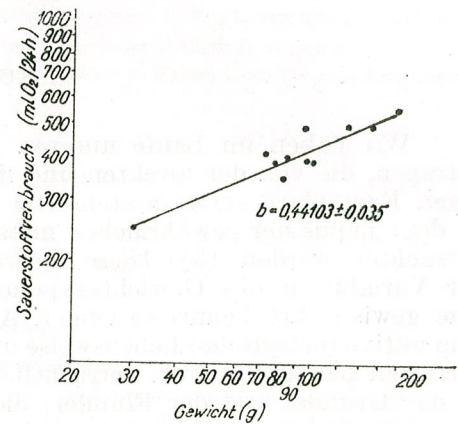


Abb. 3. — Das Verhältnis zwischen dem Sauerstoffverbrauch und dem Körpergewicht bei der Grundel (*Gobius (Apollonia) melanostomus* Pallas 1811 und *Gobius (Ponticola) cephalarges* Pallas 1831) bei 21,0°C. (Jeder Punkt stellt die Angaben für ein Exemplar dar.)

diejenigen die einen hohen metabolischen Wert erreichen sowie einen betonten Mobilitäts- und Aktivitätsgrad aufweisen nur unbedeutende Gewichtsexponente. Vergleichsweise sind diese Gewichtsexponenten derselben Ordnung wie diejenigen die in hyperthermischen Bedingungen erhalten wurden [6], [5], [1], [14], [11].

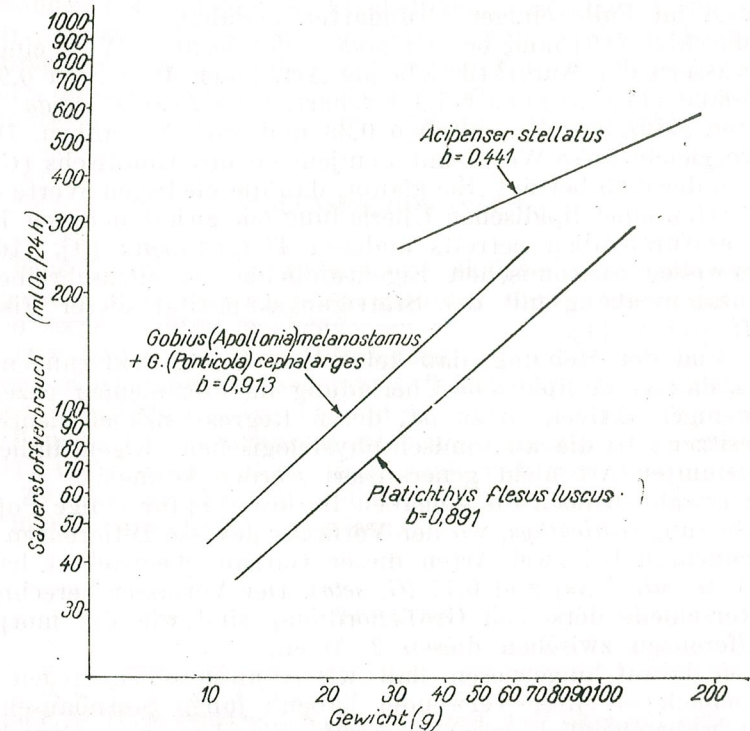


Abb. 4. — Schematische Darstellung der Regressionsgeraden für vier Seefischarten.

Die Analyse der Regressionsgleichungen zeigt, daß im allgemeinen der Gewichtsexponent der Fische mit hohem Sauerstoffverbrauch pro Gewichtseinheit (zum Beispiel der Sternhausen) geringere Werte hat, während die Gewichtsexponenten der anderen zwei Arten, mit einem geringeren Sauerstoffverbrauch pro Gewichtseinheit, viel höher sind. Die oben erwähnte Ähnlichkeit ist auch von diesem Gesichtspunkte deutlich. Die Werte des energetischen Metabolismus bei poikilothermen Tieren sind immer niedrig wenn diese tiefen Temperaturen ausgesetzt sind, und ihre Regressionsgleichungen zeigen hohe Gewichtsexponenten. Diese Tatsache entspricht einer weniger aktiven Lebensweise. Die metabolischen Werte sind aber höher im Falle der höher gelegenen Temperaturen, was einem tiefer gelegenen Gewichtsexponenten der mobileren Arten entspricht.

Diese doppelte Übereinstimmung ist offenbar. Leider haben wir keine Literatur zur Verfügung, um unsere Angaben zu vergleichen und eine Hypothese aufzustellen, über die Bedeutung dieser vielfachen Kor-

relationen zwischen den studierten Arten. Unserer Meinung nach bildet die Korrelation: metabolische Rate—Gewicht—Aktivität bzw. Mobilitätsgrad—thermisches Niveau, ein interessantes Gebiet für zukünftige Studien.

Wir möchten doch einige Hinweise über in der Literatur befindliche Werte der Gewichtsexponenten geben. In dieser Hinsicht sind höhere Exponenten im Falle einiger Grundarten erwähnt.

Wohlschlag [19] fand bei *Rhigophila dearborni* DeWitt, eine in den Tiefengewässern der Antarktik lebende Art, einen Wert von 0,965.

Ruhland [17] hat auch bei 4 Fischarten der Fam. *Cichlidae* niedrige Exponenten gefunden, die zwischen 0,33 und 0,54 schwanken. Die Verfasserin vergleicht diese Werte mit demjenigen des Goldfischs (*Carassius auratus* L.), der 0,85 beträgt. Sie glaubt, daß die niedrigen Werte der vier *Cichlidae*-Arten einer lipidischen Überladung (sie zitiert in dieser Hinsicht einige Literaturangaben betreffs anderen Tiergruppen: [9], [16]) oder einigen gewissen anatomischen Eigentümlichkeiten zuzuschreiben sind, die in Zusammenhang mit der Stättigungskapazität dieser Fische für Sauerstoff stehen [4].

Wir sind der Meinung, daß keine von diesen Erklärungen befriedigend ist, da: a) die lipidische Überladung im allgemeinen bezeichnend für die weniger aktiven Arten ist, deren Regressionskoeffizienten hohe Werte besitzen; b) die anatomisch-physiologischen Eigentümlichkeiten einer bestimmten Art nicht generalisiert werden können.

Wir erwähnen noch die Angaben Barlows [1] für einige Populationen der Gattung *Gillichthys*, wo der Verfasser gewisse Differenzen des Gewichtsexponenten bei zwei Arten dieser Gattung beobachtet hat: von 24°C, 0,55 (*G. mirabilis*) und 0,71 (*G. seta*). Der Verfasser berechnet, daß diese Unterschiede derselben Größenordnung sind wie die morphologischen Differenzen zwischen diesen 2 Arten.

Es sei darauf hingewiesen, daß wir in unseren Versuchen Exemplare verschiedenen Alters verwendet haben: junge Sternhausen, junge und auch wahrscheinlich geschlechtsreife Flundern und Grundel verschiedenen Alters.

Unserer Meinung nach kann diese Altersverschiedenheit keine wichtige Änderung der Ergebnisse verursachen. Es ist allgemein bekannt, daß die metabolische Rate vom Alter unabhängig ist [21] oder, daß sie mit dem Alter wenig schwankt [17].

Auf jeden Fall ist der ermittelte Gewichtsexponent des Sternhausens gering genug um von einer eventuellen Alterswirkung nicht beeinflusst sein. (Die geschlechtsreifen Exemplare wurden stets außer ihrer Fortpflanzungsperiode untersucht).

Es ist wahrscheinlich, daß im Falle einer vom Alter verursachten Änderung der metabolischen Rate auch eine gewisse Änderung des Aktivitätsgrades vorkommt.

Die Tatsache, daß die in der vorliegenden Arbeit gemachten Beobachtungen unsere Kenntnisse über die Vielfältigkeit der Beziehungen zwischen Metabolismus und Gewicht, und insbesondere über die physiologischen und ökologischen Einflüsse ergänzen, bildet unserer Meinung nach hinreichende Begründung für die zukünftige Entwicklung ähnlicher Untersuchungen.

Die deutlich unterschiedlichen Werte der Regressionskoeffizienten zeigen mit genügender Klarheit, daß unsere Kenntnisse über das Verhältnis zwischen energetischen Metabolismus und Körpergewicht einer neuen Orientierung bedürfen. Diese Verhältnisse dürfen selbstverständlich nicht als stabile Korrelationen betrachtet werden, da sie die charakteristischen Schwankungen der biologischen Erscheinungen ziemlich streng verfolgen.

Wir glauben, daß zukünftige Untersuchungen dieser Korrelationen die Komplexität der Verhältnisse zwischen dem lebenden Organismus und seiner Lebensweise, insbesondere von dem physiologischen Gesichtspunkte betrachtet, in einem größeren Masse erklären werden.

SCHLUSSFOLGERUNGEN

1. Eine Korrelation zwischen dem Verhältnis Sauerstoffverbrauch — Körpergewicht und dem ökophysiologischen Typus wurde bei vier Seefischarten experimentell nachgewiesen.

2. Die Bedeutung der Differenzen des Verhältnisses Sauerstoffverbrauch—Körpergewicht scheint von dem Aktivitätsgrad (Mobilitätsgrad) der betreffenden Art bedingt zu sein. Eine aktive Art (vom pelagischen Typus: der Sternhausen) zeigt einen niedrigen Gewichtsexponenten (0,441), während die anderen drei, weniger aktiven Arten (von benthonischem Typus: der Grundel und der Flunder) hohe Regressionskoeffizienten (0,913 bzw. 0,891) ausweisen.

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INFLUENCE OF TEMPERATURE ON GLYCEMIA AND ENERGY METABOLISM IN AMPHIBIANS

BY

CONSTANȚA MATEI-VLĂDESCU and DUMBRĂVIȚA SCHMIDT

The influence of temperature on glycemia was studied in two species of amphibians, *Rana ridibunda* and *Triturus vulgaris*. At the same time, energy metabolism was measured at different temperatures in *Rana ridibunda*.

It was ascertained that glycemia presents variations depending on temperature and that these are comparable with the variations of energy metabolism. At low temperatures (3–5°C) both glycemia and energy metabolism have lower values than at 18–20°C, while at high temperatures (30–32°C) the value of both parameters increases visibly.

A certain correlation between glycoregulation and thermoregulation appears evident in poikilothermic and homeothermic animals.

The few data existing in literature concerning the influence of temperature on glycemia in amphibians are contradictory.

On the one hand, hyperglycemia was described in frogs kept at low temperatures [22] or even an "a frigore" diabetes [13], while, on the other, Schwarz and Bricka showed that hibernating frogs have less sugar in the blood at a water temperature of 10°C (20–30 mg/100 ml) than at 30°C (40–150 mg/ml) [21].

Przylecki [20] and Ahlgren [1] recorded a hyperglycemic effect of high temperatures in amphibians.

For the purpose of elucidating the influence of the temperature factor on the glycemia of amphibians, we undertook a series of experiments on *Rana ridibunda* and *Triturus vulgaris*, in which we followed up the evolution of glycemia in specimens kept for different time intervals at different temperature levels.

At the same time it seemed interesting to establish a correlation between appeared glycaemic modifications and variation of energy metabolism, depending on temperature.

of frogs which survived for several days [4] at 30–32°C. This increase was evident with both methods. It was particularly due to the modification of the quantity of glucose in the blood (from 15 to 38 mg%), the rest of reducing substances remaining relatively constant (14–16 mg%) as is shown by the comparative dosings made in the first 44 hours.

II. Variation of energy metabolism depending on temperature

As may be seen in figure 3, the variation of energy metabolism depending on temperature in *Rana ridibunda* is typical of poikilothermic animals. The passing of animals to lower and lower temperatures was accompanied by the significant decrease of energy metabolism, while

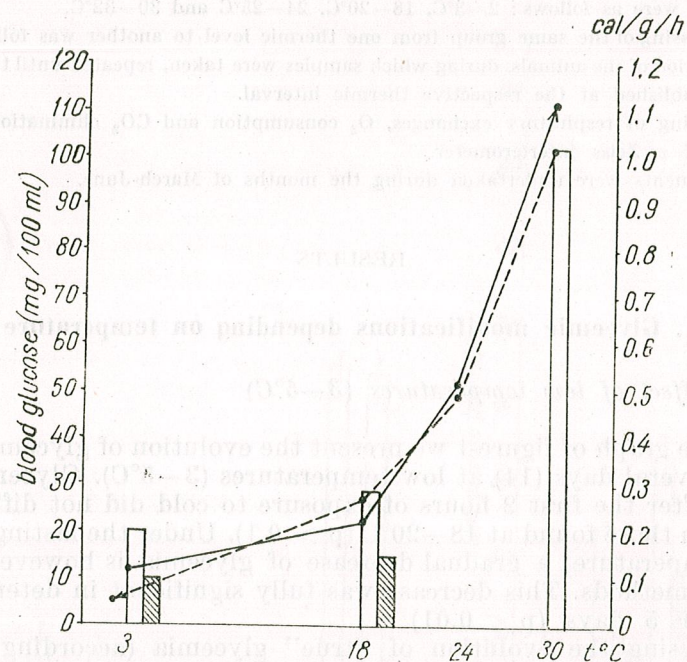


Fig. 3. — Variations of energy metabolism and of glycemia according to temperature in *Rana ridibunda* (solid line = values of energy metabolism in the group of gradually "heated" animals; broken line = idem in the group of gradually "cooled" animals).

the gradual "heating" of animals induced the intensification of respiratory exchanges and of heat production.

