日本生理誌・第43巻8・9号・昭和56年9月1日発行（毎月1日発行）
〔昭和27年5月6日　第3種郵便物認可〕

ISSN：0031-9341

日本生理学雑誌

JOURNAL OF THE PHYSIOLOGICAL SOCIETY OF JAPAN

43巻　8・9号　1981

The 58th Annual Meeting of the Physiological Society of Japan

April 1 - 3, 1981

University of TOKUSHIMA・TOKUSHIMA

日本生理誌
J. Physiol. Soc. Japan

日本生理学会

NASAの技術を導入した未来のフローメーター登場！

NARCOMATIC電磁血流計

RT-500

米国ナルコ・バイオシステムズ社がRT−400に続き開発したナルコマチックRT−500はこれまでの常識を破る革命的な新型の自動血流計で、ナル調整やゲイン調整は必要ありません。オートマチック・ゼロの特徴により、血管上のプローブが動いてもベースラインの変動はなく、正確且つ迅速な血流測定ができます。

※カタログ等の御請求は本社医用電子課へ

《特　長》

- オートマチック・ゼロによりゼロレベルの変動はありません。
- 流量はデジタル表示で直読できます。
- 操作が簡単ですから臨床用として最適です。
- コンパクトで持ち運びに便利です。
- プローブはすべて較正済みで臨床用から研究用まで豊富に用意されています。

日本総代理店

株式会社東海医理科
TOKAI IRIKA CO., LTD.

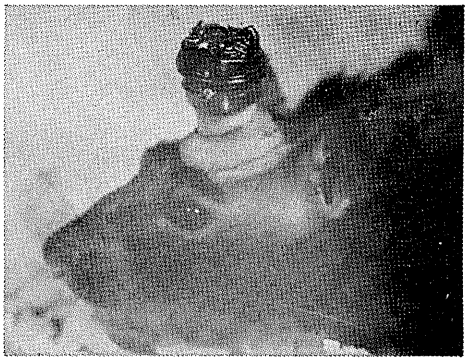
〒101 東京都千代田区内神田3-2-12クリハラビル ☎(03)254-0052(代)
札幌:(011)752-0176　北陸:(0764)78-5652　名古屋:(052)524-5408
大阪:(06) 787-0544　広島:(0822)93-2163　福　岡:(092)472-3800

米国MIDGARD社製

脳波からユニット電位まで
測定できるミニ・テレメータ

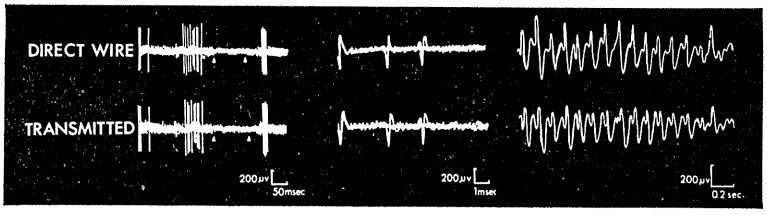
Miniature FM Transmitter

Model MXM-100



本装置はEEGからユニット電位までの生体信号を無線で送ることができるテレメータです。

モデルMXM-100のユニークな特徴はインピーダンスの高い微小電極と共に使用できることです



日本総代理店

株式会社東海医理科
TOKAI IRIKA CO., LTD.

〒101 東京都千代田区内神田3-2-12クリハラビル ☎(03)254-0052(代)
札幌:(011)752-0176　北陸:(0764)78-5652　名古屋:(052)524-5408
大阪:(06) 787-0544　広島:(0822)93-2163　福　岡:(092)472-3800

生理学教室史原稿のお願い

生理学教室史は昭和41年（1966）より逐次日生誌に掲載されて来ましたが，未だに初期の目的を達せず本学会の継続事業となっております．

この件に関しては日生誌第43巻第5号（1981）に編集委員会としての生理学教室史完成への希望と提案をさせていただきました．その後各先生方からその完成を期待するとの激励を受け意を強くしました．

ここに改めて正式に生理学教室史の原稿執筆をお願いする次第です．原稿執筆要領は，すでに日生誌掲載の諸生理学教室史に準じていただき，すでに掲載後10年余の歴史を閲した教室には龍頭蛇尾にならぬ程度の追補をお願い申し上げます．

昭和56年8月1日

日本生理学会
生理学教室史編集委員会

記

原稿締切日：**昭和57年6月1日**

送り先：日本生理学会生理学教室史編集委員会
〒113　東京都文京区本郷3-30-10　布施ビル内

註：期限までの原稿をもって，日本生理学教室史上巻として纏め，第60回大会の記念となるよう上梓する予定です．

第58回日本生理学会大会号目次

1. 研究方法 (1)

2. 分子生理 (2—8)

3. 細胞生理 (9—34)

4. 能動輸送（35—52）

5. 興奮性膜 (53—81)

6. シナプス・終板 (82—100)

7. 脊髄・末梢神経（101—110）

8. 脳幹・間脳（111—139）

9. 小　脳（140—150）

10. 終　脳（151—167）

11. 筋運動とその制御（168—176）

12. 脳波・誘発電位（177—181）

13. 行動・表現（182—205）

14. 神経化学 (206—214)

15. 視　覚 (215—256)

16. 聴　覚（257—268）

17. その他の感覚（269—296）

18. 骨格筋 (297—315)

19. 平滑筋 (316—327)

20. 心　筋（328—352）

21. 自律神経系 (353—370)

22. 循　環（371—394）

23. 血液・腎・体液調節 (395—414)

24. 呼　吸 (415—429)

25. 消化吸収 (430—435)

26. 内分泌・生殖 (436—458)

27. 運動・体力・疲労 (459—465)

28. 環境・エネルギー代謝 (466—488)

29. 体温調節・発汗（489—505）

第58回日本生理学会大会　　於：徳島県郷土文化会館　1981. 4

第58回日本生理学会大会を顧みて

第58回日本生理学会大会
当番幹事　松本淳治・井上五郎・高田　充

第58回日本生理学会大会は昭和56年4月1日（水），2日（木），3日（金）の3日間，徳島市藍場町徳島県郷土文化会館で開催され，それに先立って3月31日に常任幹事会，各種委員会が徳島大学医学部で開かれましたが，それは前回（昭和35年，第37回大会）開催時と現在のキャンパスの変化を比べて見て頂くためでした．

出題数は口演435題，ポスター展示72題，計505題でした（口演，ポスター展示の区別は会員の意志に従い，従来の最多演題数は昭和53年，新潟における476題）．それを生理学会による演題分類別から見ると（但し，味覚・嗅覚・皮膚感覚・筋求心系をその他の感覚に入れた），20題以上は細胞生理，興奮性膜，脳幹・間脳，行動表現，視覚，その他の感覚，心筋，循環，血液・腎・体液調節，内分泌・生殖，環境・エネルギー代謝であり，10題以下は研究方法，分子生理，脊髄・末梢神経，筋運動とその制御，脳波・誘発電位，神経化学，消化吸収，運動・体力・疲労でした．

参加者総数は約1,600名，懇親会（会場は徳島厚生年金会館）出席者数は約350名であり，前回に引き続いて懇親会を開き，徳島名物の阿波踊りを有名連の指導の下に全員で踊りましたが，会員相互の親睦には有益だったと思います．

常任幹事の方針として，一切の飾りを廃して質素・倹約を旨とし，学会運営の実をあげるように最善の努力をすることにしましたが，なお反省する点もあり，将来の参考となる事項を以下に列挙しますと，

1. 予め常任幹事会にはかり一任されましたので，予稿集末尾の人名索引を廃止しました．このことによって準備の手数が省かれ，また経費の節約になりました．
2. 学会場を学外に求め，市の中心部にしました．借用料のために参加費を1,000円値上げしましたが，市の辺縁部にある医学部への交通費を勘案すると，結局，参加者にとっては経済的であり，また8会場が分散せずに館内に纏められたためにあらゆる面において好都合だったと思います．
3. 口演時間の告知をタイマーで行ったために進行係が省かれ，人件費が節約されました．
4. 「春宵談話会」と銘打って三人の特別会員に，後輩会員の指針となる話を気楽にして頂きましたが好評でした*．スケジュールの関係上，生理学教育シンポジウムと同時に開かざるをえなかったのが心残りです．
5. ポスター展示，ビデオ供覧には余裕のある会場を当てることができましたが，会場の広さと上記の分類別による演題数との間には相関がなく，一部の会場に不手際のあったことを反省しています．
6. 学会記念写真を希望された方は185名でした．今回は，カラー写真にしました．

終りに会員の皆様の御協力を感謝いたします．

---

* 本誌前号（43巻7号）に掲載された．

THE 58th ANNUAL MEETING
OF
THE PHYSIOLOGICAL SOCIETY OF JAPAN

Titles and Authors

April 1—3, 1981

University of Tokushima, Tokushima

1

MEASUREMENT OF THE REACTION PARAMETERS IN PROTEIN SYSTEM WITH A DIALYSIS REACTOR

HASHIMOTO, M., HIGASHI, T., ISOMOTO, A. AND TYUMA, I. The Ist Dept. Physiol., Sch. Med. Univ. Osaka, UOZUMI, M. Div. Env. Health Res., Osaka Pref. Inst. Pub. Health.

A semi-permeable membrane dependent reactor was constructed. This reactor comprised two parallel planar semi-permeable membranes that separated three compartments, i.e., the compartment between the two membranes that contained an enzyme (protein) solution, the two outside compartments that contained the constantly flowing substrate (ligand). In this continuous and stationary flow system, the substrate (ligand) reacted with the enzyme (protein) through the membranes and flowed out of the reactor, then the concentration change of the effluent substrate (ligand) was followed with a spectrophotometric flow monitor. The behavior of this reactor, which coupled the flow and diffusion with chemical transformations, was described by fairly complex partial differential equations. We deduced an approximate solution with suitable boundary conditions. The experiments were carried in use of xanthine oxidase and xanthine as an enzyme and its substrate (albumin and sulfanilamide as a protein and its ligand). These data were fitted to the solution and Michaelis constant of xanthine oxidase system (the binding constant of albumin and sulfanilamide) was determined. Studies on the application of this method to the biological systems are now in progress.

2

RELATION BETWEEN HILL CONSTANT AND ALLOSTERIC CONSTANTS. H. WATARI, Y. ISOGAI* and H. NISHIKAWA* Department of Molecular Physiology, Institute for Physiological Sciences, Okazaki. *Department of Physiology, Kyoto Prefectural University of Medicine, Kyoto.

Hill constant was derived algebraically as a function of allosteric constants c and α_m or β_m ($=c\alpha_m$), and the relation between L, c, and α_m or β_m, was also obtained, where $L=T_0/R_0$, $c=K_R/K_T$, $\alpha_m=F_m/K_R$, $\beta_m=F_m/K_T$, R_0 and T_0 are concentrations of unligated R and T states respenctively, K_R and K_T are microscopic dissociation constants, and F_m is the ligand concentration at the maximum slope of the Hill plot. Nomographs which enable easier estimation of allosteric constants, L and c, were constructed from the two given values, the maximum slope of the plot, n, and α_m or β_m, in the cases where the maximum number of ligands, N, was 2, 4, 6 and 8. In the nomograph, log c is plotted against log L^2c^N keeping the value of the maximum slope of the plot and that of α_m or β_m constant. These nomographs show that the representation is symmetrical with respect to $L^2c^N = 1$.

3

EFFECT OF STEROID DERIVATIVE ON RED CELL FUNCTIONS. KON,K., MAEDA,N. and SHIGA,T. Dept. of physiol., Sch. of Med., Ehime Univ., Ehime.

The effect of DHS (dehydroepiandrosterone sulfate, one of steroid derivatives in plasma) on the rheological and transporting functions of human erythrocytes was investigated. DHS was rapidly incorporated (mainly) into erythrocyte membrane by specific binding to membrane protein (band 3) and by partitioning to lipid bilayer.

The following dysfunctions of erythrocyte were observed by the incorporation of DHS. (1) Inhibition of anion transport, proved by inhibition of sulfate self-exchange rate. The incorporation of DHS was partly reduced in the presence of DIDS (a specific anion transport inhibitor). (2) Increased cell suspension viscocity (measured by a cone-plate viscometer), probably due to the echinocytic transformation by DHS. (3) Retardation of deoxygenation rate (measured by rapid mixing with hydrosulfite). (4) Alteration of membrane fluidity (detected by the spin label method); the molecular motion of acyl chain decreased in superficical region, but increased in middle portion. In conclusion, it was assumed that the various dysfunctions of erythrocytes by DHS was introduced not only by the medification of membrane lipid organization, but also by the specific binding of DHS to band 3 protein.

4

INTRAMOLECULAR SULFHYDRYL-DISULFIDE EXCHANGE REACTION OF BOVINE PLASMA ALBUMIN — N-A ISOMERIZATION. INOUYE, H., NAGAOKA, S., ERA, S., AND SOGAMI, M., Dept. of Physiology, Sch. of Med., Gifu Univ., Gifu

Bovine mercaptalbumin (N), when incubated at low ionic strength and alkaline pH, isomerizes to a new component (A), having a more positive electrophoretic mobility than N near pH 5. The reaction is sulfhydryl (CYS-34) catalyzed and reversible (Sogami et al (1969) and Nikkel et al (1971)). A moving-boundary electrophoresis method was employed which separates A from N in a pH 4.82 buffer system. By this method, apparent equilibrium constant of this reaction was nearly equal to 1 at both 3° and 25°. The result suggests A and N to be the same energy level at low ionic strength. However, the reaction rate was greatly increased with an increase in temperature. The difference TRP-fluorescence spectra (λ_{EXC} = 300 nm) between N and aged albumin (reaction mixture of N and A) at pH 5.8 in 0.10 M KCl were not linear to A content, obtained by electrophoresis method. Furthermore, a difference in electrophoretic mobility between N and A increased as A content increases. These results strongly suggest that N-A isomerization is not a reversible first-order reaction (two-state) but a multi-state reaction. It might be worthwhile to note that the N-A isomerization of bovine mercaptalbumin is completely suppressed in the presence of 20 mM caprylate and/or 40 mM N-acetyltryptophanate at 25°.

5

CD-RESOLVED SECONDARY STRUCTURES OF BOVINE PLASMA ALBUMIN IN ACIDIC REGION. ERA, S., NAGAOKA, S., ASHIDA*, H., INOUYE, H. AND SOGAMI, M. Dept. of Physiology, Sch. of Med., Gifu Univ., Gifu, and *Dept. of Physiology, Defense Med. Col., Tokorozawa

Fractions of α-helix (f_α), β-form (f_β) and disordered form (f_γ) were estimated using Chen's method with two constraints : $\Sigma f_i = 1$ and $1 \geqq f_i \geqq 0$. Computed CD spectra ($[\theta]_\alpha$, $[\theta]_\beta$ and $[\theta]_\gamma$ at any wavelength) were determined from CD spectra of 5 proteins of known structure using program for multicomponent spectrum analysis (Anal. Chem. 37, 1000 (1965)). Using $[\theta]_{222}$ or $[\theta]_{208}$, two transitions of bovine plasma albumin were seen, one corresponding to the N-F transition and the other to the acid-expansion (N-F: pH 4.1-3.4, EXPANSION : pH 2.9-2.0 in 0.02 M $NaClO_4$). Values of f_α, f_β and f_γ of the N-Form in 0.02 M $NaClO_4$ at pH 5.65 were 0.73, 0.15 and 0.12, respectively and were comparable to 0.68, 0.18 and 0.14 obtained by Reed et al (1975). Changes in secondary structures from the N-to F-forms and from the F-form to the acid-expanded (E) form in 0.02 M $NaClO_4$ were as follows : (N$\rightarrow$F), Δf_α = -0.10, Δf_β = 0.06, Δf_γ = 0.04 ; (F$\rightarrow$E). Δf_α = -0.05, Δf_β = 0.00 and Δf_γ = 0.05. Changes in secondary structures in 0.10 M KCl were as follows : (N$\rightarrow$F), Δf_α = -0.12, Δf_β = 0.07, Δf_γ = 0.05 ; (F$\rightarrow$E), Δf_α = -0.10, Δf_β = 0.01, Δf_γ = 0.09. Major increase in the β-form was correlated with the N-F transition.

6

ANALYSIS OF OXYGEN-LINKED COMPETITIVE BINDING OF CARBON DIOXIDE AND ANIONIC LIGANDS TO HEMOGLOBIN. IMAI, K., IMAIZUMI, K. AND TYUMA, I. Dept. of Physicochem. Physiol., Med. Sch., Osaka Univ., Osaka 530

Carbon dioxide and anionic non-heme ligands such as Cl^-, 2,3-diphosphoglycerate and inositol hexaphosphate participate in the regulation of oxygen affinity of hemoglobin by binding competitively to specific sites including the α-amino termini of the α and β chains. To express the oxygen-linked and competitive ligand binding we introduced some models and derived linkage equations from binding polynomials. These equations expressed the observed dependences of overall oxygen affinity upon CO_2 and Cl^- concentrations very well. It was found to be important to assume that the bicarbonate ions, which are introduced to the hemoglobin samples in proportion to CO_2 concentration, exert an effect equivalent to that of Cl^-. The competitive binding between CO_2 and the organic phosphates could not satisfactorily be interpreted by the present models. More detailed information regarding the binding sites and the interactions between them is needed to get satisfactory models.