The figuration on the same graph of energy metabolism values and of mean glycemic values, recorded at 4–5 days of adaptation to the respective thermic levels, renders it possible to see that the variations of the two investigated parameters, depending on temperature, are comparable (Fig. 3).

DISCUSSION OF RESULTS

The results obtained by us show that in *Rana ridibunda* a decrease of energy metabolism and of glycemia occurs under the influence of low temperature, while at high temperatures a gradual increase of respiratory exchanges and of the quantity of sugar in the blood is produced.

Variations in energy metabolism are typical of poikilothermic animals [5], [18].

The evolution of glycemia is however different. Thus, we did not record the occurrence of hyperglycemia or of "a frigore" diabetes observed by Loewit [13] and by Scott and Kleitman [22] in other species of amphibians, though the animals remained for a long time (14 days) at fairly low temperatures (3–5°C).

Scott and Kleitman [22], for instance, have indicated an increased sugar concentration in the blood in *Rana pipiens* even after 2 to 9 days of maintaining the animals at 8–9°C.

In our experiments the sense of glycemic modifications under the influence of temperature was similar to that shown by Schwartz and Bricka [21].

Different results concerning glycemic modification at the lower ring of temperature were obtained not merely in amphibians but likewise in other lower vertebrates.

Thus in fishes, respectively in *Leuciscus baicalensis*, a decrease of glycemia was recorded at the cooling of water below the thermic limits of the adaptation zone [19], while in the carp a significant increase of glycemic values was ascertained at 5°C [17].

In reptiles C. Vlădescu points out to a more increased glycemia at 8–10°C than at 32°C in *Emys orbicularis* [27] and an "a frigore" hyperglycemia (at 4°C) in *Natrix natrix natrix* [28]. On the other hand however, Algauhari [2] establishes that in *Psammophis sibilans* glycemia is not affected by temperature variations (7–40°C).

Taking into consideration the fact that both amphibians and fishes and reptiles are typically poikilothermic animals, which do not present adrenergic reactions to low temperatures, the occurrence of hypoglycemia in such conditions is more easily accounted for.

At the lowering of temperature, metabolism intensity of these animals diminishes, a reduced O₂ consumption is recorded, while at the same time a slowing down of tissue glycogenolysis processes is induced [8], [9], [26], which might have as consequence, the diminution of the quantity of glucose in circulating blood.

The lowering of body temperature in hibernating mammals (from 35° to 10°C) is likewise accompanied by a characteristic hypoglycemic condition [4].

On the contrary, in non-hibernating mammals, hypothermia (up to 30–29°C) leads to very intense hyperglycemia in the first 30 minutes, with a progressive recurrence tendency after 120–180 minutes [7], [15], [16].

Acute exposure (4 hours) to cold (3°C), though determining in rats an increased noradrenalin and adrenalin secretion, and a diminution of

hepatic and muscular glycogen concentration, is followed nevertheless by a slight decrease of glycemia, due to an increased oxidation of glucose associated with an enlarged O_2 consumption and an increased heat production [23].

Rats adapted to cold (4–6 weeks at 2–5°C) succeed in regulating very well their glycemic level; this does not differ significantly from that of normothermic animals. This fact is attributed to a number of factors all assuming an increase in the rate of glucose absorption and metabolism in tissues [6].

As regards the hyperglycemic reaction observed by us in *Rana ridibunda*, to the rise of temperature of the surrounding environment, this could be due particularly to the intensification of the glycogenolysis process [8], [9] as a consequence of a strong adrenergic stimulation [26]. This hyperglycemic state occurs in conditions of a substantial increase of energy metabolism. A similar hyperglycemic reaction was likewise described by Pegheli and Remorov [19] in fishes, by Przylechi [20] and Ahlgren [1] in other species of amphibians, and by Yanny (cit. [2]) in reptiles, respectively in *Uromastix aegyptia*.

Certain researches show that in mammals (rats) too glycemia is greater at a higher air temperature (36°C) than at lower temperature (23–25°C) [3]. This takes place however in conditions of an oxygen consumption, relatively near at the two temperatures (2.7 cmc O_2 /min./100 g at 24°C, and 2.2 cm O_2 /min./100 g at 36–37°C [24].

In mammals there are certain data about the cessation or inhibition of medullosuprarenal responses during acute exposure to heat [29]. At the same time it was established that in the dog hyperthermia of the pancreas region induces a slight lowering of the glycemic level and the acceleration of the disappearance of induced hyperglycemia, by an intensification of insulin secretion [11], [12], [14].

The analysis of parallel variations of glycemia and of energy metabolism depending on temperature in poikilothermic and homeothermic vertebrates renders certain response differences in the two groups evident, which may constitute a proof of the existence of a relationship between glycemic regulation and thermoregulation [25].

No doubt that further investigations are necessary for the specification of these relationships on different evolution steps in the series of vertebrates.

CONCLUSIONS

1. The data so far arrived at concerning the influence of temperature of glycemia in amphibians are controversial and inconclusive.
2. The results of the researches set out in the present paper show that in *Rana ridibunda* glycemia presents variations depending on temperature, and that these are comparable with the variations of energy metabolism: — in animals adapted to low temperatures (3–5°C) glycemia is of 20 ± 2 mg/100 ml, while energy metabolism of 0.085 ± 0.007 cal/g/h. — at the temperature of 18–19°C, the value of glycemia is of 29 ± 1.34 mg/100 ml and of energy metabolism of 0.221 ± 0.008 cal/g/h.

— in animals which survived for several days at 30–32°C, glycemia increased to 102 ± 7.50 mg/100 ml, while energy metabolism to 1.116 ± 0.024 cal/g/h.

3. Comparative dosings by the two methods show that the variations observed are given especially by the modification (decrease or increase) of blood glucose concentration, the remaining reducing substances being little variable.

4. A certain correlation between glycoregulation and thermoregulation in poikilothermic and homeothermic vertebrates appears evident.

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INFLUENCE OF GLUCAGON ON GLYCEMIA AND ON PANCREATIC ISLETS IN *RANA RIDIBUNDA*

BY

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The effect of glucagon doses of 1 mg and 2 mg/kg b.w., administered in a single injection or in daily injections (9 and 11 days), on glycemia and on pancreatic islets, was investigated in *Rana ridibunda*.

Glucagon induced a hyperglycemia proportional to the dose.

Repeated hormone administrations did not lead to a permanent hyperglycemic state. This fact may be correlated to an activation of pancreatic B cells. A degeneration of B cells and a decrease of the number of A cells was induced in the endocrine pancreas of animals submitted to glucagon treatment.

Glucagon has an evident hyperglycemic effect in mammals [1], [14], birds [15] and reptiles [2] leading, in the case of repeated administration of large doses, to the occurrence of a diabetes [5], [20] accompanied by characteristic modifications of pancreatic islets [2], [9]. This diabetes disappears at the interruption of the treatment.

In most species of lower vertebrates (fishes, urodelian amphibians) only a slight response is obtained at the administration of large doses of mammalian glucagon [6], [23]. In anurans, however, glucagon has a visible, though moderate and transitory hyperglycemic action [17], [18]—[21]. There are but few data about modifications of glycemia and of the islets of Langerhans following repeated hormone administrations in amphibians [19].

In this paper we present the results of experiments undertaken by us in *Rana ridibunda* in view of investigating the action of repeated glucagon doses upon blood glucose concentration and on different types of endocrine pancreatic cells.

MATERIAL AND METHODS

34 specimens of adults *Rana ridibunda*, of both sexes, weighing on an average 80 g, were used. Animals were kept in aquariums with a little water on the bottom, at a constant temperature of 20°C, in a thermostated chamber. No nourishment was administered to the animals.

Experiments were carried out in the months of September and October. Two series of experiments were effected on groups of 4–5 specimens each, in which the action of two glucagon doses (1 mg/kg b.w., and 2 mg/kg b.w.), administered in a single injection or in daily injections for 9–11 days was investigated.

Injectable U.S.P. glucagon (lot no 668 Elli-Lilly Company, Indianapolis, U.S.A.) was employed. The preparation represents a mixture of 10 mg lyophilized glucagon (under the form of chlorhydrate) and 140 mg lactose. This mixture was dissolved in 10 cc solvent (lot no 669) supplied at the same time with the hormone. Before injecting, the solution was diluted with physiological saline solution up to the concentration of 0.01% glucagon and 0.14% lactose, for the dose of 1 mg glucagon/kg, and respectively to 0.02% glucagon and 0.28% lactose, for the dose of 2 mg glucagon/kg. From these dilutions, 1 ml/100 g body weight has administered to each animal in the dorsal lymphatic sacs, after the pH value was adjusted to 8.5–9.2. Each control animal received 1 ml/100 g b.w. of 0.14% and respectively 0.28% saline lactose solutions with a pH likewise adjusted to 8.5–9.2.

Blood samples for glyceimic dosing were collected before and after 90 minutes and 24 hours after the first injection. Blood samples were also taken before and after 90 minutes from the administration of the 9th (1 mg/kg b.w.) and respectively of the 11th (2 mg/kg b.w.) dose. Glycemia was dosed by King's method [12].

After taking the last blood samples, animals were sacrificed and the pancreas was collected for effecting a histological and histochemical control. The pancreas fragments were fixed in Bouin Hollande, embedded into paraffin and sectioned 5–6 μ thick. Sections were stained by the following techniques: silver impregnation [11], pseudoisocyanine [3], phosphotungstic acid hematoxylin [4] and paraldehyde fuchsin [8] + trichrome [7]. The sections stained with pseudoisocyanine were examined and photographed in monochromatic light, at 578 μ .

RESULTS

In the graph of figure 1, we present the modifications of glycemia after administration of a single injection of the glucagon + lactose preparation or only of lactose. The analysis of this graph reveals a hyperglycemic effect proper to glucagon. Hyperglycemic values found 90 minutes after the injection of glucagon + lactose preparation were greater than those produced by lactose alone. Thus an average difference of 14 mg was recorded in the case of the first dose ($p < 0.05$) and respectively of 34 mg after the second ($0.1 > p < 0.05$).

Hyperglycemia obtained was proportional to glucagon and lactose doses employed. This is shown very clearly in figure 2, in which percentual values are given, computed in relation to initial glycemia considered as 100%.

24 hours after administration of glucagon + lactose preparation, glycemia was slightly higher than the initial value ($p < 0.01$). In the case of lactose, however, glycemia reverted to the value prior to injection ($p > 0.1$).

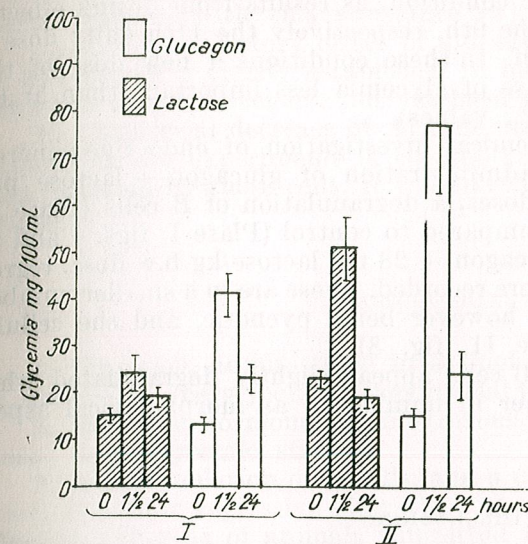


Fig. 1. — Influence of glucagon and lactose administered in a single dose, on glycemia in *Rana ridibunda*.
I. 1 mg glucagon + 14 mg lactose/kg b.w.
II. 2 mg glucagon + 28 mg lactose/kg b.w.

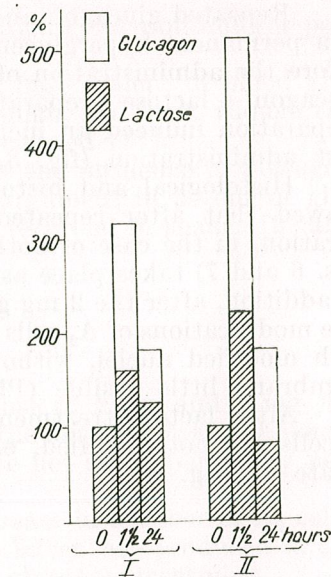


Fig. 2. — Comparison of the hyperglycemic effect of lactose and of glucagon (percent values).