7

Purification and properties of quasi D-amino acid oxidase from hog kidney. K. SHIGA, Y. NISHINA, K. HORIIKE*, H. TOJO**, H. WATARI, AND T. YAMANO**, National Institute for physiological Sciences, Okazaki, *Dept. of Biochemistry, Shiga Univ. of Medical Sci., Ohtsu, **Dept. of Biochemistry, Osaka Univ. Medical School, Osaka

A new material for the flavoprotein research, quasi D-amino acid oxidase(Q D-AO), was discovered from hog kidney.

It was a different molecular species from D-amino acid oxidase(D-AO), although spectral and functional properties were quite similar between their two enzymes. Further, their amino acid compositions were also similar to each other, but the small differences did exist. For example, while 4 moles of methionine and 20 moles of proline per mole subunit were observed in Q D-AO, 5 moles of methionine and 22 moles of proline per mole subunit were present in the case of D-AO.

N-terminal anino acid was methionine and C-terminal amino acid was leucine in the both cases.

8

THE RELATIONSHIP BETWEEN THE BILIARY EXCRETION OF BILE SALTS AND FORMATION OF BILE

K.KITANI First Laboratory of Clinical Physiology Tokyo Metropolitan Inst. Gerontol.

Currently, the formation of bile-salt-dependent bile is explained on the basis of the The formation of bile-salt-dependent bile is currently explained on the basis of the osmotic driving force generated by the biliary excretion of bile salts.This mechanism was reevaluated by three different experiments on Nembutal -anesthetized male rats. 1) The linear regressions between bile flow(F) and bile salt excretion rate(X) for dehydrocholate, taurocholate(TC) and tauroursodeoxycholate(TU)yielded slope values (ul per umol)of 18.0, 9.0 and 5.3 for these bile salts. The difference in slope values between TC and TU can not be explained by the difference in osmotic efficiency of these bile salts. 2) TC infusion in rats with low bile salt concentration(C) in the bile produced by an external bile fistula yielded a non-linear relation between F and X with a 4 times higher slope value in the range of C below 20mM, while the relation between F and C was kept linear in the wide range of C. 3) One hr after the start of infusion of free ursodeoxycholate, X dropped sharply whileF continued to increase (a complete dissociation of F and X).These results suggest that a fraction of bile can be formed by the presence of bile salts inside hepatocytes rather than the excretion. The hypothesised secretory action of bile salts may differ between TC and TU and the effect may be positively correlated with the intracellular concentration of bile salts, which can explain all data obtained in these three experiments.

9

ANALYSIS OF BLOCKING OF INTERCELLULAR COMMUNICATION WITH FLUORESCENT DYE INJECTION.
KAZUO SUZUKI. Department of Physiology, Tokai University, School of Medicine, Bohseidai, Isehara, 259-11.

Intercellular communication is known to be blocked easily by alteration of various cellular environmental conditions. Loewenstein et al. (1967) postulated that intracellular Ca^{++} plays an essential role for maintenance of communication process. Our preceding study (Suzuki et al. 1978, Cell Struct. Funct. 3: 161) indicated, however, that the electrical decoupling between salivary gland cells of *Chironomus plumosus*, brought about by application of various drugs or enzymes such as corticosteroid or trypsin, were consistent with two opposite states of gland stiffness. Thus, the present experiment aimed to know the configuration of cell surface by injection of fluorescent dye when electrical communication was blocked by various agents, mentioned above. The different configurational changes of cell surface, being consistent with alteration of gland stiffness, have been found: corticosteroid or procaine brought about the increase of stiffness and smooth cell surface, and, Ca-chelate (EGTA) or Ca-ionophore brought about the decrease of stiffness and rough cell surface. It is suggested that the blocking of intercellular communication induced by corticosteroid may be due to a different mechanism apart from intracellular Ca-ion.

10

PASSIVE ELECTRICAL PROPERTIES OF ISOLATED CHROMAFFIN GRANULES
ASAMI,K., OGAWA,M. & IRIMAJIRI,A.
Dept. of Physiology, Kochi Medical School, Nankoku, Kochi

We have used a rapid dielectric-dispersion technique to characterize the passive electrical properties of chromaffin granules isolated from bovine adrenal medullae. The accuracy of the whole analysis was much improved by paying particular attention to the following points:(1)The granule preparations were highly purified through "Ficoll-sucrose-D_2O" density gradient. (2)The average diameter of granules under the specified condition was estimated from electron microscopy combined with stereological analysis. (3)Dielectric measurements were performed by the use of a computer-controlled analyzer system scanning over a frequency range of 0.01-500MHz within 90 sec. (4)The numerical analysis was carried out on the basis of Hanai-Wagner's theory developed for a concentrated suspension system. The results obtained are:(a)the membrane capacity of isolated chromaffin granules $\simeq 1\mu F/cm^2$;(b)the relative permittivity of the intragranular space = 30~40 irrespective of the external NaCl concentration;and(C)the intragranular conductivity changed depending on the external salt concentration or on the external osmolality.

11

NGF(NERVE GROWTH FACTOR)-INDUCED FORMATION OF FUNCTIONAL SYNAPSES BETWEEN DISSOCIATED RAT ADRENAL CHROMAFFIN CELLS IN CULTURE
OGAWA,M., IRIMAJIRI,A., ISHIKAWA,T* & SEGUCHI,H* Dept. of Physiol. and Dept. of Anat*, Kochi Medical School, Nankoku, Kochi

Chromaffin cells dissociated from 10 day-old rats survived in culture with NGF extending fiber-like processes. Many outgrowing processes reached their neighboring chromaffin cells or clustered cells to make network when the cells were cultured over 3 weeks. Every chromaffin cell generated action potentials in response to current pulses delivered through the recording microelectrode even in the presence of TTX. The action potentials and passive electrical properties were generally similar to those reported for the cultured sympathetic neurons. The processes conducted spikes, which was blocked by TTX. Spontaneously occurring excitatory postsynaptic potentials(epsp) were detected in the networked chromaffin cells and the largest epsp triggered action potentials. In an attempt to establish the functional synapses, we impaled two cells simultaneously each of which were presumedly interconnected with a common process. A few msec after the peak of an action potential in one cell, a potential change resembling spontaneous epsp's was recorded from the other cell. Pharmacological examination suggests that the newly formed synapses were chemical in nature.

12

MEMBRANE POTENTIAL OF RABBIT CRYSTALLINE LENS FIBER. OKAJIMA, Y. AND AKAIKE, N. Dept. of Pharm., Kumamoto Univ. Med. Sch., Kumamoto 860, Japan.

The membrane potential of rabbit crystalline lens fibers was measured at the depth of 200 μm in the anterior and posterior surfaces under in vitro and in vivo conditions by using conventional micro-electrode techniques. The measured intracellular fiber potentials were quite similar at both sides. Ouabain at a concentration of 10^{-5} M depolarized the membrane potential of anterior lens fibers, but the posterior fibers were not affected. At 10^{-4} M ouabain, however, the posterior fibers were also depolarized. The results suggest that the ouabain-sensitive Na-K ATPase activities are greater in the anterior side. In 90 mM-Cs external solution, the posterior fibers depolarized faster than in the anterior ones. The result shows that a layer of epithelial cells at the anterior side may wark as a diffusional barrier of Cs^+ from the lens anterior to the interior.

13

ON THE ASPECTS OF INTRACELLULAR ATP LEVEL AND MACROMOLECULAR SYNTHESES IN THE CELL CYCLE OF L CELLS. (2) YONEZU,T., HOSOKAWA,K., TANABE,S., OOSAKA,N., YAMAGUCHI,H. AND OKA,Y. Dept. of Physiol., Sch. of Med., Univ. of Tokushima, Kuramoto-cho, Tokushima

The aspects of cellular ATP level and macromolecular syntheses in the cell cycle were studied in populations of synchronized L cells by selective detachment of mitotic cells. These L cells were treated with the inhibitor of cellular ATP generation, such as 2-deoxy-D-glucose(2-DG), carbonylcyanide chlorophenylhydrazone(CCCP) and iodoacetate(IAA). When these inhibitors were combined, such as 2-DG plus IAA, 2-DG plus CCCP or IAA plus CCCP, cellular ATP content decreased rapidly and within two hours had fallen to 3 to 20% of the control level in G_1 phase cells, to 6 to 19% in early S phase cells, and to 5 to 30% in middle S phase cells, individually. In this condition, the inhibition of the incorporation of ^{3}H-thymidine in G_1 phase cells was related to the decrease of cellular ATP content, but the inhibition of ^{3}H-uridine was related to the inhibition of cellular lactate production rather than the decrease of cellular ATP content. And also, th inhibitions of the incorporation of ^{3}H-uridine and amino acid mixture in early S phase cells were leniently in spite of the severe decrease of cellular ATP content. In contrast, the incorporation of ^{3}H-amino acid mixture in middle S phase cells was not related significantly to cellular ATP content.

14

INDUCTION OF DNA SYNTHESIS IN PRIMARY MONOLAYER CULTURE OF ADULT RAT HEPATOCYTES (VI). HASEGAWA, K., OHTAKE, H. AND KOGA, M. Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi 321-02.

Effect of culture medium components on survival and DNA synthesis in primary culture of adult rat hepatocytes was examined. When hepatocytes were cultured in a medium supplemented with fetal bovine serum (FBS), glucagon and insulin, DNA synthesis was induced regardless of pyruvate concentration in the culture medium. In a serum-free medium, hepatocytes survived and DNA synthesis was induced only when pyruvate was present at concentrations higher than 5 mM. Supplementation of glucose or fructose (20 mM each) in low pyruvate medium (1 mM) did not prevent hepatocytes from degeneration. Omission of proline from the culture medium completely inhibited the increase in DNA synthesis. FBS added to proline deficient medium did not recover DNA synthesis. Aphidicolin (0.03 mM), hydroxyurea (5 mM) and cytosine arabinoside (0.05 mM) inhibited the incorporation of [^{3}H]thymidine by 95 to 99%, indicating that increase in [^{3}H]thymidine incorporation was due to DNA replication. An autoradiographic analysis showed that about 40 to 50% of nuclei were labeled with [^{3}H]thymidine. These results suggest that pyruvate and proline are essential for the induction of DNA synthesis.

15

PRIMARY CULTURE OF NORMAL AND NEOPLASTIC MAMMARY EPITHELIAL CELLS OF THE MOUSE. ENAMI, J. AND KOGA, M. Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi 321-02.

We examined the conditions for growth of normal and neoplastic mouse mammary epithelial cells in primary monolayer culture. Conditioned medium from an established cell line of mammary fibroblasts stimulated the growth of epithelial cells, suggesting that mammary fibroblasts produce a growth-promoting factor(s) for mammary epithelial cells. Long-term cultivation of epithelial cells, however, has not been possible by this culture method. In contrast, long-term sustained growth of epithelial cells was observed when the cells were cocultured with an established cell line of preadipocytes. Even repeated passages have been successfully done by this culture system.

16

ENDOGENOUS CELL GROWTH INHIBITORY FACTORS IN RAT LIVER SUPERNATANT. Matui,H.** Tokuda,M.** Kurosaki,T.** Hori,Y.** Doi,A.* Hatase,O.*

Nisida, I.* *Dept. of Physiol., Kagawa Med. School; **Dept. of Physiol. Okayama Univ. Med. School

Regenerating rat livers are good models for the investigation of the regulating mechanism of cell ploliferation in vivo. In this model, humoral regulators in sera were reported, but endogenous hepatic regulating mechanism is still under discussion. In this communication, we report the presence of endogenous cell growth inhibitory factors in rat liver cytosol, and their properties. Rat liver supernatant was prepared from normal and partially hepatectomized rat livers. It was fractionated by DEAE-cellulose chromatography and gel filtration. Inhibitory effects of each fraction on DNA, RNA, and protein synthesis in semi-synchronized L-cells were assayed. Two fractions showed strong inhibitory activities at low concentration (0.5-1.0 O.D.unit;260nm) in assay media. One was a nucleotide rich fraction. The other revealed a specfic UV pattern and its content was lower in regenerating livers than that in normal ones.

17

OPTICAL MONITORING OF ANOXIC LIVER DEGRADATION.
NAKASE, Y., KOBAYASHI, S., SUZAKI, T., YAONO, S. and OGATA, E.*
Tateisi Inst. of Life Sci., Kyoto, *Dept. of Intern. Med., Sch. Med., Univ. of Tokyo, Tokyo

Continuous monitoring of normoxic and anoxic liver function was performed by using scanning spectrophotometry and fluorometry which were favourable as nondestractive methods to monitor intact organs(1977).

Rat liver was perfused with Krebs-Henseleit-bicarbonate buffer solution saturated with gas mixture of 95% O_2-5% CO_2 or 95% N_2-5% CO_2 at 32 C. Lactate + pyruvate(10:1), octanoate, norepinephrine, ethanol and succinate were introduced into perfused liver, and the liver responces were measured by means of oxidoreduction of the respiratory chain, respiratory rate and glucose out put.

Most reactions of perfused liver were decreased with anoxia. In those, the strongly diminished reactivity to norepinephrine and the increased cellular permeability for succinate suggested that anoxia caused the damage of plasma membrane.

18

REDOX STATE OF PYRIDINE NUCLEOTIDE ASSOCIATED WITH MIXED-FUNCTION OXIDATION OF DRUGS IN PERFUSED RAT-LIVER. T. SUZAKI and S. KOBAYASHI. Tateisi Inst. Life Sci., Kyoto

Redox states of intracellular pyridine nucleotide(PN) and oxygen(O_2) uptake associated with mixed-function oxidation of hexobarbital and aminopyrine in perfused rat-livers were studied using an organ fluorometer and a Clark-type O_2 electrode, respectively. In perfused livers from fed, phenobarbital-treated rats("PB"), oxidation of the PN and a rise in the O_2 uptake were observed to correlate well with increase in the hexobarbital concentration($<100\mu M$). Addition of aminopyrine caused increase in the O_2 uptake and reduction of the PN. In perfused livers from fasted "PB", hexobarbital($100\mu M$) served as substrate caused approximately twice the oxidation of the PN in comparison to the livers from fed "PB", while the O_2 uptake being smaller by half or by one third(0.28 ± 0.03 moles/min/g liver). Sorbitol(4mM) stimulated the O_2 uptake(0.86 ± 0.09 moles/min/g liver) and oxidized the PN to a smaller extent. These results suggest that, in perfused livers from fasted "PB", the ability of NAD(P)H supply regulates the mixed-function oxidation. (In collaboration with Dr. T. Iyanagi, Tsukuba Univ.)

19

MEASUREMENT OF RAMAN LINE BY ONE PULSE LASER AIZAWA,K. SAKAI,S. SAITO,H and O'HATA,S Dept. of Physiol. Tokyo Medical College Shinjuku-ku Tokyo, 160.

The measuring system of Raman line by one pulse laser (10 nano second) consist of N_2 pulse laser (Jobin Yvon), dye monochromator (Jobin Yvon), a microscope system, DL-203 spectrometor (Jobin Yvon), OMA II detector (Princeton) and a stimulative pulse regulation system. Non delayed one pulse from a stimulator make a sudden display a pulse laser, which have a wave length at 337 nm, a harf pulse width at 10 nano second and 4 milli joul per pulse. The wave length of the pulse laser change into 450 nm by the emission of cumarine 450 on the dye monochromator. The pulse laser form a 20 maicro meter on the $NaNO_3$ crystal with a collecting lense and it's area scatter the Raman line by one pulse laser incident upon a crystal. The Raman line through the DL-203 spectromator and enter the detactor surface. Until Raman line enter the detector surface, it's head is closed with a high voltage gate. The gate open for 10 micro second with a pulse delayed 70 micro second from the stimulator, and the same time Raman line enter the detector. Therefore, the S/N ratio is improving. We measured Raman line of $NaNO_3$ (ν_1) at 1050, (ν_3) at 1390 and (ν_4) at 720 cm^{-1}.

20

SPECTROPHOTOMETRIC TITRATION OF TYROSINE RESIDUES IN BRAIN TUBULIN. Sakai, S., Aizawa, K., Saito, H., O'hata, S. and Yamao, M.* Dept of Physiol., Tokyo Medical College, Shinjuku-ku, Tokyo 160, *Dept. of Biol. O'tsuma Women's Univ. Chiyoda-ku, Tokyo 102

The absorption peak of tyrosine shifts from 275 to 295 nm with intensification when the phenolic group is ionized into phenoxide ion by alkali. We studied the effect of colchicine-binding to tubulin on the tyrosine residue, measuring ΔA at 295 nm. Tubulin was prepared by the method of Shelanski. From the ΔA value with guanidine-treated tubulin, 34 tyrosine residues (pK=10.60) were calculated per 110000 dimer. The number is nearly close to that determined by amino acid analysis. With guanidine-non-treated tubulin (control tubulin), 26 tyrosine residues (pK=11.10) were calculated. These tyrosine residues were rapidly ionizable or free. On the contrary, colchicine-binding tubulin prepared in R. buffer gave 22 tyrosine residues (pK=11.30), although 24 residues were observed if stored at -80°C for 7 days after prepared in R. buffer, or prepared in K^+ free buffer. Four or two tyrosine residues in tubulin molecules are thus effected by colchicine binding to the protein.

21

ON THE ARRANGEMENT AND FUNCTION OF VASOPRESSIN

O'HATA,S. AIZAWA,K. KITAHARA,M. IMAGAWA,M. SAKAI,S. YAMAO,M. AND SAITO,H. Dept. of Physiol., Tokyo Medical College., Shinjuku-ku Tokyo

Vasopressin is consisted of 9 amino acids as following:
Cys-Tyr-Phe-Glu(NH_2)-Asp(NH_2)-Cys-Pro-Arg-Gly(NH_2) (Arginine Vasopressin)

Cys-Tyr-Phe-Glu(NH_2)-Asp(NH_2)-Cys-Pro-Lys-Gly(NH_2) (Lysine Vasopressin).

Therefore, we get as a characteristic common to all: Cys-Tyr and Glu(NH_2)-Asp(NH_2)-Cys-Pro. If we give attention to the arrangement of amino acids Glu(NH_2)-Asp(NH_2)-Cys-Pro, we get the matrix S as following:

$$S = \begin{pmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{pmatrix} = \begin{pmatrix} Glu(NH_2) & Asp(NH_2) \\ Cys & Pro \end{pmatrix} = \begin{pmatrix} 146 & 132 \\ 121 & 115 \end{pmatrix}.$$

Hence, 146,132,121 and 115 present the molecular weights of Glu(NH_2),Asp(NH_2),Cys,Pro, respectively. From the invariant of the transformation ~~of coordinates~~ of the matrix S, we get the molecular weights of ATP, C-AMP, 5'-AMP, adenylcyclase and proteinkinase,respectively. And,these materials above mentioned are in conjunction with the action of vasopressin.

22

REVERSIBLE UNCOUPLING OF CULTURE CELL MEMBRANE JUNCTION BY TUMOR PROMOTER.

ENOMOTO, T., SASAKI, Y., SHIBA, Y., KANNO, Y. AND *YAMASAKI, H. Dept. of Physiol., Hiroshima Univ. Sch. of Dent., Hiroshima. *Unit of Chemical Carci., Internat. Agency for Res. on Cancer, Lyon, France.

Effect of tumor promoters on membrane potential, membrane resistance and electrical cell coupling was investigated on FL cells. The cells dissociated with 0.02% EDTA solution were contacted by gentle centrifugation and cell pairs contacted were cultured on cover glass in Eagle's MEM medium supplemented with 10% calf serum. Most cells (>90%) established the electrical coupling by 3 hr after culture. 12-O-tetradecanoyl phorbol-13-acetate (TPA) added at onset of culture inhibited the farmation of cell coupling, but did not affect membrane potential and membrane resistance. Other promoters, phorbol-12-13-didecanoate, ingenol dibenzoate and mezerein also suppressed the formation of cell coupling, but phorbol and 4α-phorbol-12-13-didecanoate which were inactive as tumor promoter did not inhibit it. When coupled cells were treated with TPA, the percentage of coupled cells decreased from 90% to 35% and to less than 10% 4 hr and 8 hr later, respectively. When cells uncoupled by treatment with TPA was transfered into normal MEM, cell coupling rapidly recovered to control level.

23

ROLE OF MEMBRANE ON THE CIRCADIAN RHYTHM OF LOCOMOTOR ACTIVITY IN PARAMECIUM

HASEGAWA, K., KATAKURA, T., TANAKADATE, A. AND ISHIKAWA, H. Dept. of Physiol., Sch. of Med., Kitasato Univ., Sagamihara, Kanagawa 228

The roles of K and Na in external medium on the circadian rhythm of locomotor activity (LA) in Paramecium were tested. Adding various amount of KCl and NaCl to a strow infusion (control medium), we observed changes in the LA and compared them with the LA-rhythm in control medium. Immediately after the onset of light, the LA decreased rapidly in control medium (low-K), while it increased transiently in high-K medium. Immediately after the termination of light period, the LA increased rapidly in control medium, while the LA decreased transiently in high-K medium. These transient variations of the LA in high-K medium were, however, countervailed with the addion of NaCl to the medium. The transient increase of the LA immediately after the onset of light period was offset by adding 1.0 mM of NaCl, while the transient decrease in the LA immediately after the termination of light period was not restored until the addition of NaCl more than 4.0 mM. The LA change in control medium was well coincident with the change in the intracellular concentration of K which was measured by the atomic absorption analysis. It was concluded that light may directly cause the change in the transmembrane permeability of K which may follow the change in the intracellular concentration of K and that Na may affect to restore the intracellular K concentraion which oscillates with a circadian period.

24

IN VIVO ADMINISTRATION OF ISOLATED ANTIBODY HIGHLY SPECIFIC TO RAT MAST CELLS. OKADA,T., KIMURA,S., KOBAYASHI,T., FUJISAWA,M., NAGASAWA,T. AND KINOSHITA,Y. Dept.of Physiol.,Osaka City Univ.,Med. Sch.,Abeno-ku, Osaka

Biologically intact mature rat mast cells could be purified with a modified coil planet centrifuge for this system enabled quite effective cell separation without viscous high density media which may impair the cell membrane or change its antigenicity. Anti-rat-mast-cell-antiserum was prepared from rabbits immunized with purified mast cells(over 97 % in purity). This antiserum was highly specific to rat mast cells and could liberate histamine completely at a 1:30 dilution. Only mast cells were stained with FITC in indirect immunofluorescence technique, performed with peritoneal cells or with frozen sections of rat skin tissues. Histamine releasing activity of the antiserum was not decreased after absorption with non-adherent cells of various lymphoid or hematopoietic organs origin. The Γ-globulin fraction containing the antibody was isolated by DEAE-cellulose column chromatography following ammonium sulphate precipitation. Mast cells were nearly completely destroyed after incubation with complement and the antibody fraction at a concentration of 600μg/ml. Results of in vivo administration of antibody will be discussed.

25

STUDIES ON WATER CONTENT OF RED CELLS IN VERIOUS CONDITIONS KAGEYAMA, K., YAMATO, K., OKA, H., WADA, S., SARASHI, A. AND KINOSHITA, Y. Dept. of Physiol., Osaka City Univ., Med. Sch., Osaka.

Effects of osmotic pressure, pH, incubation and reagents i.e. lead chloride, mercuric chloride, oleic acid and lysolecithin etc. on water content of human red cells were investigated. The water content was measured by a new method based on gas-liquid chromatography and isotopic technique using ^{3}H-sucrose to correct intercellular water content. Maximum and minimum water content of red cells were determined in condition without hemolysis. Values of 78.50 % and 54.86 % were obtained from the red cells exposed with 180 mOsm and 800 mOsm of saline respectively. Minimum value of incubated red cells was 65.87 % at 50 h of incubation (the original value: 70.86). On the contrary, the maximum value has been 73.96 % at 24 h as reported previously. The minimum values according to lead chloride (40 μg/ml) and lysolecithin (0.5 mg/ml) were respectively 67.31 % and 68.61 %. These results revealed that osmotic pressure effect had the highest ability to change water content of red cells before hemolysis.

26

DISTRIBUTION OF ELEMENTS AND WATER IN THE ACINAR CELLS OF EXOCRINE GLANDS DETERMINED BY ELECTRON PROBE X-RAY MICROANALYSIS. SASAKI, S., NAKAGAKI, I.,SHIGUMA, M., OYABU, T., MORI, H., MURAKAMI, M. AND IMAI, Y. Dept. of Physiol., Osaka Med. Coll., Takatsuki, Osaka 569, Japan

Electron probe X-ray microanalysis using freshly frozen hydrated and dried thin sections of canine submandibular gland and pancreas was performed to determine the distribution of elements and water in the exocrine acinar cells of resting and stimulating states. The X-ray spectra obtained from the cytoplasm showed high peaks for K and P, and the spectra from the secretory granules showed high peaks for Na, S, Cl, K and Ca in the resting state of submandibular gland. On pilocarpine stimulation, there rose the peaks for Na, Cl and Ca in the spectra obtained from the cytoplasm and the peaks for Na and Cl in the spectra from the secretory granules. Similar data were obtained in pancreatic acinar cells. The local dry-mass fractions of acinar cells which were estimated by comparing the continuum radiation of spectrum from the frozen hydrated sections (-130°C) with that from the frozen dehydrated sections, were about 20% and 30% in the cytoplasm and the secretory granules of resting acinar cells, respectively. Each value was not significantly altered in the stimulating state having a tendency to decrease slightly. The quantitative X-ray microanalysis was also performed using frozen dried sections of the glands and the standard curves for elemental concn-P/B ratio.

27

SECRETORY AND ELECTRICAL PROPERTIES OF SYRIAN HAMSTER PANCREAS (MESOCRICETUS AURATUS)

Y. SUZUKI, S. ITAGAKI, N. IWATSUKI* AND N. UEDA** Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata, 990-23 *Dept. of Appl. Physiol., Tohoku Univ. Sch. Med., Sendai, **Dept. of 3rd Int. Med., Asahikawa Med. Coll., Asahikawa

In the anaesthetized hamster the resting flow rate of pancreatic juice was 0.5μℓ/min ±0.08, and the amylase output 5.8u./min ±0.8. Infusion of caerulein (16ng/hamster) did not cause a detectable increase in flow rate. Infusion of a mixture of caerulein and secretion caused a tenfold increase in flow rate accompanied by a marked increase in amylase output. The resting membrane potential of acinar cells was -61.7mV±0.7 under superfusion with standard Krebs-Henseleit solution. Increasing $[K]_o$ from 4.7 to 47mM decreased the membrane potential by 40mV. Current-voltage relations were almost linear between -5 and -80mV. The input resistance was 28.6MΩ±1.6 and the time constant 18msec. Electrical coupling between two neighbouring cells could be detected only at less distances than 50μm. A specific resistance of 8.3KΩ cm^2 and a specific capacitance of 2.1μF/cm^2 were obtained from assuming that the electrical unit in the acinar tissue is a sphere with a diameter of 50μm, that acinar cells take up 83 % of the pancreatic volume, and that the average volume of an acinar cell is 1,060μm^3. Application of ACh, caerulein or bombesin caused membrane depolarization accompanied by a reduction in input resistance and time constant. The ACh equilibrium potential was -4mV±1.2.

28

ELECTRON CARRIERS AND STIMULUS-SECRETION COUPLING IN THE PANCREATIC ACINAR CELL OF RAT.

KANNO, T., HABARA, Y. & IKEI,N. Dept. of Physiol., Hokkaido Univ. Fac. Vet. Med. Kita-ku, Sapporo 060

Development of an organ scanning spectrophotometer (Tateishi Institute of Life Science, Kyoto) enable us to record changes in absorption spectra of the electron carriers, while effluent of the pancreatic duct was continuously collected from the isolated perfused rat pancreas. Detectable reductions of cytochromes, c + c_1. b, and a(a_3) were recorded in the mean absorption spectrum obtained between the 46th and the 92ed sec after the initiation of continuous stimulation with 2 mU/ml CCK. The reductions were gradually enhanced as the stimulation was continued, and reached to their peak levels about 10 min after the initiation of stimulus. In the same preparations, the secretory response was detected about 10 min, and reached the maximum level about 20 min after initiation of the continuous stimulus. When the concentration of CCK was increased to 50 mU/ml, the degree of reductions in the electron carriers and the secretory response were both enhanced, and the time lapse between the onset of reduction of electron carriers and the secretory response was shortened.

The present experiments show that the reduction of electron carriers precedes the secretory response of the acinar cell.

29

EFFECTS OF CROSS-LINKING REAGENT ON MITOCHONDRIA.

N. KUMAZAWA and T. TSUJIMOTO. Dept. of Physiol., Wakayama Medical College, Wakayama 640.

Effects of glutaraldehyde (abbr. as GA), a cross-linking reagent, on the chemical and functional modifications of mitochondria were studied correlatively with changes in microenvironment. Mitochondria were treated with GA during centrifugation through "sucrose density gradient layer". Spin probes were labelled after the fixation. Two kinds of probes, NO-maleimide or NO-stearate, were used in search of protein or lipid domain. Progressive losses of primary amino groups were shown in mitochondria treated with increasing concentrations of GA. On the other hand, the cross-linking effect became apparent with GA higher than 30 mM. Sensitivity toward hypotonicity increased with GA lower than 30 mM, and decreased with GA higher than 30 mM. Concomitant with the above effects, increase of the weakly immobilized signals of maleimide probe were detected with samples treated with GA lower than 30 mM. While, the treatment with GA higher than 30 mM decreased the weakly immobilized signals and the mobility of probe. Significant increase of the weakly immobilized signals were shown on standing at room temperature in samples treated with GA, and the changes were larger than the samples treated with lower concentrations of GA. Significance of the stability of signal was discussed with regard to the conformational state of mitochondrial sample.

30

PROTEIN PHOSPHORYLATION BY CYCLIC NUCLEOTIDES AND Ca^{2+} IN NEURONAL AND GLIAL CELL FRACTIONS SEPARATED FROM RAT CEREBRAL CORTEX

ANDO, M., NANBA, T. and NAGATA, Y., Dept. of Physiol., School of Med., Fujita-Gakuen U. Toyoake, Aichi 470-11

Phosphorylation patterns of separated protein fractions in neuronal and glial cell fractions from rat cerebral cortex by the addition of cyclic nucleotides (cAMP, cGMP) and Ca^{2+} were comparatively studied.

1), Both cAMP and cGMP-dependent protein kinase activities were found rather higher in glial than in neuronal fractions.

2), Some different patterns of protein profiles in between neuronal and glial cells were shown in SDS-polyacrylamide gel electrophoretic (SDS-PAGE) analysis. But, endogenous phosphorylation patterns from [^{32}P]ATP into protein fractions of both brain cells were not always coincident with the protein profiles in SDS-PAGE analysis.

3), Addition of Ca^{2+} to the medium during 2 min incubation strongly accelerated [^{32}P]-incorporation into some proteins with various molecular weights (52,000, 68,000, 73,000, 80,000 and 86,000 daltons) rather in neuronal than glial cell fractions.

4), Although cAMP or cGMP did not significantly stimulated the [^{32}P]-incorporation into the proteins from neuronal and glial cell fractions, co-addition of Ca^{2+} in the medium increased the protein phosphorylation rather in neuronal than glial cells.

31

The uptake of ^{36}Cl into cultured neuronal cells

ASOU,H.,KANAMATU,T.,TAKAGI,Y.,TURUMIZU,T.,and HIRANO,S. Dept.of Physiol. Toho Univ.

The uptake of Cl^- were studied in neuronal cultured cells(N-18 neuroblastoma, C-6 glioma TH-RG, Primary cultured cells) using ^{36}Cl as a tracer.

In cultured astrocytoma cells and primary astrocytes, the net uptake of ^{36}Cl were enhanced in the presence of 54 mM K^+ in the medium. N-18 neuroblastoma cells were cultured and incubated under the same conditions failed to exhibit any K^+-dependent uptake of ^{36}Cl. The uptake of ^{36}Cl by the glioma cells and primary astrocytes were significantly affected by added HCO_3^- in the incubation media. None of these charcteristics were observed with neuroblastoma cultures studied under similar conditions.

The observations have been discussed that the K^+-dependent HCO_3^--stimulated Cl^-uptake were associated with astroglial intracellular compartment.

32

TRANSMITTER RESPONSES IN TWO NEWLY ISOLATED CLONES OF NEUROBLASTOMA X GLIOMA HYBRID.

OGURA, A. AND AMANO, T. Lab. Neurochem., Mitsubishi-Kasei Inst. Life Sci., Tokyo, 194

Two of the hybrid clones, obtained by cell fusion between a mouse neuroblastoma N115 TG-2 and a rat glioma C6BU-1, were characterized electrophysiologically and biochemically from the viewpoint of transmitter responsiveness.