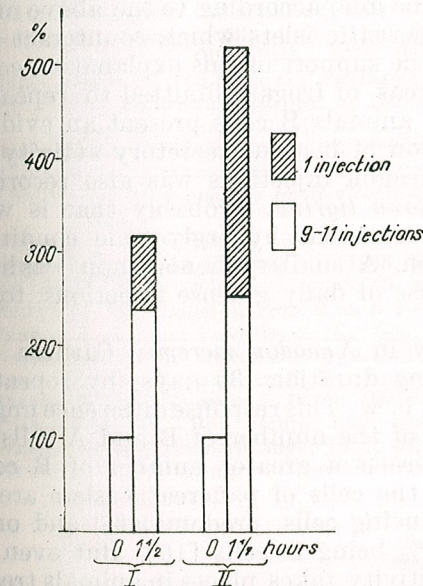


Fig. 3. — Diminution of the hyperglycemic effect of the 9th and 11th glucagon dose, as compared to the effect of the first dose.

Repeated glucagon and lactose doses did not lead to the occurrence of a permanent hyperglycemic condition, as results from dosing effected before the administration of the 9th, respectively the 11th daily dose of glucagon + lactose preparation. In these conditions a new dose of this preparation induced an increase of glycemia less important than at the first administration (fig. 3, % values).

Histological and histochemical investigation of endocrine pancreas showed that after repeated administration of glucagon + lactose preparation, in the case of both doses, a degranulation of B cells (Plate II, figs. 6 and 7) takes place as compared to control (Plate I, figs. 4 and 5). In addition, after the 2 mg glucagon + 28 mg lactose/kg b.w dose, regressive modifications of A₂ cells were recorded. These are in a smaller number, with modified nuclei, without however being pycnotic, and the cellular membrane little visible (Plate II, fig. 8).

After lactose treatment B cells appear slightly degranulated while A cells are not modified, either in number or as morphological aspect (Plate II, fig. 9).

DISCUSSIONS

Glucagon-induced glycemic modifications in *Rana ridibunda* resemble those recorded in other species of anurans. Doses of 5 mg/kg b.w. in *Bufo arenarum* [17], of 1 mg/kg in *Rana tigrina* [18], or even much smaller doses (0.025–0.2 mg/kg) in *Rana catesbiana* [22] induce an evident hyperglycemia in the first 2–4 hours after administration. After 24 hours glycemia reverts to values close to the initial ones [17].

Penhos and Lavintman [17] recorded that pancreatectomy and concomitant extirpation of pancreas and hypophysis increases the sensitivity of toads to glucagon. This may be due, according to the above mentioned authors, to the absence of pancreatic islets which counteract the hyperglycemic effect of glucagon. To the support of this explanation come also our own observation on the pancreas of frogs submitted to repeated injection with this hormone. In these animals B cells present an evident degranulation, the sign of a stimulation of insulino-secretory activity. B cells hyperactivity after repeated glucagon injections was also recorded by Sabnis and Rangnekar [19] in *Rana tigrina*. Probably that is why the animals have not presented a permanent hyperglycemic condition after repeated glucagon administration. A similar phenomenon was likewise recorded in amphibians in the case of daily glucose injections, for a long time [13], [19], [21].

In reptiles, however, respectively in *Xenodon meremii*, Cardeza [2] obtained a hyperglycemic state of long duration (30 days) by repeated administration of 1 mg glucagon/100 g b. w. This response difference might be correlated to different proportions of the number of B and A cells in two species. While in amphibians there is a greater number of B cells than A cells [16], in snakes, 49% of the cells of pancreatic islets are A cells (among which A₂, glucagon producing cells, predominate) and only 33% B cells, the rest of less than 18% being D cells [10]. But even in snakes, an intensification of B cells activity takes places in animals treat-

ed with glucagon, which accounts for the difficulty of obtaining a permanent diabetes with this substance [2].

An insulino-secretory effect of glucagon, independent of blood glucose increase, was clearly established in mammals and man, though the mechanism of this effect has not yet been elucidated [14].

The numerical decrease of A₂ cells under the influence of glucagon treatment in our experiments is yet another argument in favour of glucagon secretion by these cells. It was likewise recorded in snakes [2] and mammals [9].

CONCLUSIONS

1. Glucagon, administered in a single dose of 1 mg and 2 mg /kg b.w. induces a hyperglycemia, proportional to the dose, in *Rana ridibunda*.
2. Repeated hormone administrations are not accompanied by permanent hyperglycemic states.
3. A degranulation of B cells, and a decrease in number of A₂ cells, as well as certain regressive alterations of the latter are produced in the endocrine pancreas of animals submitted to glucagon treatment.

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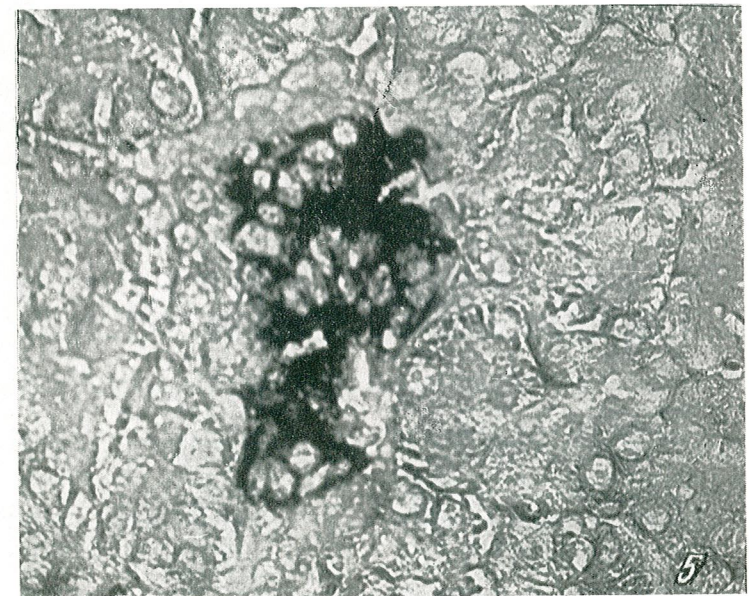
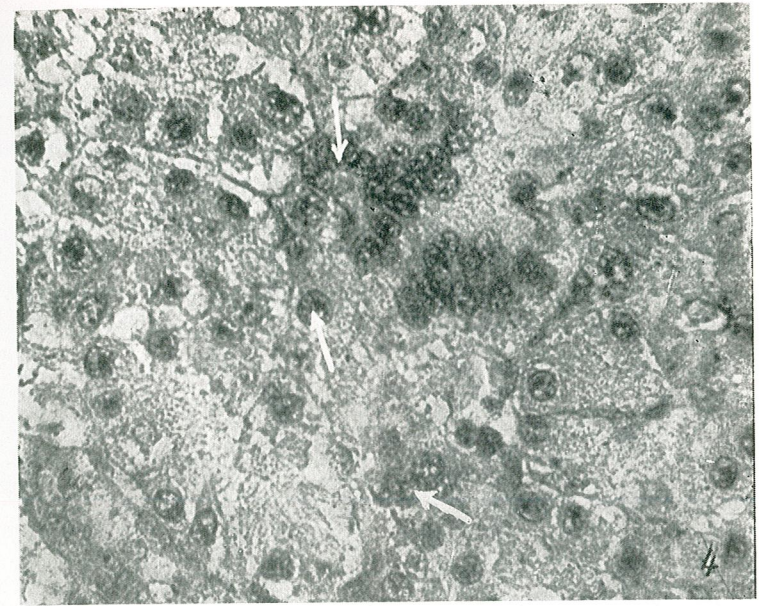


Plate I. An islet of Langerhans belonging to an untreated specimen, successively stained by silver impregnation (Fig. 4) and with pseudoisocyanine (Fig. 5). $\times 900$.

Fig. 4. — Note the disposition of A_1 cells. (\rightarrow)
 Fig. 5. — After removal of silver and application of metachromatic reaction with pseudoisocyanine, B cells are rendered evident. In both techniques A_2 cells remain unstained.

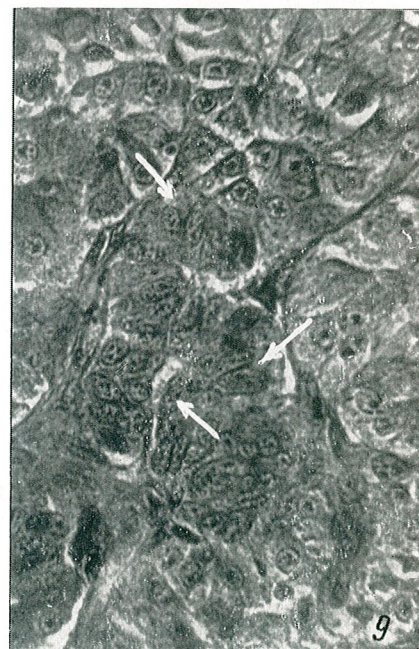
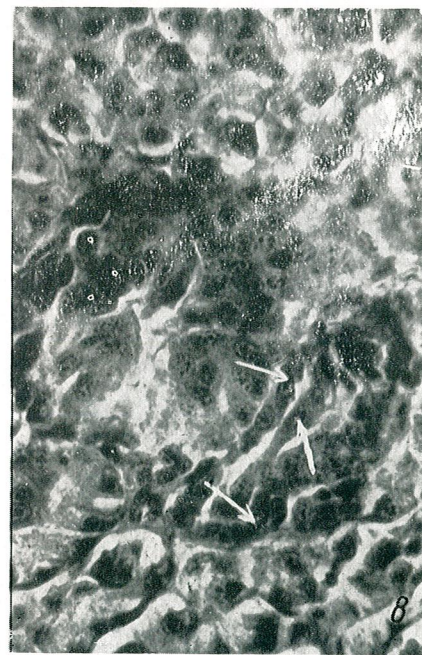
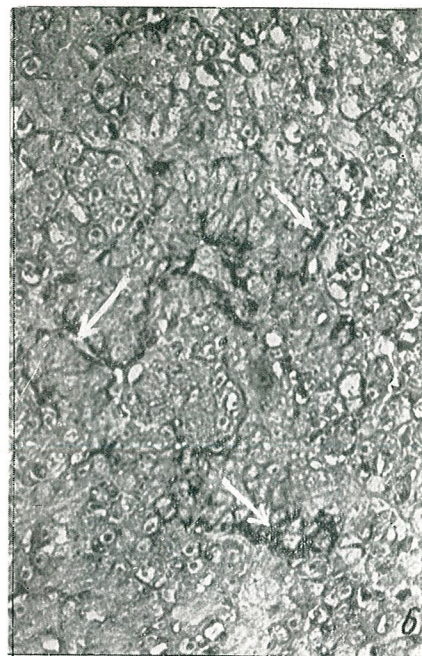


Plate II. Figs. 6 and 7.—Reaction with pseudoisocyanine following an 11-day treatment with the glucagon preparation. The degranulation of B cells (→) is observed. $\times 500$; $\times 790$.

Fig. 8. — Image of an islet following a treatment similar to the above one. Certain A cells (A_2 cells) present regressive modification (→) PTAH $\times 790$.

Fig. 9. — After 11 days from lactose administration, B cells are slightly degranulated (→) paraldehyde fuchsin + trichrome, $\times 790$.

DER EINFLUSS DES VARIABLEN MAGNETFELDES AUF DIE NATRIUMPERMEABILITÄT DER ABGETRENNTEN FROSCHHAUT

VON

W. MÜLLER und P. JITARIU

Experiments have been carried out in two stages, during different seasons (the first stage—December 1967, the second—April 19—June 7, 1968). Frogs have been exposed to the variable magnetic field for 3 hours. With the December frogs Na-permeability rises from 1.04 μval in the control frogs to 1.78 μval ; $p < 0.001$. With the April 19—June 7 frogs Na-permeability also rises, from 2.04 μval of control frogs to 4.10 μval of the frogs exposed to a variable magnetic field; $p < 0.001$. Consequently the variable magnetic field leads to a rise of Na-permeability of isolated frog skin irrespective of season, and seems to influence the cell metabolism of the ventral skin of frogs.

Die Permeabilität biologischer Membranen wird sowohl auf Zellmembranen als auch auf membranförmigen Anordnungen von Zellen untersucht. In beiden Fällen kann die Diffusion von Teilchen auf zwei Arten geschehen: einerseits dank des elektrochemischen Gradienten der Membranen, wobei die Membran keine aktive Rolle spielt, andererseits entgegen dem elektrochemischen Gradienten, auf Grund der Energie die durch den Stoffwechsel zustande kommt. In beiden Fällen stellt aber die Membran ein Regelsystem der zellulären Prozesse dar [3].