A hybrid clone, designated NG115-301, was of spindle shape with a few straight fibers. Most of the clone cells were electrically unexcitable, but a Co-sensitive TTX-resistant action potential was observed in some cells differentiated by a prolonged exposure to dibutyryl cAMP. Iontophoretically applied serotonin (5HT), dopamine (DA) and norepinephrine (NE) caused a membrane hyperpolarization with a considerable delay accompanied by a significant desensitization. Among them, the 5HT-evoked response was found K-dependent and blocked by submicromolar methysergide and spiroperidol. NE, DA and 5HT were also shown to induce an increase in intracellular cAMP concentration.

Another hybrid clone, NG115-401, was of polygonal shape with or without short fibers, and was electrically active to elicit a Co-sensitive Na-independent action potential followed by a TEA-sensitive rectification. The cell responded to DA and NE with a rapid depolarization coupled by a membrane resistance decrease. The PGE_1-induced cAMP increase in this clone was inhibited by simultaneously applied DA, NE or 5HT.

These clones may serve for a study of the iono- and metabotropic receptor responses.

33

THE NEWT RED CELL MEMBRANE POTENTIAL AND K^+ AT LOW TEMPERATURE. KAWANO, K., FUKUSHIMA, M. AND IBUKI, C. Ist Dept. of Physiol., Nippon Medical School, Bunkyo-ku, Tokyo

At low temperature the newt red cell membrane exhibits a fairly large membrane potential, as recorded with the microelectrode (-23.0 mV at 0°C, cf. -16.2 mV at 18°C).
To ask for its cause;
1) The effect of the oxygenation : At lower temperature hemoglobin takes oxygen more tightly and higher oxygenation makes hyperpolarization of the membrane. Then, using completely oxygenated and completely deoxygenated red cells, the relation of the membrane potential to temperature was investigated. It was revealed that each regression line was parallel to that in the general air (0°C : oxy. -25.1 mV, deoxy. -21.6 mV).
2) The effects of ions : The effects of the concentration of external ions at 0°C were compared with those observed at room temperature. An increase in external K-ions decreased the membrane potential to a more pronounced degree whereas a change in Cl^- affected the potential to a less degree, as compared with the findings observed at room temperature. Considering these, the hyperpolarization at low temperature is probably due to K ion. Permeability ratio, P_K/P_{Cl}, would become larger at low temperature.
To make this point clearer, the relation of membrane current to a pre-set voltage was studied using a suction electrode and internal perfusion. K^+ current was then recognized at low temperature.

34

Electric Property in the Low Resistance Position of the Human Skin

SAITO, T. Dept. of Physiol. Nippon Dental Univ., Tokyo.

The resistance and capacitance of the human skin were measured from olden time. And those values were decided already. But on the other hand it was well known that there was the position where the resistance was low, especial in the acupuncture.
The auther measured the resistance and capacitance in three kind of position those values were nemarkably different, high resistance, low resistance, and middle class. The values of resistance r and capacitance c par cm^2 by Ag-AgCl 0.2 mm diameter electrodes were shown as follows.

1. r=416kΩ c=1.08μF 2. r=29.6kΩ c=0.044μF 3. r=1.78kΩ c=unmeasurable

There were represented the resitant diagram of the human skin with 1 cm^2 squar section electrode.
Now he measured 4 mm^2 square area at 25 points which were cross points in 1 mm distance and 16 points which were center points in 1 mm squares with 0.2 mm diameter round electrode and made equivalent resistance diagram at 1MΩ , 5MΩ , 10MΩ and 20MΩ.

35

GENERATION MECHANISM FOR HYPERPOLARIZING RESPONSES AND MEMBRANE POTENTIAL OSCILLATION IN CULTURED EPITHELIAL CELLS (INTESTINE 407). YADA, T. AND OKADA, Y. Dept. of Physiol., Fac. of Med., Kyoto Univ., Kyoto

Cultured epithelial cells (Intestine 407), which had a resting potential of about -13 mV, responded with a hyperpolarizing response (HR) of about -70 mV to the penetration of a microelectrode, a mechanical stimulation on the cell surface or an electrical stimulation of the cell membrane. Oscillation of membrane potential was observed after the HR. TEA and nonyltriethylammonium (C9), K^+ channel blockers, suppressed both HR and the oscillation. Inhibitors for Ca^{2+}-activated K^+ conductance (quinine and quinidine) also inhibited them. The intracellular Ca^{2+} injection induced a sustained hyperpolarization. These results indicate that these hyperpolarizations are due to a stimulation of Ca^{2+}-activated K^+ channel. Since HR was inhibited by the application of verapamil, nifedipine or Co^{2+}, it can be conceived that HR is elicited by a Ca^{2+} inflow through Ca^{2+} channel upon the stimulation. Energy depletion with metabolic inhibitors induced a sustained hyperpolarization. Oxalate and dantrolene sodium inhibited the oscillation but not HR. Caffeine induced a significant hyperpolarization of the resting potential without affecting HR. These observations suggest that the energy-dependent microsomal Ca^{2+} uptake mechanism is closely associated with the generation of membrane potential oscillation.

36

OSCILLATORY CHANGES IN INTRACELLULAR Cl^- ACTIVITY DURING MEMBRANE POTENTIAL OSCILLATION IN L CELLS. *UEDA, S. AND OKADA, Y. Dept. of Physiol. and *Dept. of Intern. Med., Fac. of Med., Kyoto Univ., Kyoto

Fibroblastic L cells show spontaneous oscillation of membrane potential (V_m) composed of repeated hyperpolarizing responses. Such hyperpolarizations are known to be caused by a K^+ conductance increase. When a Cl^--selective liquid ion-exchanger microelectrode and a standard microelectrode were simultaneously impaled in an L cell, a synchronous oscillation of the intracellular Cl^- activity (aCl_i) was observed during a V_m oscillation. A decrease in the aCl_i value was associated with the spontaneous hyperpolarization. The depolarization produced by the current injection through a standard microelectrode resulted in an increase in aCl_i. Reduction of extracellular Cl^- concentration induced a significant decrease in aCl_i with little changes in V_m. The chloride equilibrium potential (E_{Cl}) always changed in parallel to the V_m changes, under these experimental conditions. Based on these observations, it was concluded that the membrane permeability to Cl^- is significantly high and the Cl^- redistribution is rapidly attained during the V_m oscillation in L cell. The high Cl^--permeability might explain the difference between the peak level of hyperpolarizing response and the value of potassium equilibrium potential (E_K).

37

MEMBRANE TRANSPORT OF MONOVALENT CATIONS IN RELATION TO CHANGES IN INTRACELLULAR CATION COMPOSITION IN HeLa CELLS
IKEHARA, T., SAKAI, T. AND MIYAMOTO, H. Dept. Physiol., Kinki Univ. Sch. Med.

A kinetic study has been made on Rb^+ transport, especially with respect to the activity of Na^+,K^+-pump in HeLa cells. The pumping activity was strongly stimulated when cells were chilled and cell Na^+ increased and cell K^+ decreased. The increase in active Rb^+ influx seemed to be mainly due to an increase in the maximal rate of influx rather than changes in the affinity of Rb^+ to the pump. However, precise experiments at low extracellular concentrations of Rb^+ and Na^+ showed that a change in the dissociation constants of Rb^+ seemed to be induced upon cell chilling. This was confirmed from an analysis of the Michelis-Menten like equations. Also, competition between extracellular Rb^+ and Na^+ to the cation binding sites of the pump affected the change. The competition of Na^+ against $Rb^+$and the stimulation of pumping activity as cell Na^+ was increased would affect the Na^+/K^+coupling ratio in the active transport. Because, the coupling ratio varied from about 1 to about 1.5 as cell Na^+ was increased from the normal level to a higher level.

38

THE MEASUREMENT OF INTRACELLULAR Ca ION ACTIVITY WITH DOUBLE-BARRELED Ca ION SELECTIVE MICROELECTRODES.

KOTERA,K., KAJINO,K., KUBOTA,T. AND FUJIMOTO,M. Dept. of Physiol., Osaka Medical College. Takatsuki, Osaka.

To measure intracellular free Ca ion, (Ca)i, we constructed a Ca-selective microelectrode using liquid ion exchanger (WPI). Electrodes were calibrated with solutions containing 10^{-8}M - 10^{-3}M $CaCl_2$, 100 mM KCl and 1mM $MgCl_2$. At (Ca) > 10^{-5}M, the potential changes in ionic barrel were linear with a slope constant (α) of about 28 mV for a 10-fold change in (Ca). At (Ca) < 10^{-5}M, α varied from 3 to 20 mV. The (Ca)i of bullfrog sartorius muscle was 3.6 ± 0.5 X 10^{-6}M, whereas that of renal proximal tubule was 2.9 ± 0.2 X 10^{-5}M. In perfusion experiment, when 5 μM A23187 was added to the peritubular perfusate, the proximal tubular (Ca)i increased 2 times in association with a depolarization of peritubular membrane potential (E_M). When Na in the perfusate was lowered, a marked increase of (Ca)i and moderate depolarization were produced with a rise of (Na)i and a fall of (K)i. It is considered, therefore, that the increased (Ca)i not only increases the membrane permeability to Na more markedly than to K, but also depresses Na-K pump, and that an Na-Ca exchange mechanism, which exists in the peritubular membrane, might play an important role in maintaining low (Ca)i to continue the net transport of Na and K across the proximal tubule.

39

PARTIAL PURIFICATION OF Ca^{2+}-BINDING PROTEIN(S) AND DYNAMIC Ca^{2+} REGULATING SYSTEM IN MITOCHONDRIAL MATRIX

TOKUDA,M.** KUROSAKI,T.** MATSUI,H.** HORI,Y.** DOI,A.* HATASE,O.*, Nisida, I., * Dept. of Physiol. Kagawa Med. School; ** Dept. of Physiol., Okayama Univ. Med. School

We communicate the partial purification and properties of Ca^{2+}-binding protein(s) in mitochondrial matrix of rat livers. The results are as follows:

1) The Ca^{2+}-binding activity was lost by boiling for 1 min., but the binding activity was resistant to trypsin treatment.(37°C, 30 min.)
2) Scatchard plotting showed the high affinity binding.(Kd=1.3x10^{-5}M)
3) Mg^{2+} and Mn^{2+} had low inhibitory (or competitive) effects on Ca^{2+} binding.
4) This protein(s) might consist of plural subunits and be larger than 1x10^5 D in molecular weight.

The functions of this protein(s) are still anbiguous, but it might be possible to regulate the concentration of free Ca^{2+} in the matrix space and the activities of matrix enzymes, and modulate the configuration of mitochondria.

40

DOES THE ACTIVE Na TRANSPORT CHANGE WITH A DIFFERENT SETUP OF BULLFROG SKIN?

TAKADA, M. AND HAYASHI, H. Dept. of Physiol., Saitama Med. Sch., Moroyama, Iruma-gun, Saitama.

Three kinds of experimental setups were used. The first type of this experiment was made using the cannula whose inside facing to the dermis. The second type was done by the cannula whose inside facing to the epidermis. The third type was carried out by using the Ussing type chamber with or without gasket. Short circuit current (SCC) of type I was significantly larger than that of type II. Membrane resistance (R_M) was much less than that of type II. Type III is intermediate. These changes in SCC and R_M with different setups seem to be explained in terms of E_{Na}, R_{Na}, and R_Σ. The differences in setups may correnspond to the different actions of various chemicals such as calcium, cadmium (Cd), and amiloride (Am). Cd of 10 mM increased the SCC in % in the order of type III>II>I, and decreased the R_M in % in the order of II>III>I. Am of 10^{-5} M decreased the SCC in % in the order of I>III>II, and increased the R_M in % in the order of II>III>I.

41

MICROCALORIMETRIC STUDY ON STEADY-STATE REACTION OF Na^+, K^+-ATPase.

UYESAKA, N. AND SHINAGAWA, Y. Dept. of Physiol., Fac. of Med., Kyoto Univ., Kyoto

Steady-state microcalorimetric measurements were carried out by flow microcalorimeter (LKB, 2107-020) at high sensitive and stable condition, namely, the value of heat effect could be recorded at full scale deflection of 5-10 μV, equivalent to 86-172 μW, within maximum baseline drift of 0.2 μV/24 hours. We found remarkable heat change accompaning by the reaction of membrane ATPase in synaptosomes and brain microsomes. Many calorimetric measurements were carried out to clarify the specificity of the heat change, because the heat effect in biological membrane was associated with different reaction in it. Using Na^+, K^+-ATPase obtained by NaI treatment from pig brain cortex, we found exothermic heat production specific to the overall reaction of this enzyme. That is, the specificity of substrate (ATP, CTP, etc.), the effect of cations (Na^+, K^+, Mg^{2+}, etc.), and the effect of inhibitors (ouabain, oligomicin, etc.) were examined, and the calorimetric response was in good agreement with Na^+-ATPase activity investigated by Pi liberation. Especially, the enhancement of enzyme activity due to the concentration of Na^+ or K^+ was observed clearly as an increase in heat change. Dependence of ATPase activity in the steady state upon the concentration of ATP or Mg^{2+} was studied by microcalorimetry, and the apparent kinetic parameters obtained were in reasonable agreement with those done by other method.

42

CHANGES IN THE INTENSITY OF THE INTRINSIC FLUORESCENCE OF MEMBRANE VESICLES PREPARED FROM FROG MUSCLE.

KITASATO,H.,MURAYAMA,K.,NISHIO,K. AND MARUNAKA,Y. Dept.Physiol., Shiga Univ.of Med.Sci., Ohtsu,Shiga 520-21

To get an information of the time course of the change in conformation from the state of high affinity for intracellular K ions to that of high affinity for intracellular Na ions, we tried to measure the fluorescence of membrane vesicles having Na-K dependent ATPase activity. The membrane vesicles were prepared from frog muscle. The fraction of vesicles capable of taking up Ca ions were eliminated by centrifugating microsomes incubated in Ca-loading solution in a sucrose density gradients. The fluorescence of the vesicles having Na-K dependent ATPase activity was increased by elevating the concentration of K ions in the suspension. Similarly, ATP induced an increase in the intrinsic fluorescence. Against our expectation, ADP also increased the fluorescence of the membrane suspension.

43

REGULATION OF NA^+,K^+-ATPASE ACTIVITY BY VANADATE: STIMULATION BY PMS + REDUCING AGENTS.

KANIIKE, K. Dept. of Physiol., Kinki Univ. Sch. Med., Sayama, Osaka.

The stimulation of Na^+-dependent active transport of amino acid by Phenazine methosulfate (PMS) + ascorbic acid (VC) and PMS + NADH in Ehrlich ascites by Christensen et al (1977) and Yamamoto et al (1977). The stimulation of Rb^+ active transport by PMS in the presence of endogenous NADH in Hela cells has been reported by Miyamoto et al (1980). The increase of active Rb^+ transport was assumed to be caused by the reactivation of resting pump or the accerelation of the pumping rate.

The effects of PMS + VC and PMS + NADH were examined on Na^+,K^+-ATPase in the membrane preparation obtained from guinea pig kidney. The stimulation of Na^+,K^+-ATPase activity by PMS + VC and PMS + NADH was observed in the presence of vanadate. Vanadate is known to inhibit Na^+,K^+-ATPase activity reversibly at low concentration (several hundred nM) and to present at these concentrations in various tissues of mammalian. The apparent Ki of vanadate for Na^+,K^+-ATPase was increased 10 - 100 times by PMS + VC or PMS + NADH. Vanadate (+5 oxidation state) can be reduced to non inhibitables (+4 oxidation state) by PMS + VC or PMS + NADH. The stimulation of the enzyme activity by PMS + NADH in the presence of vanadate may explain the mechanism for the stimulation of Rb^+ active uptake in Hela cells. It may be further suggested that sodium pumps may be regulated by redox state via vanadate inhibition in mammalian cells.

44

INTRACELLULAR ENERGY TRANSPORT IN MUSCLE STUDIED BY ^{31}P-PULSED FIELD GRADIENT NMR. YOSHIZAKI, K., SEO, Y., AND MORIMOTO, T. Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto

Creatine phosphate exists in muscle, heart, and brain. The distribution of creatine kinase has been elucidated to be in mitochondria, myofibrils, sarcoplasmic reticulum, nucleus, and cell membrane. A hyothesis that creatine phosphate and creatine kinase provide a mechanism for intracellular energy transport of 'energy-rich' phosphate from energy-production system (mitochondria) to energy-consumption system (e.g., myofibrils) has been proposed. However, the efficiency of the energy transport has not been clarified. In this study, the diffusion coefficients of phosphorus metabolites in frog muscle were measured by ^{31}P-pulsed field gradient NMR to elucidate the efficiency. The values of ATP, creatine phosphate, inorganic phosphate were 2.0, 2.8, 3.3 x 10^{-6} cm^2/sec in intact muscle, respectively. The values were reduced by a factor of about 2 from those in solution. The diffusion rate of creatine phosphate was 1.4 times larger than that of ATP in muscle cells. Thus, the role of creatine phosphate not only as an energy reservoir but also as an energy carrier in muscle cells is suggested.

45

ELECTROGENIC PROTON PUMP IN THE PLASMODIAL MEMBRANE OF PHYSARUM POLYCEPHALUM. KURODA, R.[1], KURODA, H.[2] AND SAKAI, T.[3] [1]Dent. Hygien. Sch. and [2]Dept. Physiol., Sch. Dent., Aichi-Gakuin Univ., Nagoya, and [3]Dept. Physiol., Kinki Univ. Sch. Med., Oosaka.

We previously suggested the existence of an electrogenic ion pump in the plasma membrane of Physarum plasmodium. Here, we examined the relation between membrane potential (Vm), internal ATP concentration ($[ATP]_i$) and external pH's (pH_o). Both metabolic inhibitors (KCN and NaN_3) and inhibitors of membrane ATPase (diethylstilbestrol (DES) and orthovanadate) brought about a quick and large depolarization. The $[ATP]_i$ was sharply decreased by KCN and NaN_3 in good correlation with the decline of Vm, and attained the minimal level about 1 min after application of these inhibitors. Plotting of Vm versus $[ATP]_i$ for the first minute of KCN inhibition yielded the saturation curve which was readily fitted by a Michaelis equation. From such fits, a voltage asymptote of about -100 mV and Km for ATP of about 1 mM were obtained. DES, by contrast, affected the $[ATP]_i$ only slightly, suggesting that this inhibitor has an effect directly on the electrogenic ATPase. Efflux of H^+ ions was estimated from changes of the pH_o produced by suspensions of liquid-cultured microplasmodia in a calibrated buffer solution. Inhibition by KCN or DES gave roughly proportional changes in Vm and net efflux of H^+ ions. The data, thus, indicate that the pump is the proton-ejecting pump fueled by ATP.

46

EFFECTS OF NA AND INSULIN ON 3-O-METHYL-D-GLUCOSE TRANSPORT MARUNAKA, Y., KITASATO, H., MURAYAMA, K., NISHIO, K. AND *SATO, S. Dep. of Physiol., Shiga Univ. of Med. Sci., Ohtsu, *Dep. of Urol., National Hosp. of Maizuru, Maizuru

It is well known that insulin stimulates glucose uptake in skeletal muscles. We studied effects of Na and insulin on glucose transport. We used sartorius muscles of *Rana catesbeiana*. Since glucose is metabolized in muscles, we used ^{14}C-3-O-Methyl-D-Glucose which was not metabolized in muscles. By using the back-add and extrapolating method, we calculated the amount of intracellular 3-O-Methyl-D-Glucose(3-O-MG). We obtained the following findings. 1) 3-O-MG uptake in Na-free Tris-Ringer was less than in Na-Ringer. 2) Muscles with high $[Na]_i$ took up more 3-O-MG than with low $[Na]_i$. 3) Insulin stimulated 3-O-MG uptake in Na-Ringer, but did not stimulate the uptake in Na-free Tris-Ringer and Na-free Li-Ringer. 4) Furthermore, insulin stimulated the efflux of 3-O-MG from muscles. 5) In the presence of insulin, the efflux of 3-O-MG from muscles into Na-free Tris-Ringer was larger than into Na-Ringer, even though, in the absence of insulin, there was no difference between 3-O-MG efflux into Na-free and Na containing solutions.

47

EFFECT OF CONSTANT BLOOD FLOW ON SECRETION AND HEAT PRODUCTION OF DOG SUBMANDIBULAR GLAND. MURAKAMI,M.,MORI,H.,OYABU,S.,NAKAGAKI,I.,SASAKI,S. AND IMAI,Y. Dept.of Physiol.,Osaka Medical College,Takatsuki,Osaka 569

Under normal circulation of dog submandibular gland, the electrical stimulation of chorda tympani induced a massive salivary secretion(0.4-0.8 $ml.min^{-1}.g^{-1}$ gland weight) and an increase in glandular temperature(0.1-0.8 °C) and an increase in glandular blood flow rate(5-8 times higher than the resting flow rate). Under constant blood flow in the glandular circulation, the secretory process was divided clearly into 2 phases of early peak and later plateau. In the secretory peak phase,both secretion and heat production were independent of the rate of blood flow. In the secretory plateau phase,both secretion and heat production depended on the rate of blood flow. These results suggests that the secretion in the plateau phase was supplied with energy stuff and secretory materials by the arterial blood and that the secretion in the early peak phase was performed by using the stored materials and energy in the gland.

48

POTASSIUM-DEPENDENT CHLORIDE TRANSPORT IN THE SEAWATER EEL INTESTINE ANDO, M. Lab. of Physiol., Fac. of Integrated Arts & Sci., Hiroshima Univ., Hiroshima 730

When mucosal Na^+ was replaced with K^+, while serosa was bathed with normal Ringer solution, the net Cl^- flux was not reduced. Replacement of serosal Na^+ with K^+ redeced the net Cl^- flux, which became zero after bathing both mucosal and serosal sides with KCl Ringer solution. When serosal Na^+ was replaced with choline$^+$ while mucosa was bathed with KCl Ringer solution, the net Cl^- flux was reduced slightly, 76 % of it was still remained. After treatment with ouabain under mucosal K^+ and serosal Na^+ condition, the net Cl^- flux was reduced to almost zero. Applying ouabain under various mucosal Na^+ concentration made by mixing normal Ringer with KCl Ringer solution, ouabain sensitive Na^+ and K^+ fluxes were estimated, both of which follow saturation kinetics. Serosa-to-mucosa Na^+ flux was explained by simple diffusion. When serosal K^+ concentration was increased progressively, Cl^- flux increased progressively until $[K]_S$ = 20 mM, and was inhibited above $[K]_S$ = 50 mM. Coupling ratio between active Na^+ and Cl^- fluxes was 3 : 4. Serosa-to-mucosa K^+ flux was explained by simple diffusion (P_K = 0.053 cm/h). When mucosal K^+ concentration was reduced progressively by mixing KCl Ringer with choline Cl Ringer solution, Cl^- flux decreased progressively. Coupling ratio between active K^+ and Cl^- fluxes was almost unity. Serosa-to-mucosa Na flux follows simple diffusion (P_{Na} = 0.045 cm/h). From these results, a possible model for Cl transport was proposed.

49

THE MECHANISM OF INHIBITION OF GLY-GLY TRANSPORT BY GLY-LEU IN GUINEA PIG SMALL INTESTINE

Himukai, M., Kameyama, A., and Hoshi, T. Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

Previously, we (Himukai and Hoshi 1979) reported that inhibition of Gly-Gly influx by Gly-Leu was not competetive but mixed type kinetically. Further analyses of Gly-Gly influxes measured in the presence of Gly-Leu at various concentrations showed that the Dixon plot of $1/J_{Gly\text{-}Gly}$ vs. (Gly-Leu) was linear. The results suggest that Gly-Gly and Gly-Leu are transported by separate systems and another binding site for Gly-Leu (Km: 0.4mM) is involved in Gly-Gly transport system. This binding site for Gly-Leu is not related to Gly-Leu transport (dead end). Another series of experiments were carried out in order to know whether this binding site was related to Gly-Leu hydrolysis or not. Kinetic analysis of Gly-Leu hydrolysis by brush border membrane preparations showed that there were two hydrolytic systems; one having a higher affinity (Km: 0.3mM) and the other a lower affinity (Km: 2.7mM). The strong inhibition of Gly-Gly transport by Gly-Leu may be attributed to binding site which has a Gly-Leu hydrolyzing activity and consequent interaction with Gly-Gly transport.

50

MEMBRANE CONDUCTANCE CHANGES ASSOCIATED WITH Na^+-DEPENDENT SECONDARY ACTIVE TRANSPORT

Kawahara, K., Yokoyama,* R., and Hoshi, T. Dept. of Physiol., Faculty of Med., Univ. of Tokyo, Tokyo, and *Dept. of Information Sci., Iwate Univ. Morioka

In order to evaluate the membrane conductance changes induced by Na^+-dependent active transport of sugar and amino acids, a new electrophysiological method has been developed. We injected current (as rectangular waves) into the tubular lumen and recorded resulting changes of transepithelial (V_l) and cell membrane potential (V_c) at various distances from the source. To analyze the intraluminal and intramural spreads of electrotonic potential, we used the electrical equivalent circuit for the proximal tubule. Thus we found that $V_l(x)$ and $V_c(x)$ were composite exponential functions.
We compared the theoretical value with the experimental one and determined membrane resistances both in the absence and presence of 20 mM alanine in the lumen. Under control conditions the resistances of luminal membrane (r_a), peritubular membrane (r_b), and paracellular shunt pathway (r_s) were 4.3×10^4, 4.4×10^4, $5.3 \times 10^3 \Omega \cdot cm$, respectively. The corresponding specific resistances were $R_a = 1350$, $R_b = 2100$, $R_s = 166 \Omega \cdot cm^2$. Alanine injection reduced R_a to $800 \Omega \cdot cm^2$ and increased R_b to $4200 \Omega \cdot cm^2$. R_s was almost constant. The decrease of R_a can be ascribed to a conductive property of Na^+/alanine cotransport, while the increase of R_b may be due to the cotransport-associated depolarization which probably reduces K^+ conductance of the peritubular membrane.

51

ELECTROCHEMICAL PROFILE FOR ION TRANSPORT ACROSS THE PROXIMAL AND DISTAL TUBULES OF BULLFROG KIDNEY.

FUJIMOTO,M., KOTERA,K., KUBOTA,T., KAJINO,K., AOKI,S., MATSUMURA,Y. and SATAKE,N. Dept. of Physiol., Osaka Medical College, Takatsuki, Osaka.

Ionic activities of K^+, Cl^-, and H^+ were directly measured with ion-selective microelectrodes in the lumen and cell of bullfrog nephron under normal conditions. The luminal and cellular fluids in the proximal tubule contained 2.92 and 67.4 mM for K^+, respectively, and 71.7 and 9.9 mM for Cl^- activities with pH 7.39 and 7.34, and the PDs were -8.0 and -68.4 mV with respect to the interstitial fluid containing 2.64 mM K^+, 72.5 mM Cl^-, pH 7.55. On the other hand, the distal luminal and cellular fluids had 3.52 and 39.7 mM for K^+, 114.8 and 6.4 mM for Cl^-, 7.23 and 7.24 for pH, and +8.5 and -64.7 mV for PDs. The electrochemical potential gradients calculated from the above data indicate that the luminal membrane of proximal tubule has the ability to accumulate K^+ and Cl^- into the cell and to secrete H^+ into the lumen against energy gradients. In contrast, the luminal membrane of distal tubule has relatively high permeabilities to K^+ and Cl^-, but a low permeability to H^+, suggesting that the luminal electro-positivity in this segment might be related to an uphill movement of H^+ across the luminal border.

52

ACTIVE SODIUM TRANSPORT ACROSS THE MONOLAYER CANINE KIDNEY CELLS(MDCK)

F.MARUMO, K.OZAWA* & A.SATO*, Dept.Med.,Kitasato Univ.Sch.Med.,Sagamihara & *Dept.Dent.Tech.,Tokyo Med.Dent.Univ.Sch.Dent.,Tokyo

MDCK, an epithelial cell line derived from a normal canine kidney, was cultured on collagen coated membrane filter in a CO_2 incubater for 3-4 weeks. Ham's F_{12} with 10% calf serum was used for culture medium. MDCK cells formed monolayer membrane with tight junction on the membrane filter approximately 3 weeks after starting culture. Membrane was fixed in Ussing type lucite chamber at 37°C with CO_2 bubbling in Eagle's minimal essential medium. PD was monitored by Keithley electrometer 610C, and short-circuit current(SCC) was measured. PD was 0.75±0.11 mV(mean±SD,n=16) and SCC was 13.3±3.85 uA. SCC was stable up to 3 hrs and showed temprature dependency between 32 to 38°C. SCC was inhibited by 5×10^{-5}M ouabain and restored by replacement of medium. 10^{-4}M 2,4-DNP with NaF inhibited SCC while 10^{-3}M 2,4-DNP alone could not. 45 mU/ml arginine vasopressin enhanced SCC.

Present data suggest that Na is actively transported across MDCK cell monolayer membrane, and that MDCK mimics the function of medullary tubular cells. MDCK may be useful for research as a model of renal cells.

53

EFFECTS OF DIVALENT CATIONS ON THE Na- AND Ca-CHANNELS OF MOUSE NEUROBLASTOMA CELLS.

Miyake, M. Faculty of Pharmaceutical Sciences, Hokkaido University

The effects of divalent cations were studied on the Na- and Ca-spikes of mouse neuroblastoma cells, which evoked mixed Na and Ca action potentials under appropriate tissue culture conditions. Barium ions, which passed effectively through the Ca-channels, suppressed the maximum rate-of-rise of Na-spikes evoked by anode-break stimulations (hyperpolarizations more negative than -90 mV) with a half-blocking dose of about 2 mM. Other divalent cations (Sr^{2+} and Ca^{2+}), to which the Ca-channels were also permeable, showed more or less a similar blocking effect on the Na-spike component ($Ba^{2+} > Ca^{2+} > Sr^{2+}$). Cobalt ions, a well-known blocker for Ca-channels, also inhibited Na-spikes of N-18 cells with a half-blocking dose of about 1 mM. This value was only 5-times larger than that of the blocking effect of Co^{2+} on the Ca-spike component. On the other hand, the half-blocking dose of Cd^{2+} on the Ca-spike component (about 7 μM) was much less than that on the Na-spike component (0.4 mM). Thus, the effect of Cd^{2+} as a Ca-channel blocker was more specific than that of Co^{2+} in mouse neuroblastoma cells.

54

CALCIUM INFLOW FOLLOWING ACTION POTENTIALS IN FROG MUSCLE SPINDLES AND THE EFFECTS OF RUTHENIUM RED.

FUJITSUKA,N., ITO,F. and KATSUTA,N. Dept. of Physiol. Nagoya Univ. Sch. Med. Nagoya 466.

Voltage-dependent calcium inflow and the calcium control function of mitochondria in nerve terminals of the frog muscle spindle were studied electrophysiologically and ultrastructurally by application of ruthenium red (r.r.). Calcium inflow following individual action potentials was revealed as a slow depolarizing deflection after substraction of the amplitude between full-sized spikes in normal Ringer solution and in Ringer solution containing both 5 mM $MnCl_2$ and 10 mM TEA. The slow depolarizing component was increased by application of 0.5 mM r.r., appearing as a plateau following individual full-sized spikes or a long lasting depolarization of up to 20 sec during stretch. Ultrastructural profiles after the electrophysiological study showed accumulation of r.r. granules in the sensory nerve terminals and in the mitochondria.
A hypothesis that calcium channels distribute on the encoding site and entered calcium ions are processed by mitochondria in the frog spindle terminals is discussed.

55

POTENTIAL-DEPENDENT EFFECT OF SEA ANEMONE TOXIN ON CRAYFISH GIANT AXON.

FUJITA,S. AND *WARASHINA, A. Dept. of Neurochem., Brain Inst., Niigata Univ. and *Dept. of Physiol. Niigata Univ. Sch. of Med., Niigata

Effects of a purified toxin (PaTX) from the sea anemone, Parasicyonis actinostoloides, on crayfish giant axons were studied electrophysiologically. The toxin acted on the axon to prolong the falling phase of action potential. It also decreased the maximum rate of rise of action potential and the resting potential with a certain delay. It was found that the development of toxicity was reduced when the nerve membrane was depolarized by an increase in potassium concentration in the external medium of axon or by a current injection through the membrane, presumably due to a suppression of the toxin association with binding sites in the membrane under depolarization. The potential dependency in toxin action of PaTX was determined in detail together with other toxins (ATX II and ScVM) from the sea anemone, Anemonia sulcata, and the scorpion, Leiurus quinquestriatus. These toxins exhibited different potential dependences, that is the depolarization required for the half-maximal reduction of toxicity are around 5, 37 and 18 mV for PaTX, ATX II and ScVM, respectively.

56

ACTIVATION-INACTIVATION OF POTASSIUM CHANNELS AND DEVELOPMENT OF A POTASSIUM-CHANNEL SPIKE IN INTERNALLY PERFUSED SQUID GIANT AXONS

INOUE, I., Inst. Marine Biol., Sch. Med., Univ. Tokushima, Seto-cho, Naruto City, 771-03

A spike due to calcium permeability through potassium channels was separated from the action potential generated in squid axons internally perfused with a 30 mM NaF solution and bathed in a 100 mM $CaCl_2$ solution by blocking sodium channels with tetrodotoxin. Currents through potassium channels were studied under voltage clamp. The records showed a clear voltage-dependent inactivation of the currents. The inactivation was composed of at least two components; one is relatively fast having a time-constant of 20-30 ms, and the other very slow having a time-constant of 5-10 s. To generalize voltage clamp was done under a variety of salt compositions of both the internal and external solutions. A similar voltage-dependent inactivation having the two components could be recognized in all the currents through potassium channels. Although the direction and intensity of current strongly depended on the salt compositions of the solutions, the time-course of these currents at each corresponding voltage were very similar. These results strongly suggest that the inactivation of the currents is attributed to an essential dynamic process of potassium channels themselves. Thus, generation of the potassium-channel spike can be understood as an event which occurs under a particular condition in which the equilibrium potential across the potassium channel becomes positive.