Die Bauchhaut des Frosches wird oft zum Studium der Natriumpermeabilität benützt. Ussing (1954—1960) hat an Hand von früheren und eigenen Forschungen eine sichere und einfache Untersuchungsmethode für die Messungen des aktiven Transports durch die Froschhaut ausgearbeitet. Im folgenden untersuchen wir den Einfluß des variablen Magnetfeldes nach dreistündiger Einwirkung auf die Natriumpermeabilität der abgetrennten Froschhaut, indem das lebende Tier die angeführte Zeit in einer Spule gehalten wird.

ARBEITSMETHODE

Die Versuche wurden in zwei Serien zu verschiedenen Jahreszeiten durchgeführt. Die erste Serie im Dezember 1967 und die zweite Serie vom 19. April bis zum 7. Juni 1968. Die Frösche für die erste Serie haben wir im Aquarium gehalten. Für die zweite Serie wurden die Tiere einige Tage vor den Versuchen aus der Natur gebracht. Die Spule für das variable Magnetfeld, mit der gearbeitet wurde, hat folgende Parameter: Eintrittsstrom 220 V, 50 Hz, 2 A. Dimensionen der Spule: 5200 Windungen, 64 cm² Querschnitt und 25 cm Länge. Unter diesen Bedingungen erreicht das Magnetfeld 250–300 G. Die Spule wurde mit Wasser gekühlt. Die Kontrolle wurde in einer gleichgroßen Spule ohne elektrischen Strom gehalten. Die Frösche wurden in einer Vorrichtung gehalten, so daß sie immer im zentralen Bereich der Spule waren, wo das Magnetfeld am stärksten ist. Die Behandlung dauerte 3 Stunden und ebenfalls 3 Stunden wurde die Kontrolle in der Spule ohne Magnetfeld gehalten. Nach der Behandlung wurden die Frösche gleich getötet und die Bauchhaut abgetrennt. Die Haut wurde zwischen die Halbkammern der Installation gespannt, die nach der von Ussing und Mitarbeiter [4] eingeführten Methode gebaut ist (Abb. 1). Die Hautoberfläche die mit der Ringerlösung aus den Halbkam-

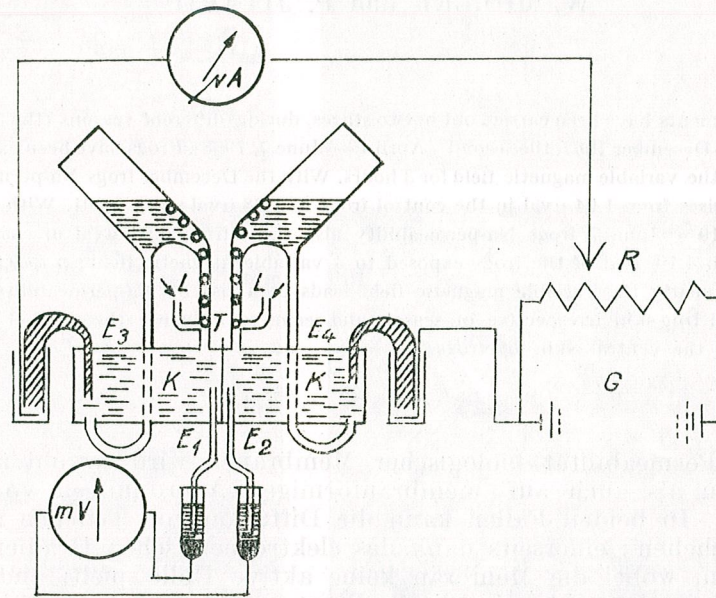


Abb. 1. — Schema des Apparates für die Bestimmung der Na-Permeabilität und des Kurzschlußstromes (Nach H. Ussing und K. Zerahn). K, Halbkammern; T, Tegument; L, Lufteintritt; E₁ und E₂, Elektroden 1 und 2; E₃ und E₄, Agar-Ringerbrücken für Kurzschlußstrom; G, Galvanische Elemente; R, regelbarer Widerstand.

mern in Berührung kommt beträgt 2,83 cm². Bei unseren Arbeiten haben wir folgende Ringerlösung benützt: NaCl 112 mM, KCl 2,0 mM, CaCl 1,0 mM, NaHCO₃ 2,5 mM. Folgende Formel wurde benützt:

$$Na_{net.} = \frac{I \times t}{F}$$

F = Faraday-Konstante (96496)

I = Kurzschlußstrom in μ A

t = Zeit in Sekunden

Mit dieser Formel errechnet man den Totalfluß an Natriumionen in μ val. Das Membranpotential wurde über Kalomelektroden und über Ringer-Agarbrücken mit einem Millivoltmeter gemessen. Der Kurzschlußstrom der von galvanischen Elementen herrührt, wird durch eine variable Resistenz von 4000 Ω geregelt und über Ringer-Agarbrücken mit einem Mikroamperemeter ($2,8 \times 10^{-7}$ A) gemessen. Es wurde bei 22–24°C gearbeitet. Den nötigen Sauerstoff haben wir der Ringerlösung in Form von Luft zugeführt. Die Ablesungen wurden bei jeder Messung 20 Minuten hindurch von 5 zu 5 Minuten gemacht.

ERGEBNISSE

Der aktive Transport durch die Haut der Frösche die drei Stunden im variablen Magnetfeld gehalten wurden, steigt bei den Versuchen die im Dezember gemacht wurden von 1,04 auf 1,78 μ val. Diese Intensivierung der Diffusion ist statistisch errechnet sehr signifikant (Tabelle 1). Aus den Ergebnissen, die bei der Versuchsserie vom 19. April bis zum 7. Juni erzielt wurden, geht hervor (Tabelle 2), daß bei diesen Fröschen das Magnetfeld dieselbe Wirkung hat. Die Diffusion der Natriumionen steigt von 2,04 auf 4,10 μ val. Diese Differenz ist statistisch errechnet auch sehr signifikant.

Aus Abb. 2 geht hervor, daß in den Frühjahrsmonaten die Natriumpermeabilität durch die abgetrennte Froschhaut viel größer ist als im Dezember. Dieses ist eine natürliche und bekannte Erscheinung. Die Wirkung des variablen Magnetfeldes ist aber unabhängig von der Jahreszeit in der gearbeitet wurde. Im Falle beider Serien bewirkt das Magnetfeld eine Intensivierung der Natriumpermeabilität.

Das Magnetfeld übt seine Wirkung auf den ganzen Frosch aus, so daß man einerseits von einer direkten Wirkung auf die Zellen der Froschhaut sprechen kann, andererseits auch von einer indirekten Wirkung über andere Organsysteme. Zerahn [5], Leaf und Renshaw [2] haben festgestellt, daß zwischen Stoffwechsel, beziehungsweise Sauerstoffverbrauch und aktivem Transport wechselseitige Beziehungen bestehen. So kann bei unseren Versuchen das Magnetfeld einerseits lokale Wirkung haben und verschiedene Prozesse in den Zellen der Haut direkt abändern. Andererseits ist es möglich, daß die Vorgänge in den Zellen der Bauchhaut über das Nervensystem und hormonell beeinflusst werden. Wahrscheinlich kommen aber beide Wege in Frage.

Das variable Magnetfeld, welches wir durch einen Wechselstrom von 50 Hz mit einer elektrischen Spule erzielen, ruft in einem Leiter einen Induktionsstrom hervor. Wahrscheinlich tritt auch in den Versuchs-

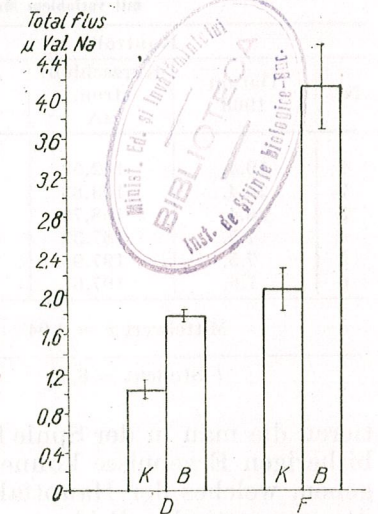


Abb. 2. — Der aktive Transport durch die abgetrennte Froschhaut nach einer Behandlung von drei Stunden mit variablem Magnetfeld.

K, Kontrolle; B, Behandelte; D, Dezemberfrösche; F, Frühjahrsfrösche.

Tabelle 1

Aktiver Transport der Natriumionen durch die Froschhaut bei den Versuchen mit dem variablen Magnetfeld im Dezember 1967

Kontrolle				Behandelte			
Nr.	Datum 1967	Kurzschlußstrom μA	Totalfluß $\mu\text{val. Na}$	Nr.	Datum 1967	Kurzschlußstrom μA	Totalfluß $\mu\text{val. Na}$
1	15.12.	83,72	1,04	1	15.12.	154,56	1,92
2	15.12.	79,80	0,99	2	15.12.	146,72	1,82
3	16.12.	105,00	1,30	3	16.12.	134,40	1,67
4	16.12.	80,08	0,99	4	16.12.	133,28	1,65
5	18.12.	103,32	1,28	5	18.12.	134,40	1,67
6	18.12.	61,60	0,76	6	23.12.	158,76	1,97
7	23.12.	100,80	1,25				
8	23.12.	57,40	0,71				
Mittelwert $\bar{x} = 1,04$				Mittelwert $\bar{x} = 1,78$			

t Student = 6,63

$p < 0,001$

Tabelle 2

Aktiver Transport der Natriumionen durch die Froschhaut bei den Versuchen mit variablem Magnetfeld vom 19. April bis zum 7. Juni 1968

Kontrolle				Behandelte			
Nr.	Datum 1968	Kurzschlußstrom μA	Totalfluß $\mu\text{val. Na}$	Nr.	Datum 1968	Kurzschlußstrom μA	Totalfluß $\mu\text{val. Na}$
1	19.4.	142,52	1,77	1	19.4.	206,36	2,56
2	26.4.	103,88	1,29	2	26.4.	290,08	3,60
3	26.4.	158,76	1,97	3	26.4.	363,44	4,51
4	7.5.	187,32	2,32	4	7.5.	334,88	4,16
5	7.5.	197,96	2,46	5	7.5.	440,72	5,48
6	7.6.	197,68	2,45	6	7.6.	347,20	4,31
Mittelwert $\bar{x} = 2,04$				Mittelwert $\bar{x} = 4,10$			

t Student = 8,4

$p < 0,001$

tieren die man in der Spule hält eine Induktion auf, aber an Hand unserer bisherigen Ergebnisse können wir uns vorläufig noch nicht Rechenschaft geben, welches der Hauptfaktor ist der den aktiven Transport verstärkt, das magnetische Feld an und für sich oder die elektromagnetische Induktion.

Mit einem Magnetfeld von 250–650 G, erzeugt durch zwei Eisenmagneten die in die Halbkammern beidseitig der Froschhaut eingebaut wurden, erzielten Bianchi und Mitarbeiter [1] eine Abschwächung der Natriumdifusion durch die Froschhaut. Abgesehen von der Tatsache, daß hier eine andere Art von Magnetfeld benützt wurde, haben die angeführten Autoren auf der abgetrennten Froschhaut gearbeitet und nicht das ganze Tier dem Einfluß des Magnetfeldes ausgesetzt. Außerdem wirkt ein genügend starkes Magnetfeld wahrscheinlich auch direkt auf die

Beweglichkeit der Ionen in einer Lösung und es scheint uns erklärlich, daß dadurch die Natriumpermeabilität verringert wird. Daher glauben wir, daß unsere Ergebnisse die oben angeführten nicht widerrufen.

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INFLUENCE OF VAGUS NERVES UPON GLYCEMIA
IN *GALLUS DOMESTICUS* L.

BY

CORNELIA NERSESIAN-VASILIU and N. ŞANTA

The researches were carried out in basal conditions on adult fowls of the Leghorn race.

The evidencing operation of the vagus does not modify glycemia, even if the animal is not anaesthetized.

Electrical stimulation (10 rectangular pulses/sec., 1.5 msec., 5 v., 10 min.) of the central end of the right vagus induces a 8.8 % hyperglycemia after five minutes and is maintained over 120 minutes.

Stimulation of the peripheral end of the left vagus induces a gradual and lasting hypoglycemia (over 120 minutes).

Stimulation of the peripheral end of the right vagus and of the central end of the left vagus does not modify glycemia significantly.

Our results agree with those obtained on mammals, and plead for the existence of some similar glycoregulating mechanisms.