57

INTERNAL PERFUSION OF ISOLATED NERVE CELL BODY BY SUCITON PIPETTE METHOD AND DIVALENT CATION CURRENTS.

AKAIKE, N., OYAMA, Y. AND NISHI, K. Dept. of Pharm., Kumamoto Univ. Med. Sch., Kumamoto 860, Japan.

The experiments were done on isolated nerve cell bodies of Helix aspersa using the suction pipette method of internal perfusion and voltage clamp. Divalent cation effects such as Ba^{++}, Sr^{++}, Ca^{++}, Mn^{++}, Zn^{++} and Cd^{++} on Ca channel were examined without the presence of external Ca and Mg ions. Comparing maximum peak inward currents, the average relative sizes of divalent cation currents were in the order of $Sr \fallingdotseq Ba \gg Ca \gg Mn > Zn > Cd$. The voltage peaks for divalent cation currents are shifted to more positive potentials in the order of $Zn \fallingdotseq Mn > Ca > Ba > Sr$. The results for Mn and Zn indicate greater binding of surface charge by these ions than by Ca ion. The present results clearly showed that the divalent cations sometimes used to block the Ca channel such as Mn and Zn ions can actually carry minimal amounts of current through the channel. The I_{Mn} was completely blocked by either organic or inorganic Ca-blockers. Also, I_{Mn} was blocked by Mn, Cl, Ba, Verapamil and Diltiazem ions which were perfused internally.

58

ASYMMETRICAL CAPACITANCE CURRENT IN THE Na INACTIVATION PROCESS.

MURAYAMA, K. KITASATO, H., NISHIO, K., AND MARUNAKA, Y. Dept. of Physiol., Shiga Univ. Med. Sci., Ohtsu

To clarify the gating mechanism of Na channel, the relation was studied between the inactivation of Na conductance and the asymmetrical capacitance current (I_S), so called 'gating current'. I_S was obtained from voltage clamped crayfish giant axons internally perfused with 188 mM TEA internal solution bathed in Tris-TTX solution by summing the capacitance currents during depolarizing and exactly matched hyperpolarizing pulses. To all test pulses, I_S-ON at the start of the pulse was outward and showed an instantaneous rise and a smooth decay of two distinct phases. I_S-OFF at the end of the pulse was inward having an instantaneous fall and a single component decay. The total charge displacement of I_S, Q was obtained by the integral of I_S. Q-ON increased in a S-shape in proportion to the magnitude of the pulse (3.8 nQ/cm^2 at -80 mV to 23.9 nQ/cm^2 at 40 mV). We confirmed that the gating charge displacement was immobilized in two phases. The fast immobilization was tested by calculating the ratio, Q-OFF/Q-NO for various durations of test pulses, resulted in an exponential decay with τ=1.7 ms from 1 ms:0.72 to 5 ms: 0.33. Testing the slow immobilization by varying the duration of prepulse to -100 mV showed that the immobilization of Q-ON was slowly released reaching to its maximum at about 30 sec to 1 min(450 ms: 7.5 nQ/cm^2 to 30 sec: 23.1 nQ/cm^2).

59

THE STRUCTURE-ACTIVITY(S-A) RELATIONSHIP OF GRAYANOTOXIN(GTX) DERIVATIVES IN SQUID GIANT AXON AS DETERMINED BY INTERNAL PERFUSION AND VOLTAGE CLAMP METHOD.

SEYAMA, I. Dept. Physiol., School of Medicine, Hiroshima University, Hiroshima

A study of the S-A relationship of GTXs in the frog skeletal muscle (Masutani, et al., J. Pharmacol. exp. Therap.(in Press) 1981) has clarified that the biological activity of GTX depends on both the stereospecificity and hydrophylicity of the GTX molecules. Since GTX has been shown to act only from the intracellular sites, the S-A relationship of GTX should be examined in an experimental condition where GTX is accessible directly to receptive sites on the intracellular surface in order to eliminate passage through the cell membrane. By using the internal perfusion method and the voltage clamp method, I_{Na} through GTX opened channel for the S-A relationship for 19 GTX analogues could be isolated by clamping the membrane at -50mV with E_K and E_{Cl} arranged to have the same value. It has been shown that the change in the number of OH groups in the C and D rings of the GTX molecules from 4 to 6 decreases the potency of the biological activity, K_d, from 11.0 to 139.1uM. 14,16-O-Diacetyl-ΔH_2-GTX II having 3 OH groups remarkably reduced the biological activity. Modifications in C-3,-5,-6 and -10 moieties eliminated the biological action. The conclusion derived from the S-A study in the frog skeletal muscle is in well accord with that in the squid axon, in which the optimal number of OH groups is 4 instead of 5 in the frog skeletal muscle.

60

KINETIC PROPERTIES OF CURRENTS THROUGH A SINGLE ANOMALOUS K RECTIFIER CHANNEL AND A SINGLE Na CHANNEL

YASUO FUKUSHIMA Lab. of Neurobiol., Inst. of Brain Res., Sch. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

The tunicate egg cell membrane shows Na, Ca, delayed K and anomalous K currents. Kinetic properties of a single anomalous K rectifier channel and a single Na channel were studied by the patch current recording technique. When the membrane potential was hyperpolarized below -100 mV in 50 to 100 mM K solution, the inward fluctuations in the patch current were observed. The time sequences of open-close events in the patch current were exactly those expected from the opening and closing rate constants for the inactivation process of the macroscopic anomalous K current.

When the membrane potential was depolarized above -65 mV in 600 mM Na and 1.5 mM Mn solution, the pulse-like fluctuations of the current were observed with their reversal level approximately equal to that of the macroscopic Na current. It was shown that the time sequences of the pulse-like events were compatible with those for a single Na channel calculated from the rate constants of the macroscopic Na current by using the Hodgkin - Huxley model. Both unit conductances of a single anomalous K rectifier channel in 200 mM K solution and a single Na channel in 600 mM Na solution were about 9 pS.

61

EXCITATION OF SQUID AXON MEMBRNAE UNDER MONO-IONIC CONDITIONS.

TERAKAWA, S. Lab. Cell. Physiol., Nat. Inst. Physiol. Sci., Okazaki.

Squid axon membranes were found to maintain electrical excitability when exposed intracellularly and extracellularly to the same solution containing a single species of slat. The use of cobalt, manganese, nickel, or barium salt was adequate for maintaining the excitability. Application of a sustained inward current through the membrane induced oscillatory change in the membrane potential and in the membrane conductance. The shape and the time course of these responses were very similar to those of repetititvely fired action potentials. The current intensity and the concentration of ion in the media had large effects on the response. The voltage-clamp technique revealed a N-shaped I-V characteristic of the membrane system. The membrane emf's of the resting and excited states were almost the same but the membrane conductance was increased in the excited states. The oscillatory response was reversibly suppressed by 4-aminopyridine, but not by tetrodotoxin or by D-600. The experimental conditions employed and the results obtained were very colse to those for some of the artificial membrane models. Theories developed for these inanimate membranes may be applicable to squid axon membranes under such mono-ionic conditions.

62

CAPACITY CHANGE OF AXONAL MEMBRANE ASSOCIATED WITH MEMBRANE POTENTIAL CHANGE.
WATANABE, A. and SAKAI, T. Nat. Inst. Physiol. Sci. and Dept. Physiol. Tokyo Med. Dent. Univ.

The membrane current of intracellularly and extracellularly perfused squid giant axons was examined with the use of the voltage-clamp technique. When the external medium was 400 mM $CaCl_2$ solution and the internal medium was either 50 mM Na-phosphate or 50 mM K-phosphate, application of a depolarizing voltage pulse produced a brief inwardly directed transient current immediately following the capacitative surge, if the holding potential was more negative than about -70 mV. When the membrane was under the current-clamp conditions a brief (about 0.1 ms) current pulse produced a grade depolarizing response. When the external medium contained Na^+ and Ca^{2+} and the internal medium contained K^+, the brief inward current could still be observed in response to a depolarizing voltage pulse from axons under the voltage-clamp with a holding potential of -150 mV. In these axons the depolarizing voltage pulse produced also the sodium current, which gradually shortened its latency and engulfed the brief inward current, as the amplitude of the voltage pulse was increased. The generation of this brief inward current could be explained by assuming that the membrane capacity increases on depolarization of the membrane.

63

EFFECTS OF INTRACELLULAR Ca ON MEMBRANE PROPERTIES AND ULTRASTRUCTURE IN SQUID GIANT AXONS.

YAMAGISHI,S. AND FURUYA,K. Dept. of Cell Physiology, National Inst. for Physiological Sciences. Myodaiji, Okazaki.

Squid giant axons intracellularly perfused with 25 to 100 mM K-glutamate solutions produced action potentials of about 130 mV in amplitude. By addition of 0.3 - 3 mM Ca ions, the amplitude of the spike decreased gradually, while the duration prolonged about 4 times. Immediately after the onset of Ca perfusion, the threshold potential lowered very close to the resting level. In many cases, the resting membranes suddenly produced large spikes without electrical stimulation. The valtage clamp experiments showed that the inward current was prolonged, and the outward current was suppressed by Ca perfusion.

According to the observation of scanning electronmicroscopy, the axoplasm and the filamentous structure neighboring the inner surface of the membrane considerably diminished by Ca perfusion.

64

SENSITIVITY OF Ca^{2+}-DEPENDENT K-CHANNEL TO VARIOUS DIVALENT CATIONS AND K-CONDUCTANCE INHIBITORS IN SYMPATHETIC GANGLION CELLS.
M. NOHMI, E. KUMAMOTO & K. KUBA. Dept. Physiol., Saga Med. Sch., Saga 840-01.

Ca^{2+}-dependent K-conductance of the cell membrane in bullfrog sympathetic ganglia is involved in mechanisms of the afterhyperpolarization (AHP) of an action potential (AP) and rhythmic slow hyperpolarizations (SHP). Substitution of all Ca^{2+} with Sr^{2+} (1.8 mM) raised reversibly the amplitude and rates of rise and fall of SHP, leading to spike-like hyperpolarizations appearing in groups, while it decreased the duration and amplitude of AHP with a lengthened duration of the spike of AP. In Ca^{2+}-free, Ba^{2+}(1.8 mM) solution, SHP was markedly and reversibly depressed in amplitude and time course, whereas AHP was shortened with a broadened spike. Replacement of all Ca^{2+} with Co^{2+}, Ni^{2+} or Mn^{2+} completely blocked SHP in a reversible (Mn^{2+}) or almost irreversible (Ni^{2+}, Co^{2+}) manner, and shortened drastically AHP. TEA (10 mM) reduced SHP amplitude, but prolonged a spike without change in AHP. Cs^+ (10 mM) and 4-aminopyridine (4-AP; 0.05-0.1 mM) affected hardly SHP and decreased slightly AHP amplitude with unchanged spike duration. Since Sr^{2+} and Ba^{2+} can permeate the ganglion cell membrane, the order (Ca^{2+}>Sr^{2+}>Ba^{2+}) of the ability to generate AHP would reflect the sensitivity of Ca^{2+}-dependent K-conductance and so was the order of K-inhibitors (TEA>4-AP, Cs^+), while the order (Sr^{2+}>Ca^{2+}>Ba^{2+}) for SHP would mean the ability to release Ca^{2+}, or to be released, in the cell.

65

EFFECT OF ATP ON g_K IN BULLFROG SYMPATHETIC GANGLION CELLS. HIRAI, K.*, AKASU, T. AND KOKETSU, K. Tokyo Res. Lab., Kowa Co Ltd., Tokyo* & Dept. of Physiol., Kurume Univ. Sch. Med., Kurume

ATP (1-1000 μM) depolarizes the bullfrog sympathetic ganglion cells by decreasing the membrane conductance. The after-hyperpolarization of action potential was also depressed by the action of ATP in these concentrations. These actions of ATP can also be observed in the presence of TEA. The mechanism underlying these unique actions of ATP were analysed by means of voltage clamp using two microelectrodes inserted into the ganglion cell body. When a depolarizing step-command (200 msec) was applied to the ganglion cell clamped at -60 mV in the presence of TTX (1 μM), the slow inward current (Isi) and following time-dependent outward current (Io) were recorded. The Isi was largely, but perhaps not exclusively, a Ca^{2+} current. The time-dependent Io was composed of at least two kinds of voltage-dependent K^+ currents; the delayed rectifier K^+ current (I_K) and the M current (I_M) reported by Brown & Adams (1980, Nature, 283, 637). ATP depressed both the I_K and I_M (preferentially I_M), while Isi showed a slight decrease in its amplitude. These actions of ATP may be responsible for the depolarization and the depression of after-hyperpolarization. Possible purinergic action in the neural system is discussed in the connection of the present result.

66

THE MECHANISM UNDERLYING ADRENALINE FACILITATION OF Na^+-PUMP. KAIBARA, K.*, KOKETSU, K., AKASU, T., HIRAI, K., MIYAGAWA, M., HASUO, H., YAMADA, M., NISHIMURA, T. AND KOJIMA, M. Dept. of Chem., Fac. Sci. Kyushu Univ., Fukuoka* & Dept. of Physiol., Kurume Univ. Sch. Med., Kurume

Facilitatory actions of adrenaline (Ad) on the Na^+-pump in frog skeletal muscle cells were studied by means of the $^{22}Na^+$-efflux measurements. Ouabain-sensitive Na^+-efflux was potently augmented by Ad (30 μM), while the other biogenic amines were less effective (noradrenaline, dopamine) or noneffective (histamine, serotonine). Effects of Ad on the ouabain-insensitive Na^+-efflux were negligible order as compared to those on ouabain-sensitive efflux. Ad (1 μM) induced increase in Na^+-efflux was blocked by propranolol (3 μM), but phenoxybenzamine (3 μM) did not show any detectable effects. This suggests that the Na^+-pump is stimulated by β-action of Ad. Effects of Ad (30 μM) on the Na^+-pump activity were also examined under various external K^+ concentrations (0.1-15 mM). The kinetic analysis was carried out based on the Michaelis-Menten type reaction scheme (Pump-site + $K^+ \rightleftarrows$ Pump-site-K $\rightarrow$ Ouabain-sensitive Na^+-efflux). The dissociation constant of pump-site-K complex and rate coefficient of final process were estimate from the efflux data. It was concluded that Ad facilitates the Na^+-pump by increasing the affinity of K^+ to pump-site and also by increasing the rate coefficient due to the interaction with the catalitic site of Na^+-pump.

67

DEPENDENCY OF ELECTROGENIC Na^+ PUMP ON MEMBRANE POTENTIAL IN BULLFROG ATRIAL MUSCLES. HASUO, H. AND KOKETSU, K. Dept. of Physiol., Kurume Univ. Sch. Med., Kurume

The possibility that electrogenic Na^+ pump induced by re-warming the external Ringer solution is dependent on the membrane potential level was suggested by one of present authors in frog skeletal muscle (J.J.P., 23, 165, 1973). The present experiment was made for the purpose to evaluate this suggestion. Cardiac muscle preparation was used in the present experiment, since the electrogenic Na^+ pump current could be recorded at different potential levels by use of voltage clamp method in this preparation. The electrogenic Na^+ pump current is defined as the membrane current which is eliminated by the action ouabain (2×10^{-6} M), and it was induced by adding K^+ or other alkali cations, such as Rb, Cs, or Li, to external K^+-free solution. These alkali cations were used in order to control the possibility that passive membrane K^+ current might be altered according to the changes in K^+ concentration at membrane vicinity caused by an activation of electrogenic Na^+ pump. Since alkali cation other than K^+, particularly Li^+, is less permeable to the membrane in comparison with K^+, a contribution of the passive membrane current of these ions to the total membrane current would be much smaller than that of K^+. The conclusion obtained from the present experiment was that the electrogenic Na^+ pump current is apparently dependent on the membrane potential.

68

EFFECT OF Ca^{2+} ON ACTION POTENTIALS IN CULTURED CHICK CORTICAL NEURONS.
MORI, J., ASHIDA, H., MARU, E. AND TATSUNO, J.
Dept. of Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama.

The effects of tetrodotoxin(TTX) and high Ca concentration on action potentials were studied in cultured cortical neurons from chick embryo. In immature neurons(7-10 days) action potentials were still elicited in TTX (10^{-7}g/ml)-containing Tyrode's solution, and such TTX-resistant action potentials were reduced as neurons grew up. In mature neurons(25-40 days) TTX(10^{-7}g/ml) partially blocked action potentials, whose maximum rates of rise were increased by the elevation of Ca concentration. In immature neurons, on the other hand, this Ca effect was also observed under the normal condition without TTX. Although no action potentials were generated in most neurons in the normal medium contained higher TTX(10^{-5} g/ml) or in the Na^+-free solution, the increase of Ca concentration in these media effectively produced action potentials in immature neurons, but less effectively in mature ones. These results suggest that Ca ions partially contribute to the generation of action potentials particularly at early stages and the Ca component may fade as neurons mature.

69

DIFFERENTIATION OF A MYOGENIC CELL LINE MC3T3-A1.
Y. AMAGAI, H. KODAMA, M. IIJIMA, & S. KASAI. Dept. of Physiol., Tohoku Dental Univ., Koriyama, Fukushima

Developmental changes of membrane electrical properties in a newly established myogenic cell line MC3T3-A1 clone M13 were investigated. Cells of this cell line proliferate as mononucleate myoblasts, once become confluent, then rapidly fuse to form multinucleate myotubes. The resting membrane potentials in myoblasts were -22.5±1.7mV and they showed only ohmic potential changes in response to intracellular current injections. On the other hand, myotubes in the earliest stage showed delayed rectifications with outward currents and action potentials after inward currents. Furthermore, in matured myotubes whose membrane potentials were -50.5±3.2 mV overshooting (32.1±2.5mV) action potentials were elicited by either current directions. These action potentials had very short duration (3.5 ±0.2msec at half height) and large maximum rate of rise (183±11.5V/sec) showing that Na and K channels had highly developed. TTX (3μM) failed to block these action potentials and Na^+-free BSS completely blocked them. This result suggest that even in matured stage MC3T3-A1 myotubes have TTX -insensitive Na channels which are found in newborn and denervated muscle.

70

EFFECTS OF COLCHICINE ON AXOPLASMIC TRANSPORT OF TISSUE CULTURED NERVE CELLS.
HORIE, H. AND TAKENAKA, T. Dept. of Physiol.,Sch. of Med., Yokohama City Univ., Minamiku,Yokohama 232

Dorsal root ganglion cells dissected from 6 day old chick embryos were cultured in Eagle's minimal essential medium supplemented with 10% horse serum and 5% chick embryo extract. After 3 days, transported particles in the neurites were observed with Nomarski differential interference contrast microscopy and a cultured medium was perfused with the solution containing the antimitotic drug. When $1x10^{-6}$M colchicine was applied to the neurites, the number of transported particles began to decrease after 30 min and completely disappeared after 60 min. The concentration required to supress the axonal transport of 50% at 60 min after drug application was approximately $1x10^{-7}$M, which coincides with the binding constant of colchicine to chick embryo brain tubulin, $5x10^{-7}$M. These results suggest that microtubules play an important role in the axoplasmic transport of tissue cultured nerve cells.

71

INTRACELLULAR CHANGES DURING BURSTING ACTIVITY IN SNAIL NEURONS. KISHII,K., ONOZUKA,M., FURUICHI,H., SUGAYA,E., ASO,H.* & HIRANO,S.* Dept. of Physiology, Kanagawa Dental College, Yokosuka & Dept. of Physiology, Sch. of Medicine, Toho University, Tokyo

During pentylenetetrazole(PTZ) induced bursting activity(BA) in snail neurons, the intracellular calcium moves toward the inner surface of the cell membrane in conjunction with structural changes of lysosome-like granules and release of Ca from them (Science 200:797 and 202:1195 & 1197, 1978) as well as intracellular protein changes. To elucidate the more detailed intracellular mechanism of BA, the roles of cyclic nucleotide, PTZ, and Ca were studied using electrophysiological and neurochemical techniques.

The ganglia of the snail, *Euhadra peliomphala*, were used for the neurochemical study. The identified PTZ sensitive neurons were used for the electrophysiological study.

Extracellularly applied concanavalin A inhibited PTZ induced BA. Incubation of ganglia in PTZ containing medium increased the cyclic AMP content. Ca was released from the lysosomal fraction by incubation with cyclic AMP containing solution. Protein kinase activity was increased by incubation with PTZ, a high Ca concentration or cyclic AMP. Intracellular injection of cyclic AMP evoked marked BA in PTZ sensitive neurons although the intracellular injection of PTZ did not provoke the BA.

The above findings suggest that the role of cyclic AMP is important in triggering intracellular change during BA.

72

TETRODOTOXIN-SENSITIVE SPIKE POTENTIAL IN CULTURED SKELETAL MUSCLE CELLS FROM DYSTROPHIC AND NORMAL CHICKENS. YAMAZAKI, S., KANO, M., SATOH, T., and YAMAMOTO, M. Dept. of Physiol., Kitasato Univ. Sch. Med., Sagamihara, Kanagawa

Cultured myotubes differenciated from normal White Leghorn chick embryos are capable of generating a TTX-sensitive spike potential in the absence of neurons, and the chick nerve extract enhances the development of the spike generation. In this study, the development and maintenance of the TTX-sensitive spike generation was studied in cultured dystrophic and normal chicken (New Hampshire line 413 and 412, respectively) myotubes, by means of the maximum rate of rise of TTX-sensitive spike potentials as an index. We used 2-week-old cultured myotubes for the developmental study and both 3- and 4-week-old myotubes for the study of the maintenance of the spike generation. From the point of view of the neurotrophic effect, both dystrophic and normal brain extracts, as well as both embryo extracts, had almost the same nature for the development and maintnance of the TTX-sensitive spike generation. However, the values from dystrophic cultured myotubes in the maximum rate of rise of the spike potential were about 80% of those from normal myotubes at both 3 and 4 weeks in culture. The reduced spike generating capability in dystrophic cultured myotubes might not be due to a neurotrophic defect, but due to a defect of the muscle membrane itself.

73

LENGTH CONSTANT ALONG INTRACAPSULAR MYELINATED TERMINALS OF THE FROG MUSCLE SPINDLE. ITO,F., KOMATSU,Y. and KANEKO,N. Dept. of Physiol. Nagoya Univ. Sch. Med. Nagoya 466.

The length constant along the intracapsular course of the axon in the frog isolated muscle spindles was measured by two methods. Electrical pulses of 100 mV in amplitude and 50 msec duration was applied across an air-gap made on the myelinated segment of the sensory axon just outside the capsule. (1) The membrane potential shifts of terminal axons induced by the antidromically spreaded currents were observed as absorption changes in light passing through the nodal membrane which was preincubated by cyanine dye (NK 2495 or 2375). The electric changes, which were tranduced by a photodiode from the absorption changes, were added 100 times on an oscilloscope screen with the trigger of the pulses. (2) The membrane potential shifts were recorded by micro-electrodes inserted intracellularly into the last node of the axon. The results of the two kinds of experiments indicate that the length constant along the intracapsular course of the axon is approximately 300 μm.

74

THE FERTILIZATION POTENTIAL IN GOLDEN HAMSTER EGGS. IGUSA,Y. and MIYAZAKI,S. Dept. of Physiol.,Jichi Med.Sch.,Tochigi

We first recorded changes in the membrane potential upon fertilization (fertilization potential) of golden hamster eggs in vitro. Before fertilization the averaged resting potential and input membrane resistance were -30 mV and 150 MΩ, respectively. The current-voltage relation was linear at membrane potentials between 0 and -100 mV.

Upon fertilization a single sperm induced several hyperpolarizing-responses (HRs), each of which reached -70~-78 mV associated with a five-fold increase in the membrane conductance and had the duration of 14 sec in average. The first HR seemed to coincide with the fusion between sperm and egg membranes. Multiple sperm entries resulted in a continuous series of rhythmic HRs. The reversal potential of the HR was -83 mV in standard medium, and it was shifted by 37 mV with a four-fold increase in the external K ion concentration, being consistent with the Nernstian slope for K ions at 31°C. The reversal potential was unaltered with the removal of Cl ions from the external medium. The HR was blocked by the intracellular injection of EGTA. The injection of Ca ions induced a hyperpolarization similar to HR. These results indicate that the HR is due to an increase in K permeability caused by an increase in the intracellular Ca concentration. The recurring hyperpolarizations upon fertilization of mammalian eggs indicate a periodic increase in intracellular Ca ions during sperm entry.

75

ALTERED VISCOELASTICITY OF CRAYFISH NERVE FIBERS BY LOCAL ANESTHETICS ICHIKAWA, O., MIYOSHI, M., AND HIJI, Y. Dept. Physiol., Tottori Univ. Sch. Med., Yonago 683

A direct stretch of nerve fibers is done to know a change of their rheological properties by applying local anesthetics. A few un-myelinated nerve fibers including four giant axons, separated out of the crayfish abdominal nerve cord, was firstly treated with collagenase in order to take the surrounding connective tissues off. And then, the experiment was done. Lidocaine and procaine anesthetized the crayfish nerve, when they were used more concentrated than 0.4% and 1.4%. While the minimum concentration of the anesthetics needed to block the conduction was remarkably reduced to 0.1% and 0.2% by addition of 1% Na-benzoate to the drugs. The action potential was hardly affected by treatment of Na-benzoate alone. From the stress relaxation study it was found that the nerve fiber became slightly softer due to anesthetics and this became fairly by Na-benzoate application. The same effect was also observed by Na-acetate or Na-salicylate. A probable explanation is that anesthetics may enter into the hydrophobic portion by losening the hydrophilic one in the phospholipid layer of the axonal membrane by above chemicals.

76

ON THE RELATION BETWEEN LIPID COMPOSITIONS AND DRUG EFFECT OF LOCAL ANESTHETICS IN THE VARIOUS ANIMAL NERVE. YAMADA, H., IMOTO, T. AND HIJI, Y., Dept. of Physiol., Tottori Univ., Sch. of Med., Yonago 683

A clear difference in the effect of some local anesthetics on the nerve conduction has been observed in un-myelinated nerves among animal species. Urethane (3.5%) or procaine (0.5%), for example, completely blocked the conduction of the action potential in the vagal nerves of rabbit or pig within a few minutes. While these drugs showed hardly any effect on the crayfish nerve for a period of one hour or more.

In this study, lipid compositions of the nervous tissues in the above animals were analysed to find a clue of the species difference for the drug effect. As a result, the content of cholesterol was found to be almost the same among the three species. On the other hand, the composition of phospholipids was characteristic. But this conclusion should be considered to be qualitative, because this experiment was performed on a small sample.

77

About the Transient and Constant Phenomena of the Muscle by the Finit Sine Alternating Current.

SAITO, T. Dept. of Physiol. Nippon Dental Univ., Tokyo.

The transient phenomenon by the sine alternating current had not be clear, because the finit sine alternating current could not been made. The auther used the function generator and counter and made the finit sine alternating current with the determined initial phase. The current is shown as $E_m \sin(\omega t + \phi_0)$, where E_m is the amplitude, ω the angle velocity and ϕ_0 the initial phase. The electric model of the living body is supposed the series circuit of the resistance r and the capacitance c, and the current i is following, (R is the input resistance of the measuring apparatus)

$$i = I_m\left\{\sin(\omega t+\phi_0+\phi) - \tan\phi\cos(\phi_0+\phi)\,\mathcal{E}^{-\frac{t}{(R+r)c}}\right\} \qquad I_m = \frac{E_m}{\sqrt{(R+r)^2+(1/\omega c)^2}} \qquad \tan\phi = \frac{1}{\omega(R+r)c}$$

The term $I_m \sin(\omega t + \phi_0 + \phi)$ means the constant phenomenon and i itself shows all the codition i, and $I_m \tan\phi \cos(\phi_0 + \phi) \exp\{-t/(R+r)c\}$ the transient stat.

Experiment is managed in M. sartorius of bulfrog in which E_m is 3 Volt and ω is changed 10^3, 2×10^3, 5×10^3, 10^4, 2×10^4, 5×10^4, 10^5 rad/sec through capillary electrodes.

78

ANALYSIS OF THE TRANSIENT K CURRENT IN THE SEA PANSY EGG. HAGIWARA, S., YOSHII, M.* & YOSHIDA, S. Dept of Physiol., Sch. of Med., Univ. of California, Los Angeles, U.S.A. and *Dept of Physiol., Nippon Med. Sch., Tokyo.

A transient (or fast-inactivating) outward K current is known to exist in the molluscan ganglion cells and is called 'A current'. The egg cell membrane of the sea pansy (coelenterate), Renilla koellikeri, shows a similar transient outward current as well as a delayed outward current. We have analyzed this transient outward current and attempted to compare it with the delayed one. The major experimental techniques employed were voltage clamp and intracellular dialysis. The results are as follows:

(1) The activation potential of the transient current is -25 ∿ -20 mV (resting potential, -72 ± 5 mV) whereas that of the delayed one is -10 ∿ 0 mV. (2) The inactivation of the transient current is rapid and is almost complete just below the activation level while it is slow for the delayed current and incomplete within a few seconds. (3) Both currents show similar reversal potentials which are predominantly determined by the K^+ gradient across the membrane. (4) The sensitivities of the conductance upon the internal K^+ differ between the two currents, suggesting that the interaction between the site and ions in the membrane channels differs between them. (5) Neither current is a Ca-activated K current.

79

MEASUREMENT OF THE RESTING MEMBRANE CONDUCTANCE UNDER A CONTROLLED VOLTAGE. HIRONAKA, T. AND IKARI, Y. Department of Pharmacology, Teikyo University School of Medicine, Tokyo 173.

Two-microelectrode voltage clamp, center-of-fiber technique was used to determine the resting membrane conductance of frog sartorius muscle. The membrane potential with the two microelectrodes inserted was -83 mV on the average (n=9). The muscle fiber was voltage clamped at the resting potential at first, and a small pulse was shortly superimposed to obtain dI/dV relation. Then the membrane potential was displaced to hold at -95 mV (near the resting potential in situ), while the command pulse was intermittently added to monitor the change of the membrane conductance. After the perturbation was settled dI'/dV' relation was obtained, and the membrane conductance at -95 mV was calculated using the equation derived as one of the best approximation:

$$G_m = \frac{Ri}{\pi^2 d^3}(dI'/dV')^3/(dI/dV)$$

where R_i designates the specific resistance of the myoplasm in Ωcm and d the diameter of the muscle fiber. The membrane conductance was 235 ± 37 μmho/cm^2 (mean ± S.E.) at -95 mV for Ri = 145 Ωcm at 20 °C and d = 80 μm.

80

GENERAL SOLUTION OF FINITE LENGTH CABLE THEORY

ASHIDA,H.,SATO,Y.*,TATSUNO,J.,MORI,J.,MARU,E.,FUJINO,K.* 2nd Dept.of Physiol.,*1st Dept. of Physiol., National Defense Medical College, Tokorozawa, Saitama, 359.

Time dependent general solution of both side sealed finite length cable with an arbitrary current injection at an arbitrary position was obtained by means of Laplace inverse transform using complex integral. This solution is a simple infinite series which converges absolutely and each term of which is composed of exponential term related to time and of cosine term related to the positions of current injection and potential measurement. It shows that unless the positions of current injection and potential measurement are not terminals, the potential decays according to not only one distinct time constant, but also infinite higher components of time constant. Almost all solutions already found under various conditions such as terminal injection, mid point injection, semi-infinite and infinite cable, are contained in this solution as particular cases. Especially, in the case of constant current injection and short cable, the solution given here converges more accurately and more rapidly than the solution expressed by error function which is solved by Hodgkin and Nakajima (1972), though it can be proved that these two solutions are mathematically equivalent. The expression given here is advantage to the analysis of the short cable, such as Xenopus toe muscle of about L=1.

81

THE STRUCTURE-ACTIVITY RELATIONSHIP ON THE L-GLUTAMATE RESPONSE IN THE ONCHIDIUM NEURON

KATO, M., OOMURA, Y. AND MARUHASHI, J. Dept. of Physiol., Faculty of Med., Kyushu Univ. Fukuoka

Application of L-glutamate (L-glu) to particular neurons (G-H cells) in the Onchidium oesophagial ganglia produced hyperpolarization, associating with an increase in K^+ permeability. On this response, the reversal potential (Erev) was -60 mV, the ED_{50}, an idicator of the affinity between L-glu and its receptive site, was 5.3 mM and the Hill coefficient n, an indicator of the cooperativity, was 2. Using these parameters as characteristics for responses, other chemicals, structurally analogous to L-glu, were examined on G-H cells. L-aspartate produced a response similar to L-glu in respect to Erev, ED_{50} and n. However G-H cells responded differently to D-glu and kainic acid from L-glu. The D-glu response had an Erev=-37.5 mV, ED_{50}=29.4 mM and n=1, and that of kainic acid had an Erev=0 mV, ED_{50}=1.5 mM and n=1. On the other hand L-glutamine, lacking the γ-COOH group, and GABA, lacking the α-COOH group, of L-glu, elicited very small responses, amplitudes less than 10% that of the L-glu response.

The above results indicate that the presense of α-NH_2, α-COOH and γ-COOH groups are all essential for the L-glu response and that the response characteristics may be closely related to the relative positions of these groups.