The influence of the vegetative nervous system upon glucidic metabolism was studied particularly in mammals. The existence of a glycoregulative centre in the bulb (Cl. Bernard) and a notable influence of hypothalamic alimentary centres (of hunger and satiety) were proved, as well as the intervention of the peripheral vegetative nervous system, particularly that of the orthosympathetic one upon glycemia. As regards the parasympathetic experimenting on monkey M. P. Daniel and J. R. Henderson [2] concluded that the subdiaphragmatic stimulation of vagus does not induce significant glucose modifications in the blood, but merely an increase in insulin concentration in the splenic vein and in the inferior vena cava.

Frohman (after [4]) likewise showed that the stimulation of the peripheral end of the vagus induces in the dog an increase in insulin concentration in the portal vein.

A. Kaneto and coll. [3], obtained, by exciting the left or right cervical vagus and the dorsal trunk of the vagus in the dog, a significant

increase in immunoreactive insulin in the pancreas efferent plasma, while the excitation of the ventral trunk of this nerve induced no similar effect. Insulin hypersecretion, however, did not always determine hypoglycemia, but merely facilitated glucose penetration into cells.

After electrical stimulation of the vagus in normal or pancreatectomized rabbit, T. Shimazu [8] obtained an increase in total hepatic glycogen-synthetase activity, effect annihilated by simultaneous stimulation of the splanchnic nerve.

Autoregulation nervous mechanisms of glucidic metabolism in birds are not yet known, and their homologizing by what is known in mammals is risky. We therefore proposed to undertake certain investigations in this respect, by beginning to study the influence exercised by vagi upon glycemia.

MATERIAL AND METHOD

Researches were effected in basal conditions on adult fowls of the Leghorn race.

The following series of experiments were effected:

1. stimulating both vagi;
2. stimulating the right vagus;
3. stimulating the left vagus;
4. sectioning the right vagus;
5. stimulating the central end of the right vagus;
6. stimulating the peripheral end of the right vagus;
7. sectioning the left vagus;
8. stimulating the central end of the left vagus;
9. stimulating the peripheral end of the left vagus.

The evidencing, stimulating and sectioning of vagi were made at the level of cervical segment.

For stimulating we used a 5 v. rectangular electrical current, with a frequency of 10 impulses/sec. and a duration of 1.5 msec., for 10 minutes, obtained from a neuroexciter of the SGL, 60 type.

Blood samples were removed from the crest, prior to and after 5, 15, 25 and 35 minutes from vagi sectioning, then, after 5 minutes from stimulation, subsequently every 10 minutes, up to 30 minutes, and thereafter at 15 minutes intervals, up to 2 hours from the application of the excitant.

Glycemia (in fact, the total reducing substances) was estimated according to Hagedorn-Jensen method.

For each experimental variant, 4-5 animals were used.

The experiments were carried out in the period August-October 1968. In this time interval the animals were kept at a relatively constant temperature (20°C) and were fed ad libitum with a mixture of maize grains, oat and barley grains and sunflower grist.

Before experimenting, the animals were always submitted to a 18 hours fast.

RESULTS AND DISCUSSIONS

The results obtained are shown in the graphs of figures 1 and 2. From their analysis the following results were obtained:

1. Successive stimulation of both vagi, for 10 minutes each, induced a slight decrease in glycemic level (from 203 to 186 mg%), which reached the minimum level after 60 min. which was also maintained at 105 and 120 minutes. It was re-established after 135 minutes, reaching values practically equal to those prior to stimulation (Fig. 1).

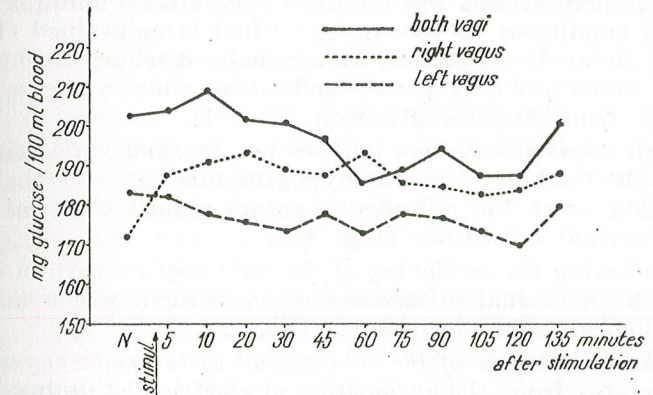


Fig. 1. — Glycemia after the stimulation of both vagi, of the right vagus and of the left vagus.

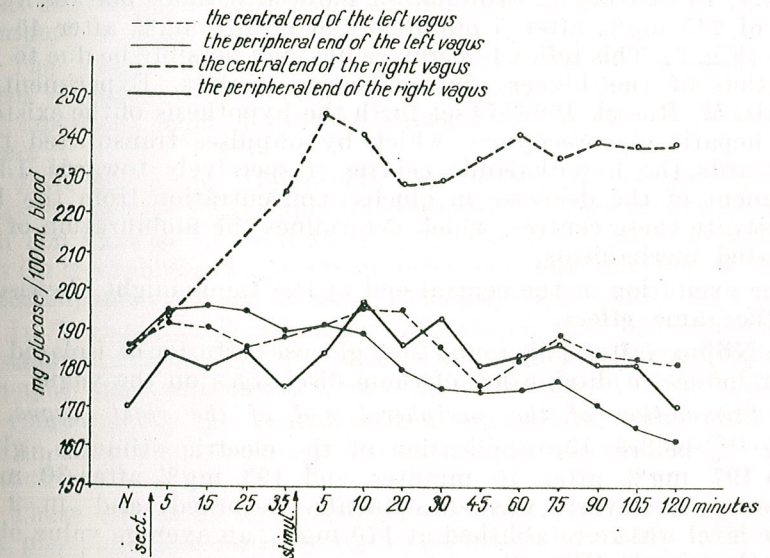


Fig. 2. — Glycemia after the sectioning of the vagi and the stimulation of the central and peripheral ends, of both the right and the left vagus.

It may be considered that in these conditions insulin secretion is intensified, which determines a certain tendency towards hypoglycemia. It may also be mentioned that an evident sleepiness in fowls submitted to experimentation was noticed when both vagi were stimulated. This

fact agrees with J. H. Penaloza-Rojas and M. Russek's observations [6] who remarked in mammals that in the case of certain electrical excitations of the vagi, animals present an electroencephalogram with a rhythm specific to sleep.

2. By a 10 minutes *stimulation only of the right vagus*, a minor but significant hyperglycemia was obtained even after 5 minutes (from 172 mg % in basal conditions to 188 mg %); which is maintained (188 mg %) to the end of the analysed period. An adrenalin discharge from the medullo-suprarenal takes probably place, facilitating glucose release from depots, particularly from hepatic glycogen (Fig. 1).

3. *Left vagus stimulation* induces less marked variations of glycemic level. A slight tendency towards hypoglycemia can nevertheless be recorded, returning after 135 minutes to values almost identical to those obtained in normal conditions (Fig. 1).

4. Following the *sectioning of the right vagus* a certain *hyperglycemia* with notable individual differences was recorded, which may be due to some typological particularities [5] (Fig. 2).

5. *The stimulation of the central end of the right vagus* led, already after 5 minutes from the application of electrical stimulus, to an evident hyperglycemia (of 20 mg %), which for a period of 120 minutes, exceeds in intensity the already raised level reached after sectioning. Thus, from 184 mg % in normal conditions, glycemia increases after 35 minutes, from vagotomy, to 225 mg %. Stimulation induced a more marked hyperglycemia: of 245 mg % after 5 minutes, and of 237 mg % after 45 to 120 minutes (Fig. 2). This reflex hyperglycemia may possibly be due to a false information of the higher glycoregulative centres. Experimenting on mammals, M. Russek 1968 [7] set forth the hypothesis of the existence of certain hepatic glycoreceptors, which by impulses transmitted through vagi towards the hypothalamic centres (respectively towards LHA) at the moment of the decrease in glucose concentration from the hepatic cells, activate these centres, which determines the mobilization of hyperglycemicated mechanisms.

The excitation of the central end of the vagus might likewise bring about the same effect.

A. Nijima (after [7]) found that glucose perfusion of isolated guinea pig liver induces a diminution of these discharges on the vagus.

6. *Stimulation of the peripheral end of the right vagus*. From 175 mg % before the application of the electric stimulus, glycemia rises to 197 mg % after 10 minutes, and 193 mg % after 30 minutes. A tendency to revert was subsequently recorded, and in 2 hours glycemic level was re-established at 170 mg %, an average value obtained in normal animals (Fig. 2).

7. In another series of experiments we *sectioned the left vagus* and followed its effect for 35 minutes. Practically no glycemia modification was recorded (Fig. 2).

8. *The stimulation of the central end of the left vagus* induced, after a period of 45 minutes from its sectioning, only slight fluctuations of the glycemia level, with a minimum at 45 minutes (Fig. 2).

9. An altogether different situation is obtained by the *stimulation of the peripheral end of this nerve*, also after 45 minutes from its sectioning. A tendency towards hypoglycemia was noticed which was maintained and became accentuated towards the end of the interval. From values of 190 mg % in the first 10 minutes from the stimulation, glycemia decreased after 90 minutes to 171 mg %, and to 162 mg % after 120 minutes (Fig. 2).

Perhaps the *left vagus* innervates predominantly the pancreas and its stimulation thus induces an intensification of the release of the anti-hyperglycemic hormone — insulin. This may likewise account for the hypoglycemic effect induced by the stimulation of its peripheral end.

We mention that the surgical operation of uncovering the vagi, effected on the unanaesthetized animal, did not modify the glycemic level. Practically, the same values were obtained before and after the operation.

It is well-established that in mammals the vegetative nervous system participates in regulating the glucidic metabolism. Nervous control may be exerted both directly on metabolizing organs, as well as indirectly on glands secreting glycoregulative hormones.

The liver is innervated: on the one hand by vagi, and on the other by splanchnic nerves. The relationships between these nerves and the bulbar glycoregulative centre, with the hypothalamus alimentary behaviour centres are not sufficiently clear; it is however assumed that they play an important role.

The VMH stimulation determines glucose mobilization from the hepatic glycogen which brings about hyperglycemia. VMH belongs to the sympathetic zone of hypothalamus, while LH to the parasympathetic one.

VMH excitation in mammals induces hepatic *glycogenolysis intensification* by phosphorylase and glucose-6-phosphatase activity, phenomena which can likewise be reproduced and after the splanchnic nerve stimulation (in the rabbit) [9]. In sheep repeated splanchnic nerves excitations are accompanied by an evident hyperglycemia [1].

In T. Schimazu's researches it is stated that by the stimulation of the parasympathetic system, hepatic glycogenesis is accelerated by glycogen-synthetase activation, which might lead to a certain hypoglycemia.

Consequently the sympathetic and parasympathetic system intervenes in certain enzymatic or biocatalytic processes involved in glucidic metabolism.

These effects of the stimulation of the vegetative nervous system upon phosphorylase and glycogen-synthetase probably fulfil an important role in glycemic regulation and in ensuring homostasis.

It was mentioned that anorexia can be produced by the blocking of vagi, though not by that of the glosopharyngeus. In the case of anorexia induced by the blocking of one or both vagi, it is established that the liver intracellular glucose increases.

Our results, agreeing with those obtained in mammals, permit to infer that fowls likewise dispose of similar glycoregulative mechanisms.

CONCLUSIONS

1. In the fowl, the vagus evidencing operation does not modify glycemia, even if the animal is not anaesthetized.
2. The stimulation of the central end of the right vagus induces an 8.8% hyperglycemia after 5 minutes, as well as from 60 to 120 minutes.
3. The stimulation of the peripheral end of the left vagus determines after 120 minutes a hypoglycemia of maximum 15%.
4. The stimulation of the peripheral end of the right vagus and of the central end of the left vagus does not modify glycemia significantly.

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VENTRICULAR MECHANICS IN TURTLE HEART STUDIED
BY PHOTOMECHANOGRAPHIC METHODS

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Photomechanographic methods were used to investigate the ventricular mechanics in turtle heart. Spatial movements of some points picked out on the ventral or dorsal wall were recorded. The curves could be read according to the electric phenomena of the heart.

The guidemark was placed on each auricle, on the ventricle as well as on the ventral face of three various points, on the right hand area and on two points on the left hand area, at the dorsal face. The movement of two points towards the right hand side and of two points on the left hand side were followed.

The curves were described and the results obtained from each point according to the three compounds of the studied movements were discussed. The lateral, the cranio-caudal and the radiary compounds, as well as, comparatively, the right and left areas were described for each compound individually.

The following conclusions were arrived at:

1. The mechanical systole of the ventricle started for every area at 0.12 seconds since the beginning of the electric systole. One did not notice the succession of contractions between the right and the left areas.

2. The ventral wall of the right ventricle area showed a different motility as against the left area. For the first movements in the cranial direction slanting to the left is characteristic; for the second, the movements are oriented towards the left side in caudal direction.

3. For the whole ventricular systole, the right area made a swinging movement starting dorsally at the basis and continuing to the right margin towards the right ventral face, to the direction of the pulmonary artery. The left area also made a swinging movement, but it started at the ventral face and continued to the left margin towards the dorsal face.

4. The spatial motility of each area corresponded to its intimate structure and to the part played in the blood evacuation process to one or the other category of vessels

CERTAIN PECULIARITIES OF CHEMICAL TRANSMISSION IN *GALLUS DOMESTICUS*

ELENA BĂRZĂ and VALERIA POPESCU

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STUDIES ON THE ENERGETIC METABOLISM IN MAN AT REST AND DURING EFFORT OF VARIOUS INTENSITIES

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EFFECT OF COBALT ON THE THYROID FUNCTION OF THE SHEEP, EXPLORATIONS BEING MADE WITH ¹³¹I RADIOISOTOPE

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THE INFLUENCE OF ELECTROMAGNETIC FIELDS ON THE RELATIONSHIP BETWEEN THE HYPOPHYSIS AND THE ADRENAL GLAND IN GUINEA PIGS

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TOXICITY VARIATIONS OF SOME SUBSTANCES WITH HYPOTENSIVE ACTIVITY

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CEREBRAL BIOELECTRICAL ACTIVITY IN ACUTE EXPERIMENTAL HYPERTENSION

L. ENESCU, L. NICA and N. OIȚA

SSB, Com. Fiziol. Anim., 1969.

THE INFLUENCE OF TEMPERATURE ON THE METABOLIC BODY SIZE IN
BLAPS MORTISAGA L. (COLEOPTERA — TENEBRIONIDAE)

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The influence of temperature on the energy metabolism was studied in *Blaps mortisaga* L. in order to establish the variation of the Q_{10} coefficient and the metabolic body size at different temperatures between 10–35°C. The oxygen intake was measured with a Warburg apparatus.

The experiments showed that the energy metabolism varies with temperature, the adjustment of the oxygen consumption values between 10–35°C being done according to an exponential function, where $y = 3.564 \cdot 1.075^x$.

Q_{10} coefficient has small values, varying between 1.66–2.13. The highest Q_{10} value was recorded at 20–25°C interval when $Q_{10} = 2.13$.

The metabolic body size is very much influenced by the temperature, the regression coefficient varying accordingly between 0.71–1.92; at 20°C the slope is 1.00.

As the metabolic body size in this species varies with temperature at such an extent, we think that when these values are to be subjected to statistical treatment in comparative studies one has to be sure that the determinations were done at the same temperature.

The energy metabolism variation in relation to temperature having an exponential trend, a simple temperature correction of the data according to Van't Hoff curve, as is usually done is inadequate.

THE ACTION OF INOSITOL UPON THE HEART OF *TESTUDO GRAECA*

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Investigating the action of Inositol upon the heart of *Testudo graeca* "in vitro", in tortoises with extirpated brain, or treated with Plegomazin (largactil), the authors found comparatively to the controls as follows: Inositol does not produce the stimulation of contractile activity when it acts upon the heart of normal tortoises. In tortoises with extirpated brain, a 100 mg/ml conc. solution of Inositol, produces a positive, inotrope and chronotrope effect followed by an increase of amplitude and a return to normal of the heart frequency.

The heart of tortoises treated for 10 days with Plegomazin, show a very low amplitude and frequency contractions. Addition of Inositol solution produces an increase of cardiac activity.

In both cases, the effect of Inositol is very similar to that obtained by addition of adrenalin.

The authors conclude that Inositol represents an additional energetical source for the cardiac muscle.

INFLUENCE OF TEMPERATURE ON THE EFFICIENCY OF USING FOOD ENERGY IN
THE MEADOW SNAIL (*HELIX POMATIA* L.)

DOINA GROSSU-MOISA

Șt. Cerc. Biol.—Zool., 1969, 21, 4.

ON THE INFLUENCE OF TEMPERATURE ON THE ENERGY METABOLISM IN THE
MEADOW SNAIL (*HELIX POMATIA* L.)

DOINA GROSSU-MOISA

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The energy metabolism in the meadow snail (*Helix pomatia* L.) was investigated during its hibernation and estivation periods, in order to establish the influence of temperature (5°C–35°C) on the metabolic rate and on the Q_{10} .

As a function of temperature the energy metabolism varied from 0.03449 ± 0.012 (5°C) and 0.27687 ± 0.077 (30°C) during hibernation period and from 0.05616 ± 0.00006 (5°C) and 0.23039 ± 0.035 (30°C) during estivation period.

The results show that during lethargic periods the energy metabolism reported to the temperature follows a curve that can be expressed by the equations: $y = 207.9921 + 17.8701x - 3.97258 x^2$ (hibernation) and $y = 223.33217 + 14.577567 x - 4.087946 x^2$ (estivation).

The value of the regression coefficients varies with temperature from 0.64786 ± 0.101 to 0.9206 ± 0.088 in the hibernation period and from 0.60555 ± 0.03122 to 1.038 ± 0.028 in the estivation period.

Q_{10} is far from constant, but decreases with increasing temperature. The summer curve decreases rapidly from 5.60 to 1.06, then shows a slight increase to 1.38 corresponding to 5°C–35°C interval. The winter curve decreases from 8.59 to 2.06 in 5°C–15°C interval, then increases to 3.01 at 15°C–20°C interval, decreasing to 2.45 at 35°C.

ON EFFORT METABOLISM OF VARIOUS INTENSITIES IN WHITE RATS

DUMITRA IONILĂ and GH. BURLACU

SSB, Com. Fiziol. Anim. 1969.

THE INFLUENCE OF ELECTRO-MAGNETIC FIELDS ON THE CONVULSIVE
ATTACK AND THE INCORPORATION SPEED OF RADIOACTIVE PHOSPHORUS
(³²P) INTO THE ENCEPHALON OF WHITE CONVULSING RATS

M. ISAC and ELENA COSMULESCU

SSB, Com. Fiziol. Anim., 1969.

SOME METABOLICAL ASPECTS OF THE CAROTENICAL SUBSTANCES
IN EMBRYONARY DEVELOPMENT WITH SALMONIDES

MATHILDA JITARIU, ELENA HEFCO, W. MÜLLER, MAGDALENA BĂDILIȚĂ,
ECATERINA DUCA, R. BRANDSCH, I. BOIȘTEANU and GH. DAVIDEANU

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We watched during two years, some aspects of the metabolical processes of the carotenoid substances in the embryonary development with *Salmo gairdneri*. We dosed the cytochrome-oxidases, succin-dehydrogenases, peroxydases and catalisis activity and also the variations of vitamin C. (as oxydo-reductor system) and vitamin A in the ripe, unfertilised ovule and then, in the fertilised egg (2-4 hours) and 2, 4, 5, 7, 9, 11 and 13 days of incubation.

As metabolical substratum was searched the soluble and contractile type of proteins and phospholipids and glucides which built up complexes with those ones.

The existing carotenoids in the ripe, unfertilized ovule were utilized during the following four hours after fertilization (81 yg% spawns disappear). From them, the hypophasical carotenoids decreased by 76 yg% while epyphasical carotenoids were utilised only to an amount of 5 yg%.

These substances present also phisical oscillations during these 13 days of incubation,

With due account for these findings, as well as for the evidence, after our data, that in *Salmo gairdneri* there exist a still uncomplete oxido-reductor system, and because carotenoids are excellent donors and acceptors of electrons, we express the hypothesis that for achieving the intensity of metabolical processes during the period of molecular and structural organization of embryogenesis, besides the cytochrome-oxido-reductor system, there probably exist a simultaneous carotenoidic oxido-reductor system.

CHANGES IN THE PROTEINS AND PROTEINIC FRACTIONS OF PLASMA IN
CHICKENS EXPOSED TO ELECTRO-MAGNETIC FIELD

M. LAZĂR and C. BÎRCĂ

SSB, Com. Fiziol. Anim., 1969.

VARIATIONS OF Na AND K IONS IN CHICKEN TISSUES EXPOSED
TO THE INFLUENCE OF ELECTRO-MAGNETIC FIELDS OF SMALL INTENSITY
AND TO THE INFLUENCE OF HOMOGENEOUS MAGNETIC FIELDS OF HIGH INTENSITY

M. LAZĂR and C. BÎRCĂ

SSB, Com. Fiziol. Anim., 1969.

THE BIOSTRUCTURE AND THE PROBLEM OF SODIUM PUMP

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According to our theory, part of the matter constituting living protoplasm is integrated into a quite particular structure, denominated biostructure, the integrity of which is maintained by metabolic energy supply. At the moment of protoplasm death biostructure breaks up. It follows that metabolic inhibitors (dinitrophenol, sodium acide, etc.) introduced into any living biological material would have an effect of partial break-down upon biostructure, with the concomitant release of water and other components it is made up of. This prediction was confirmed by some data obtained in experiments on living axons from *Sepia*. Indeed, this effect permitted to explain how metabolic inhibitors influence sodium ion effluxes from ²⁴Na-loaded axons (effluxes investigated by A. L. Hodgkin and R. D. Keynes, 1955), to establish the law which governs this process and to calculate sodium ion concentration in protoplasm free water as well as the water amount which is released from axon biostructure in the presence of inhibitors. This fact demonstrates the existence of biostructure within living cell protoplasm, show that the maintenance of biostructure integrity requires metabolic energy supply and invalidate the hypothesis about the existence of a sodium pump.

STUDIES ON THE METABOLIC RATE IN *CARASSIUS AURATUS GIBELIO* BLOCH

AL. G. MARINESCU

St. Cerc. Biol.—Zool., 1968, 20, 4.

SEASONAL VARIATION OF THE BODY WEIGHT — OXYGEN CONSUMPTION
RATIO IN *CARASSIUS AURATUS GIBELIO* BLOCH IN THE CONDITIONS
OF CONSTANT TEMPERATURE

AL. G. MARINESCU

St. Cerc. Biol.—Zool., 1969, 21, 3.

**EFFECT OF CEREBRO-SPINAL AXIS INJURY ON NORMAL GLYCEMIA
AND PROVOKED HYPERGLYCEMIA IN RANA RIDIBUNDA**

CONSTANȚA MATEI-VLĂDESCU

SSB, Com. Fiziol. Anim., 1969.

STUDIES ON THE ENERGETIC METABOLISM IN PERDIX PERDIX

GH. NĂSTĂSESCU and L. MANOLACHE

SSB, Com. Fiziol. Anim., 1969.

**STUDIES ON NYCTHEMERAL VARIATIONS OF THE ENERGETIC METABOLISM
IN SOME BIRDS (COLUMBA LIVIA DOMESTICA, STREPTOPELIA DECAOCTO,
COTURNIX COTURNIX, CARDUCLIS CARDUCLIS)**

GH. NĂSTĂSESCU

SSB, Com. Fiziol. Anim., 1969.

**CONTRIBUTIONS TO THE STUDY OF LATENT TETANY BY THE EMG AND ENM
METHOD (E/D CURVE)**

P. NEDELESCU

SSB, Com. Fiziol. Anim., 1969.

**SOME DATA ON THE INFLUENCE OF LOW FREQUENCY ELECTRO-MAGNETIC
FIELDS ON THE INHIBITION OF SOME TISSUES EXPOSED IN VITRO**

P. NEDELESCU

SSB, Com. Fiziol. Anim., 1969.

**CONTRIBUTIONS TO THE STUDY OF THE INTERMITTENT ACTION
OF ELECTRO-MAGNETIC FIELDS PRODUCED BY ELECTRICAL DISCHARGES ON TB
GUÉRIN CARCINOMA IN RATS AND EHRLICH ASCITES IN MICE**

P. NEDELESCU, V. ROBESCU and S. CÎRCIUMĂRESCU

SSB., Com. Fiziol. Anim., 1969.

**INFLUENCE OF LOW TEMPERATURE ON GLUCIDIC AND ENERGETIC METABOLISM
IN ONTOGENESIS IN THE HAMSTER (MESOCRICETUS AURATUS W.)**

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Continuing researches concerning thermoregulation in ontogenesis in certain species of animals, the authors proposed to examine in the present work the action of low temperature (4) on the glucidic metabolism and on the energetic metabolism (10° and 15°C) in young hamsters. The control lot was kept at 25°C.

The data obtained show that under the influence of the temperature of 4°C, at the age of 4 days, a hyperglycemia of 20%, as against the control (25°C) is induced, after which the glycemic level decreases, being thus maintained even for 30 days.

A gradual decrease of this index is observed, which becomes evident particularly after 17 days (25%).

In adult animals low temperature induces a glycemia due to an increased oxidation of glucose (3).

As regards energetic metabolism, in the first four days, a period of poikilothermy is recorded, oxygen consumption being very low, particularly for the young kept at 10°C. (0.0013 sub. cm/g). Their movements are feeble, and when the female leaves the nest, the young get completely benumbed. After one week, oxygen consumption is intensified at both temperatures, and the resulting modifications point out to the occurrence of homeothermia and its gradual stabilization. The four well defined stages in the evolution of chemical thermoregulation, recorded by us in hamsters kept at temperatures of 25–26°, shorten under the influence of low temperature. The efficiency of thermoregulation reaction is noticed after 17 days.

Consequently low temperature affects energetic thermoregulating metabolism, inducing at the same time a hypoglycemia in hamsters in ontogenesis.

**COMPARATIVE STUDIES ON TRUE GLYCEMIA AND ON TOTAL REDUCING
SUBSTANCES IN VARIOUS PHYSIOLOGICAL STATES IN GALLUS DOMESTICUS**

CORNELIA NERSESIAN-VASILIU and N. ȘANTA

St. Cerc. Biol.—Zool., 1968, 20, 4, 389–396.

**CHANGES OF PROTEIN PHOSPHORUS IN RATS CHRONICALLY
TREATED WITH HYDROCORTISONE**

OROS I.

Studia Univ. Babeş-Bolyai Cluj, Ser. biol., 1969, 1, 141-149.

EFFECT OF TRANSANDROSTERONE ON INTESTINAL ³⁵S-METHIONINE ABSORPTION

C. C. PARHON, ZENOBIA COVĂSNEANU, ELENA BĂRZĂ and GEORGETA PETCU

SSB, Com. Fiziol. Anim., 1969.

EFFECT OF TRANSANDROSTERONE ON INTESTINAL ABSORPTION OF GLUCOSE

C. C. PARHON, ELENA BĂRZĂ, GEORGETA PETCU and VALERIA POPESCU

SSB, Com. Fiziol. Anim., 1969.

**THE INFLUENCE OF ELECTRO-MAGNETIC FIELDS ON THE MYELOGRAM
OF RABBITS**

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The changes occurring in the myelogram of rabbits were studied with the aid of the same electro-magnetic fields as those used for the examination of the peripheral leukogram.

It was shown in a previous paper that after counting the nucleated elements they were found in a decreased number by about 10-11% after 5 sittings, then rising again to a percentage equal to the initial one after 10 sittings.

The relation G/E in the normal myelogram is 3.7; after 5 sittings it rises to 3.8, and after 10 sittings it falls to 3.1. The average error of Ma is generally less than 1, exceeding this value only if the percentage is higher than 10%.

The variability percentage is rather high in every cellular category, pointing to a lability of haemopoetic medullar tissue.

The dynamics relating to the maturation of the cellular elements of the myelogram is modified and is more striking in the granulocytic and erythroblastic series; they become reduced in the lymphocytic and monocytic series, leading as a consequence to the modification of the cytodibase.

**COMPARATIVE STUDIES ON OXYGEN CONSUMPTION OF SOME SPECIES
OF FRESH WATER FISHES**

C. A. PICOŞ, GH. NĂSTĂSESCU and GH. IGNAT

SSB, Com. Fiziol. Anim., 1969.

**INFLUENCE OF THIOUREA ON OXYGEN CONSUMPTION BY FISHES IN HYPOTHERMIA
CONDITIONS**

C. A. PICOŞ, DUMBRĂVIŢA SCHMIDT şi ELENA POPOVICI

Zeitschrift für Vergleichende Physiologie, 1969, 62.

**THE INFLUENCE OF THE HABITUATION TO CLIC OR TO REPEATED ELECTRICAL
STIMULATION OF SOME SUBCORTICAL STRUCTURES ON AHA, AHP, ACL AND ABP
REACTIVITY**

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We followed the changes of the responses recorded from Aha, Ahp, Acl and Abp, after the occurrence of the habituation to clic or to repeated electrical stimulation of Aha, Ahp and Acl, starting from the hypothesis that during the settlement of a habituation process, functionally antagonistic structures are asked for special work.

Considering as habituation test the vasomotor response to repeated electrical stimulation of Aha, we found that the appearance of the habituation was accompanied by a gradually decrease and / or a reversal of the effect of Ahp stimulation. The habituation to clic does not modify significantly the evoked potentials recorded in Aha and Ahp by their alternative stimulation with single shocks.

After the decrease of the response of Ahp to repeated electric stimulation in Aha, the single shock evoked potentials both from Aha and Ahp are plainly diminished.

The habituation to clic does not induce significant changes in hypothalamic nuclei; however it generates an augmentation of the response from Acl at a time when the response from Abp is either unchanged or slightly modified.

The habituation to clic yields a decrease of the evoked potentials recorded in Eas and Epi by single shock stimulation of mentioned subcortical structures. After the decrease or the disappearance of the response from Abp following repetitive electrical stimulation in Acl, we recorded a reduction of the evoked potential from Acl to a single shock in Abp and a slight enhancement or a lack of change of the corresponding Abp-evoked potential.

In some few experiments we noted that the coupling of sonorous and electrical stimulation in Aha delays the appearance of the habituation process both in cortex and in Ahp.

On the basis of these results the authors conclude that antagonistic structures are brought into action during the habituation, whose intimate mechanisms call for further research.

**THE RENAL SECRETION OF SOME PROTEINS SYNTHETIZED IN THE MAMMARY
GLAND**

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Experiments made on lactating cows, or on cows ready to calve, studied the factors which determine the process of elimination by urine of some proteins synthetized in the mammary gland.

The immunochemical analysis shows that before calving, there takes place a renal elimination process of beta-lactoglobulins, alpha-lactoglobulins and gamma-lactoglobulins. The concentration of these proteins in urine increases till the calving time and then, abruptly decreases as soon as the accumulated milk existing in udders is periodically eliminated through the milking process. Simultaneously with the intensification of proteinuria the increase of lactose concentration in urine and the decrease of chloride also occur. In colostrum milk the level of the chloride concentration is higher and the concentration of lactose is lower than the usual level in normal milk.

The immunochemical tests show that α -lactoglobulin and β -lactoglobulin in urine are absolutely identical with the corresponding fractions existing in milk. It is thus demonstrated that the transfer of these substances from the mammary gland into blood and from blood into urine is not accompanied by structural changes, which might determine a change of their antigenic properties. The same thing was found with blood globulins present in the urine which proved to be antigenically identical with the corresponding fraction present in the blood.

By increasing the periods of time between milkings, similar phenomena were obtained on animals being in their middle or late state of lactation. The suggestion is forwarded that, under certain conditions, some synthesis products of epithelial cells in mammary gland, instead of leaving the cell through the apex and then passing into the alveolar lumen, go through the basal region of the cell directly into blood, being then eliminated by urine.

THE ACTION OF THYROXINE-, THIOURACYL-TREATMENT AND OF THYMECTOMY ON THE ASCORBIC ACID LEVEL IN SOME ORGANS OF RANA ESCULENTA

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The importance of the ascorbic acid in the activity of the endocrine glands is not well known. Available published data are referring especially to adrenals.

Experiments were made on frogs of both sexes, weighing about 70 g, divided into 4 groups: control group, thymectomized group, frogs treated with thyroxine during 8 days, with a total dose of 1 mg per 100 g body weight and a group treated with thiouracyl during 8 days, with a total dose of 1.6 mg per 100 g body weight. The determinations were carried out with Klimov's photocolometric method.

In the muscle amount of ascorbic acid was not modified in any of the experimental variants. Thyroxine brings up a statistically significant increase ($p \cong 0.05$) in the liver tissue. Thiouracyl determined a doubling of the ascorbic acid amount of the thymus ($p < 0.001$). The thymectomy and the treatment with thiouracyl brings up a statistically significant increase ($p < 0.01$ respectively $p < 0.001$) of the ascorbic acid level of the thyroid gland.

It is possible that the increase of the ascorbic acid concentration in the thymus and thyroid gland may be due to the activation of the ascorbic acid- dehydroascorbic system. This phenomenon compensates the thyroxine deficit in the intracellular oxidative processes. The increased content of the ascorbic acid in the thyroid gland, after thymectomy shows the existence of an interrelation between thymus and thyroid, and a possibly compensatory tendency of the lack of the thymus.

INFLUENCE OF BURSECTOMY, THYMECTOMY AND THYMOBURSECTOMY ON NITRATE EXCRETION IN CHICKENS

E. A. PORA and RODICA GIURGEA-IACOB

St. Cerc. Biol.—Zool., 1969, 21, 1.

EFFECT OF AN ANABOLIZING STEROID TREATMENT ON THE FUNCTION OF ENDOCRINE PANCREAS AND ADRENALS DEPENDING ON SEX

E. A. PORA, A. D. ABRAHAM and I. MADAR

St. Cerc. Biol.—Zool., 1969, 21, 2.

SIMPLE QUANTIFYING OF TRACINGS IN EXPERIMENTAL ELECTROENCEPHALOGRAPHY

R. RACOTTĂ

Acta Biol. Med. Germ., 1968, 21, 245—248.

ELECTROENCEPHALOGRAPHIC CHANGES IN THE RABBIT AFTER INTRAVENOUS GLUCOSE ADMINISTRATION

R. RACOTTĂ

Arch. Int. Physiol. Bioch., 1969, 77.

THE INTRAHEPATIC PROJECTION OF THE AFFERENT TERRITORY OF THE PORTAL VEIN

I. TH. RIGA

SSB, Com. Fiziol. Anim., 1969.

LAMINARY CIRCULATION IN THE FETUS

D. I. RIGA and S. I. RIGA

Anatomischer Anzeiger, 1968

THE ACTION OF SOME HORMONES ON OSMOREGULATION IN *HIRUDO*
MEDICINALIS

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The transfer of the leech *H. medicinalis* from its natural environment — fresh water — into complex salines (Allen type solutions), hypo-, iso- and hypertonic against the internal medium of the animal, induces modifications of body weight (volume), of water content and chemical composition. The new steady state is achieved during 30 days of adjustment between the inflow and outflow of water and salts.

In the new osmotic gradient conditions, the steady state is characterized by a restoring of weight (volume) and hydremia at the value found in fresh water, but by an increase of "mineral substance/organic substance" ratio from 0.0369 to 0.0540 for the isotonic solution (with 7 g salts per liter) and to 0.0827 for the hypertonic one (with 14 g salts per liter).

Some of the vertebrate hormones may influence the osmoregulation phenomena in *H. medicinalis* through the changing of the hydromineral permeability of the epithelio-muscular sack, or through their action on the excretory function: a) *insulin* (like EDTA) in external environment, permeates the body surface for the monosodic phosphate labeled with ^{32}P , from outside towards the inside and increases the digestive epithelium permeability for the same substances; b) *adrenalin* and *hydrocortisone* added to the external environment, increase the ^{45}Ca penetration through the digestive epithelium, but do not change the body surface impermeability for this substance, from outside towards the inside; c) *noradrenalin*, *oxytocine*, *vasopressine*, *DOCA* and *supercortisone*, given parenterally, influence differently the body weight dynamics like the hydromineral composition during the first 48 hours of the osmotic re-equilibration process.

These experiments were accomplished on starved animals or on animals which were previously emptied of their digestive duct content, by "reverting" them like a glove finger.

THE INFLUENCE OF TEMPERATURE ON THE METABOLIC ACTION OF ADRENALIN
IN *RANA RIDIBUNDA*

DUMBRĂVIȚA SCHMIDT

St. Cerc. Biol.—Zool., 1969, 21, 3.

CORRELATIONS BETWEEN THE NATURE OF THE PATHOGENIC AGENTS AND
THE NON-SPECIFIC REACTIONS IN SUBCLINICAL PATHOGENIC CONDITIONS IN SHEEP

O. SCHÖBESCH, GR. SARBOVAN and AL. POP

SSB; Com. Fiziol. Anim., 1969.

THE USE OF ELECTROMAGNETIC FIELD (EMF) IN THE STIMULATION OF CHICKEN
IMMUNOGENIC FUNCTION

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The report describes an attempt to stimulate production of antibodies to avian pseudopestos virus in chickens of Leghorn breed. Chickens in group I and II were inoculated in the conjunctives with virus vaccin B (Hitchner) at 9 and 24 days of age respectively, and re-inoculated at 60 days of age with adsorbed vaccin. Before the first and the third inoculation, chickens in group I were submitted to low frequency (80–100 G), interrupted EMF impulses. Group II chickens were considered as conventional controls.

The stimulated antibodies neutralizing strength against avian pseudopestos virus infectious capacity were tested, by serum neutralization, on chickens serum after 21 days from the third inoculation.

Our results suggest that EMF-treated chickens show a higher immunogenic response than controls: sera obtained from EMF-treated chickens were shown to induce a neutralization effect against the infectious action of the avian pseudopestos virus in 96.6 per cent of previously inoculated embryos (10 days after hatching, with 10 DLE). The controls sera showed a lower protection ratio (77 per cent of inoculated embryos), while the sera obtained from group III, consisting of non-inoculated chickens, yielded no protection against a similar virus dose.

CONTRIBUTIONS TO THE STUDY ON THE NERVOUS REGULATION OF THE HEART
ACTIVITY IN BIRDS

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The author discusses in this paper whether heart activity is chiefly affected by the sympathetic vegetative nervous system or by the parasympathetic one. The experiment was made using Leghorn hens of one to two kg weight, which were anaesthetized by 1 g/kg urethane with a 20 per cent concentration. A proper method for opening the thoracic cavity without requiring an artificial respiration is described; this method makes possible the simultaneous recording of both cardio-and pneumograms. It was found that in such conditions a normal respiration can be maintained in birds also after opening the thoracic cavity.

There is a strong interdependence between the cardiac and respiratory nervous centers, this being expressed by the tonotrope, inotrope and chronotrope variations which occur during the inspiration and the expiration, as well as by their absence during apnea. The vagal impulses have a much stronger inhibitory action on respiration than on heart activity in birds. The much lower vagal heart inhibiting effect in birds as compared to poikilothermals and mammals proves that the heart activity regulation in birds is submitted to the prevalent influence of a strong sympathetic nervous tonus.

**OBSERVATION ON SOME STOMACH REFLEX EVAGINATION IN THE MOUTH
CAVITY OF RANA TEMPORARIA**

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A few days after its hypophysectomy, *Rana temporaria* presents, beside tegument decoloration and body oedema, a most unusual phenomenon, namely its mouth cavity is broadly open and the whole stomach is evaginated, its mucous membrane being turned outwards. This evagination may take place at various intervals following the intervention (between one hour and three days) and sometimes even during the intervention itself).

The evagination occurs suddenly and is irreversible, since if the stomach is forced again with a forceps into the abdominal cavity, it does not remain there, but evaginates once more. It was found after dissection that the intestines are in a high tonic contraction condition, having an utmost reduced diameter and the proximal section being broken up piecemeal at the same time as the evagination of the stomach takes place.

Reflexes of this kind are not known in normal or experimental conditions in vertebrates; they may play a functional role, similar to the emesis reflex for the oral evacuation of a gastric content. The hypermotility during the evagination and the persistence of the muscular tonus after its occurrence may be caused by hypophysectomy, but also by the hypothalamus excitation following the surgical trauma. It was stated that the anterior hypothalamus center excitations in mammals result in a gastric secretion increase and a gastric motility inhibition. The stomach evagination reflex in the oral cavity may be caused by the hypothalamic centers being in an excited condition.

**CONTRIBUTIONS TO THE MECHANISM OF AUTOREGULATION
OF THE HYDRO-ELECTROLYTIC AND ACID-BASIC SECRETION AT THE LEVEL
OF THE GASTRIC MUCOSA**

C. STOICESCU and EUGENIA LEONTE-DIACONESCU

SSB, Com. Fiziol. Anim., 1969.

SOME ASPECTS OF THE EXCITABILITY OF THE RHINENCEPHALON

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We succeeded in experiments performed on cats in "encephale isolé" or curarized preparations, to point out two new features of the susceptibility of the amygdalo-hippocampic circuit to electrical stimulation.

The first one consists in recruitment-potential phenomena by repetitive stimulation at a very low frequency- 0.1 c/s. Usually, such stimuli are said to be unique. It follows that the concept of unique stimulus in the electrophysiology of the rhinencephalon has to be reconsidered.

The second feature expresses itself in the occurrence of a potentiation phenomenon after an electrical seizure in the respective circuit. This phenomenon, called by us post-paroxistic potentiation (PPP), renders evident the fact that, specifically for rhinencephalic structures, long-lasting self-sustained discharges are not exhaustive, but, on the contrary, they increase the reactive availabilities.

Studying the relations between the limbic system and the formations generally implied in central nervous tone control, and taking as tests the above-mentioned phenomena, we found that the stimulation of RF at all levels, of posterior hypothalamus and of caudate nucleus when its connections with RF are preserved, had a depressive effect. A general pharmacological blocking of the RF or lesions of posterior hypothalamus had a facilitatory effect. The same facilitatory effect was produced by stimulating caudate nucleus when its connections with RF were interrupted. (These are the conditions generally known to be necessary for making evident the inhibitory influence of caudate nucleus upon the neocortex). Our experiments demonstrate in this way once again the high rhinencephalic excitability and the fact that the activating tonoregulator systems for the neocortex are inhibitory for the limbic system, those inhibitory for the neocortex being facilitatory for the rhinencephalon.

THYMUS-ADRENAL CORRELATION IN TUMORAL STRESS

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The thymus-adrenocortical correlation is essential in thymus research. It seems that on this basis connections may be found between the thymus function in stress and the immunobiological one.

Thus, in rats transplanted with Walker 256 carcinosarcoma or with OYA ascitic carcinoma, the hyperactivity of adrenal cortex, and the thymus involution developed proportionally with the aggressivity of the tumor. After bilateral adrenalectomy thymus hypertrophy persisted temporarily. In the terminal phasis of the survival of the tumor-bearing and adrenalectomized animals, the histological, ponderal and SH-groups test of the thymus showed signs of involution. This phenomenon may be explained by the direct intervention of the cancerous "Toxohormone" (Fukuoka and Nakahara-1952) on the thymus. At the same time the involution may be also caused by the migration of the thymocytes or the thymic substance towards the tumoral focus (Siegler and Koprowska-1962, Miller 1961).

Based on these data (with the reserve of the accessory adrenals) the hypothesis is forwarded that in tumoral stress, the thymic involution might be provoked also by extra adrenocortical mechanisms.

**EFFECT OF GLUCOSE ON THE ULTRASTRUCTURE OF THE ENDOCRINE PANCREAS
IN THE FROG (*RANA RIDIBUNDA*)**

T. TRANDABURU, CONSTANȚA MATEI-VLĂDESCU and VIORICA TRANDABURU

Endokrinologie, 1969, **54**, 134—142.

**AUTORADIOGRAPHIC OBSERVATIONS ON THE METABOLIZATION OF SOME
HEXOSES IN *TRITURUS VULGARIS***

T. TRANDABURU and PAULA PRUNESCU

St. Cerc. Biol.—Zool., 1968, **20**, 4.

**THE INFLUENCE OF ADRENALIN OF THE ENDOCRINE PANCREAS
IN *RANA RIDIBUNDA***

T. TRANDABURU, MARIA-LUIZA CĂLUGĂREANU and
CONSTANȚA MATEI-VLĂDESCU

Acta Anatomica (Basel), 1969.

**STUDIES OF OPTICAL AND ELECTRONIC MICROSCOPY ON THE ENDOCRINE
PANCREAS IN *NATRIX NATRIX* L.**

T. TRANDABURU and MARIA-LUIZA CĂLUGĂREANU

Z. Zellforsch. 1969, **97**, 212—225.

**THE THYMUS GLAND AND THE RECEPTIVITY TO INFECTIONS OF YOUNG
MAMMALS AND FOWLS**

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In contradistinction to the great extension of the investigations performed in species of laboratory animals concerning the role of the thymus gland in the immunologic reactivity, the studies performed in domestic animal species are only at the outset.

For these reasons, the author studies in sheep and in several species of domestic fowls of the Phasianidae and Anafidae families their receptivity to infections, in conditions of experimental reproduction of thymopriva states obtained by total and partial neonatal surgical thymectomies, and in states of hyperthymisation, obtained by grafts of isologous thymus or by the administration of isologous thymus hydrosoluble extract. Previous descriptive and topographical anatomical researches of the thymus were performed especially in local breeds of sheep.

In experimental infection with *Mycobacterium ovium*, total thymectomized lambs manifested an augmented receptivity, presenting cases of generalized tuberculosis, which is in contradistinction with the benign evolutive forms found in controls (pseudo-operated or normal animals similarly infected). A more severe evolution of the tuberculous infection was found in young fowls thymectomized after hatching. The evolution of the tuberculous infection was followed by the study of the modifications of some blood constants, of the energetical metabolism, as well as the dynamics of allergic reactions against avian PPD tuberculin.

The existence of an augmented receptivity to different infections was also found in the lots of thymoprived animals maintained in observation during long time. Spontaneous cases of pasteurellosis and colibacillosis (in chicken), of hystomonosis (in young donkeys) and egyptoma (in lambs) were found in such animals; these diseases either did not appear in controls, or had a less severe clinical evolution in them.

The author advocates the use of the "Git golaș" breed of Transylvania in the researches which need surgical thymectomy in chicken after hatching. He also points to the practical value of the evaluation test of the thymus with the help of the transcutaneous measurement, as an element of prognosis of the reactivity ability of the organism.

**INVESTIGATIONS ON THE DESENSITIZATION OF ANIMALS AGAINST THE SHOCK
PRODUCED BY SUSPENSIONS OF ISOLOGOUS NERVOUS TISSUE**

N. VARACHIU, GH. SĂLĂGEANU and ADRIANA IONESCU

SSB, Com. Fiziol. Anim., 1969.

**INFLUENCE OF LOW TEMPERATURE ON THE ENERGETIC METABOLISM OF SOME
SPECIES OF HETEROTHERMIC AND POIKILOTHERMIC ANIMALS**

NICULINA VIȘINESCU

Șt. Cerc. Biol.—Zool., 1968, **20**, 5, 507—512.

**PECULIARITIES OF THERMOREGULATION AND ENERGETIC
METABOLISM IN *ERINACEUS EUROPAEUS* L.**

NICULINA VIȘINESCU

Șt. Cerc. Biol.—Zool., 1968, **20**, 6, 565—570

**INVESTIGATIONS CONCERNING THE INFLUENCE OF X-RAYS OF DIFFERENT
INTENSITIES ON NYCTHEMERAL RHYTHMICITY OF ENERGETIC METABOLISM
IN HAMSTER (*MESOCRICETUS AURATUS* W.)**

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Proceeding from the established fact that a general irradiation of the organism with sublethal doses induces a disturbance of energetic metabolism, we proposed to examine in the present work, how far nycthemeral rhythmicity of energetic metabolism, of glucidic metabolism, as well as the condition of mitochondria from hepatic tissue, are affected.

Experiments were undertaken on 30 hamsters (30 days old, divided into three lots), irradiated with doses of 200 r and 500 r. Our investigations revealed profound modifications in the respiratory metabolism in hamsters irradiated with 500 r expressed by a sudden intensification of this process, 48 hours after irradiation (160% as against control). The level of metabolism remains generally high, and after 60 days from irradiation, nycthemeral rhythm of metabolism differs from the normal lot in intensity; diurnal values, as well as those of evening hours, remain high in the irradiated lot. Differences between day and night are likewise much more marked in this case. In the lot irradiated with 200 r, metabolic modifications are not significant. The data obtained on glucidic metabolism indicates a marked hyperglycemia in animals irradiated with 500 r, namely 160 mg glucose to 110 mg. In control animals the maximum level is recorded at 30 days. Examining under the electron microscope the mitochondria from the hepatic tissue, it is found that the action of the 500 r dose induces disturbances which occur at cellular and subcellular level. The modifications observed are expressed by a compact structure of mitochondria in which mitochondrial crystals are clearly rendered with difficulty. The absence of the endoplasmatic reticulum around mitochondria is also observed.

Consequently the 500 r dose induces modifications of the energetic and glyceimic metabolism, modifications which are correlated with those occurring in the mitochondria of hepatic tissue.

AUTOMATIC DEVICE FOR THE STUDY OF ENERGY METABOLISM AND THERMO-REGULATION IN ANIMALS

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and Institute of Prototypes of the Academy*

In view of a more complex approach of the study of thermogenesis in different animal species, as well as of the influence of effort on thermoregulation, an attempt is made to develop an original technique of high precision, by the automation of the operations and by simplifying the working procedures.

The device ensures a rapid automatic dosage, on a wide range of temperatures, of the oxygen consumption in several media and small sized species, both in *homeotherms* and in *poikilotherms*.

The respiratory containers are transparent, allowing the survey of the behaviour of the animals during the experiment. The influence of the effort on thermoregulation is gradually applied, by means of three different speed values. The containers are thermostatized (with 1–2°C intervals) a short time after the apparatus is connected into the circuit, by an air-rheostat system conducted by a mechanism. The animals are automatically supplied with oxygen from the source (five small bottles) using a Kolobukhov burette, avoiding the high carbon dioxide concentration produced by the animal during the experiment.

The device is mobile and easy to transport, and as to the electric current supply, any available source is suitable for it.

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