82

KINETICS OF THE ACCELERATION AND DEPRESSION BY DIAMINO COMPOUNDS OF THE NEUROMUSCULAR TRANSMISSION.

ENOMOTO, K., SAWADA, M. AND MAENO, T. Dept. of Physiol., Shimane Med. Univ., Izumo

Presynaptic effects of some alicyclic, aromatic and heterocyclic diamines were studied by measuring the statistical and kinetic parameters of transmitter release on the curarized and Mg-blocked frog neuromuscular preparations with conventional microelectrode techniques. 4-Aminopyridine (4AP) and phenylenediamine showed tremendous facilitatory actions on the mean quantal content (m) and the fractional release (P) whereas some of alicyclic amines such as streptomycin (SM) and neomycin diminished m and P. Change in m with 4AP and SM was associated with parallel change in the available pool (n), the probability of release (p) remained almost unaltered. To explain the antagonistic interaction on P between 4AP and SM, it was postulated that structurally related diamines like 4AP and SM compete for the occupancy of specific binding site of the Ca-dependent process X which plays the key role in the mechanism of transmitter release. Combination of 4AP or SM with the Ca-bound X site presumably modifies allosterically the action of Ca-X complex resulting in profound augmentation of the evoked release of the available transmitter with the former and its depression by the latter. The theoretically derived equations from the above competitive model agreed reasonably well with the obtained data.

83

IN VITRO SYNAPSE FORMATION BETWEEN NEURONS AND MUSCLE CELLS. Haruhiro Higashida, Yokiichi Hayashi and Naomasa Miki. Department of Pharmacology, Cancer Research Institute, Kanazawa University, Kanazawa 920, Japan.

Neuroblastoma hybrid cells (NG108-15 and NBr10A), chick ciliary ganglion (CG) neurons, and chick retina neurons were cocultured for 16 hr - 5 days with rat striated myotubes. Intracellular recordings were done with micropipettes filled with 3 M KCl. Synapses were identified as positive more than 2 miniature end-plate potentials per min were observed in a gived stable recordings. The average frequency of MEPPS of NG108-15 and NBr10A cells was 25 and 30 events/min, and that of retina neurons was about 30. CG neurons showed 24 MEPPS/min in the presence of neurite promoting factor(s) extracted from chicken gizzard, while that in the absence was 8. The synaptic responses were inhibited by d-tubocurarine reversibly, and in the presence high concentration (10 mM) Mg^{++}. Serotonin evoked depolarizing synaptic responses in the hybrid cells, and thus increased release of acetylcholine. Three peptide hormones (bradykinin, neurotensin, and angiotensin II) also facilitated MEPPS frequency at synapses between hybrid and muscle cells. The findings show that these synapses are nicotinic and are regulated likely as in vivo synapses. A part of these experiments were carried out in the Laboratory of Biochemical Genetics, NHLBI, NIH, Bethesda, MD, U.S.A. with M. Nirenberg and S. P. Wilson. (Supported by JMESC grant577072)

84

SUPPRESSIVE EFFECT OF CADMIUM ON HIGH POTASSIUM-INDUCED HYPERPOLARIZATION IN SNAIL NEURONS. HAYASHI, H. AND YAI, H. Dept. of Physiol., Saitama Med. Sch., Moroyama, Iruma-gun, Saitama.

Some molluscan ganglion cells were hyperpolarized by an excess of external K, contrary to expectations by the Nernst equation. The membrane resistance of the cells was markedly decreased with the hyperpolarization. This phenomenon was considered to represent a result of the summated IPSP's elicited by the presynaptic inhibitory fibers which were primarily depolarized by high K. We examined the effect of Cd in low pH saline on the membrane potential of snail ganglion cells in order to analyze this phenomenon further. Since Cd has been reported to block Ca channels, it might prevent neurotransmitter release from the presynaptic ending. In pH 8 control saline, the excess of K(22 mM) caused significant hyperpolarization and an evident decrease in membrane resistance, and these changes were not modified so much after 1 mM Cd addition. In pH 6.5 and pH 5 saline, the high K-induced hyperpolarization was remarkably suppressed or even changed to depolarization by 1 mM Cd. The resistance change was also diminished in low pH Cd saline. The high K-induced hyperpolarization is ascribed to the release of inhibitory neurotransmitter.

85

NEURAL CONTROL OF A MOLLUSCAN BLOOD VESSEL, THE ANTERIOR AORTA OF APLYSIA

SAWADA, M. AND MAENO, T. Dept. of Physiol., Shimane Med. Univ., Izumo

The innervation of the anterior aorta (AA) of the marine snail Aplysia californica and Aplysia Kurodai was studied using intracellular recording from neurons in abdominal ganglion and muscle fiber of the AA, recording and stimulation of the vulvar nerve, and tension and blood pressure recording from the vessel. Three motoneurons, one excitatory (RD_{AAE}) and two inhibitory (RD_{AAI}), were identified which directly innervate the aorta via their axons in the vulvar nerve. The RD_{AAI} neurons account for all the inhibition to the vessel, but at least one additional excitatory motoneuron exists. The RD_{AAI} hyperpolarize and relax the AA and may be cholinergic, since the inhibitory junctional potentials are blocked by curare and mimicked by iontophoretic and bath application of ACh. The excitatory inputs (RD_{AAE}) to the aorta cause depolarization and contraction of AA and may be serotonergic, since the excitatory junctional potentials are depressed by BOL-148 and mimicked by iontophoretic and bath application of 5-HT. RD_{AAI} and RD_{AAE} motoneurons do not connect directly with another, but are influenced by interneurons. Interneuron II causes an intense burst of RD_{AAI} activity but has only a weak effect on RD_{AAE}. Interneuron I does not connect to RD_{AAI}, but interneuron XI inhibits the inhibitory motoneuron.

86

POTENCY AND MODE OF BLOCKADE BY BARBITURATES ON VARIOUS TYPES OF ACETYLCHOLINE-RECEPTOR ACTIVITIES.

SOMEI, K., SASAKI, K., MATSUMOTO, M., SHOZUSHIMA, M., AND SATO, M.
Dept. Physiol., Sch. Med., Iwate Med. Univ., Iwate-Ken.

The ganglion cells of Aplysia contain three types of acetylcholine-receptors. The activation of one type (D_{Na}-type) produces Na^+-dependent depolarization. The other receptors are H_K- and H_{Cl}-types, the activation of which produces either K^+-or Cl^--dependent hyperpolarization. The effects of pentobarbital-sodium (PB), phenobarbital-sodium (PhB), and barbituric acid (BA) were studied on each type of receptor activities. Acetylcholine-induced responses were evaluated by the change in membrane conductance. PB and PhB showed different blocking potencies for each receptor type, but BA showed no potency of blockade for any type.
PB showed a following ratio of relative potency for each type;

$$D_{Na} : H_{Cl} : H_K = 1 : 0.5 : 0.02.$$

The blocking potency of PhB was approximately a half of that measured with PB, but the relative ratio for each type was similar. The mode of blockade was studied by plotting dose-inhibition curves for each type of receptor activities, and found to be "noncompetitive" for all types.

87

CORRELATION BETWEEN ATP, CYCLIC NUCLEOTIDES AND HISTAMINE-INDUCED HYPERPOLARIZATION IN THE ONCHIDIUM NEURON.

GOTOW, T., ABE, T., ANRAKU, M., HASHIMURA, S. Dept. of Physiol., Sch. of Med., Kagoshima Univ., Kagoshima 890, Japan

The previous study has shown that the histamine-induced hyperpolarizing response (H2-response) in the Onchidium H2-neuron is quite selectively sensitive to metabolic inhibitors and it is produced by some active transport mechanism. The aim of the present experiments was to examine how histamine affects ATP, cyclic AMP (cAMP) and cGMP levels in the H2-neuron and how their levels relate to the H2-response.

Addition of histamine (0.5 mM) to the H2-neuron resulted in a 1.5 - 2 fold increase in each level of ATP, cAMP and cGMP, but the time course of the increase showed a significant difference among their nucleotides. The increase in ATP level went before the H2-response induced by the same histamine application, while the increase in cAMP or cGMP was preceded by the peak of the H2-response. However, exposure to Na-free and DNP- or cyanide-containing salines, which blocked the H2-response, prevented the histamine-induced nucleotide changes. On the other hand, application of cAMP to the H2-neuron enlarged the H2-response, and conversely cGMP inhibited it.

These results suggest that the H2-response may be mediated or regulated by ATP, cAMP and cGMP.

88

STRUCTURE-ACTIVITY RELATIONSHIPS OF ERGOT ALKALOIDS ON TWO GIANT DOPAMINE -SENSITIVE NEURONES. TAKEUCHI, H. AND *MIYAMOTO, M. Dept. of Physiol., Gifu Univ. Sch. of Med., Gifu; *Dept. of Neurochem., Inst. for Neurobiol., Okayama Univ. Med. Sch., Okayama.

Two giant neurones (PON, periodically oscillating neurone; and TAN, tonically autoactive neurone) were identified in the suboesophageal ganglia of an African giant snail (Achatina fulica Férussac). PON is excited by dopamine (DA), while TAN is inhibited by DA.
Of the ergot alkaloids examined, ergometrine and methylergometrine had a marked and long-lasting excitatory effect on PON. Their critical concentrations necessary to produce the effect were about 5×10^{-6} Kg/l. The PON excitation produced by these two substances lasted for several hours. D-lysergic acid, its amide and piperidinamide showed also an excitatory effect on PON, however weaker than that of ergometrine.
Ergometrine and methylergometrine had a marked and long-lasting inhibitory effect (critical concentrations: 3×10^{-5} 10^{-4}Kg/l) on TAN. The three hydrogenated ergots; 9, 10-dihydroergocristine, 9, 10-dihydroergocryptine and 9, 10-dihydroergocornine had also an inhibitory effect on TAN, however weaker than those of ergometrine and methylergometrine.

89

MUTUAL SYNAPTIC EXCITATION BETWEEN THE GIANT INTERNEURONS OF THE LAMPREY SPINAL CORD HOMMA,S. AND UMENO,K., Dept.Physiol., Fac.Med., Toyama Med.Pharm.Univ., Toyama

The mutual excitation between the giant interneurons is monosynaptic and composite. DL-α-aminoadipate(AAD), 3-5 mM, reversibly depressed both the chemical EPSP in normal perfusate and the depolarizations produced by iontophoretically applied glutamate and aspartate from double-barreled microelectrodes(glutamate and aspartate potentials) in Ca-free perufsate. L-glutamate diethylester and L-glutamate-γ-methylester also depressed both the monosynaptic EPSP and glutamate and aspartate potentials but 10-20 mM was necessary. The amplitude of electrical coupling potentials were relatively little affected by the blockers. Two separate microelectrodes for passing current and for recording were inserted in a neuron. The blockers produced slight or no depolarizations, 2 ± 2.7 mV(n=13) by 5-10 mM AAD and 2 ± 2.2(n=18) by 10-20 mM GDEE but little conductance increases in Ca-free perfusate. Bath application of glutamate and aspartate produced larger depolarizations but smaller conductance increases in TTX-perfusate(0.5 μg/ml TTX, 1 mM 4AP, Ca-free) than in normal perfusate. Conductance increases increased steeply with iontophoretic current for amino acids and Hill coefficient was near 2 in absence and in the presence of AAD. These results suggest that AAD seems to be acting very probably at the postsynaptic level and that acidic amino acids or closely related substances may be serving the mutual excitation.

90

THE AFFERENT NEUROTRANSMITTER IN THE AMPULLARY ELECTRORECEPTORS: EXAMINATION OF THE FACILITATORY FACTORS IN PLOTOSUS BLOOD PLASMA. UMEKITA, S., MATSUMOTO, Y. AND OBARA, S. Dept. of Physiol., Teikyo Univ., Sch. of Med., Tokyo 173.

The previous reports have shown that after repetitive stimulation of Plotosus electroreceptors the released afferent neurotransmitter could be detected by bioassay, and also that the activity could be recovered from thin layer chromatographic plates (TLC) at a fluorescamine-negative region of Rf 25 - 30. The facilitatory factors discovered in Plotosus blood plasma were tested against these properties of the neurotransmitter. Low M.W. (<1000) components of the plasma were obtained by ultrafiltration, and fractionated by gel filtration (G 10). Four major fractions tentatively separated on the basis of 230 nm absorbance proved to contain the active factors. Each of them were further fractionated by gel filtration and by ion exchange chromatography, using various elutes. Final active fractions thus derived were developed on TLC with ethanol-ammonia after extraction with acetone-HCl. The activities could be recovered at Rf 50 - 60, 0 - 10, 80 - 90 and 20 - 30, the latter two of which were fluorescamine-negative. Since the plasma factor recovered at Rf 20 - 30 shows strong facilitatory and reversible effects on bioassay, this may be related to the released afferent neurotransmitter.

91

NON-SPIKING INTERACTION IN THE CONTROL OF MOTONEURON ACTIVITY IN CRAYFISH. TAKAHATA, M. AND HISADA, M. Zool. Instit., Fac. of Science, Hokkaido Univ., 060 Sapporo.

The activity of motoneurons innervating the uropod muscles in crayfish was shown to be controlled not only by the descending interneurons from the brain but also by the local non-spiking neurons. Cobalt staining of these non-spiking neurons revealed that they are anaxonal interneurons located entirely within the terminal ganglion from which the uropod motoneurons originate. Each of these local non-spiking neurons (LNSNs) was shown with current injection test to control the spike activity of each single motoneuron respectively in most cases. Some LNSNs, however, were found to control the set of motoneurons innervating the antagonistic muscle pairs. Some others could change the spike activity of several motoneurons innervating the same muscle. In these cases, the increase in the intensity of the current injected into an LNSN caused the recruitment or waning of motoneurons depending upon the polarity of the injected current. This observation suggested that the branches of the LNSN are functionally fractionated with respect to synaptic output to each motoneuron.

92

EFFECTS OF Co^{2+} AND La^{3+} ON THE SPONTANEOUS RELEASE OF TRANSMITTER AT INSECT MOTOR NERVE TERMINALS. WASHIO, H. and YAMAMOTO, D. Lab. Neurophysiol., Mitsubishi-Kasei Institute of Life Sciences, Machida, Tokyo.

The effect of the extracellular cobalt and lanthanum ions on the frequency of miniature postsynaptic potentials (MEPSPs) was studied in cockroach leg muscle fibers in the elevated K^+ saline with particular attention to the interaction with calcium. Co^{2+} and La^{3+} are more effective than Mg^{2+} is in suppressing evoked transmitter release. In contrast to their inhibitory effect on evoked release, those cations have been found to increase the spontaneous release of transmitter. However, our present work demonstrated dual presynaptic effect of Co^{2+} clearly, one is inhibitory and the other is accelerating. The inhibitory effect of Co^{2+} was found more effective than Mg^{2+}. The result suggests that Co^{2+} may prevent spontaneous transmitter release by occupying Ca^{2+} sites on the presynaptic membrane thereby blocking Ca^{2+} entry as well as the evoked transmitter release. But at later stage Co^{2+} may inter the nerve terminal and activate the release mechanism. On the other hand, La^{3+} markedly increased the frequency of the miniature potentials. It was also found that increasing the Ca^{2+} concentration reduced the effectiveness of La^{3+}, and invalidated it in a certain extracellular environment.

93

DRUG EFFECTS IN VITRO ON THE SYMPATHETIC GANGLION CELLS IN NEW-BORN RATS. YONEMURA, K. and TANAKA, I. Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto

Using intracellular microelectrode techniques, comparison between new-born and adult rats was made with respect to the electrical activity of superior cervical ganglion cells in vitro in response to some drugs. For test, the drugs dissolved in volumes of 5-100 μl were injected into the organ-bath of 1 ml capacity. Injection of KCl (5-40 mM) produced a dose-related depolarization (2-10 mV) in the new-born rats as well as in the adult ones. Depolarization by acetylcholine in the new-born rats was approximately twice as large as that in the adult rats. Hexamethonium at a smaller dose suppressed EPSPs in the new-born rats than that in the adult rats. An anticholinesterase (edrophonium) prolonged decay time-course of mEPSPs in the new-born rats to the same extent as in the adult rats. The minimum effective dose of tetrodotoxin to block action potential initiation in the new-born rats was similar to that in the adult rats. Some cases of the drug application produced scarce responses, particularly in the cells from adult rats, indicating that the connective tissues overlaying the cells acted as a diffusion barrier.

94

DOPAMINE RECEPTORS MEDIATING TWO DIFFERENT SYNAPTIC ACTIONS IN THE RABBIT SYMPATHETIC GANGLIA.

SUMIKO MOCHIDA, HARUO KOBAYASHI, TSUNEO TOSAKA & JUNKO TASAKA.
Department of Physiology, Tokyo Medical College, Shinjuku-ku, Tokyo 160.

Dopamine (DA) has been shown to have two different synaptic actions in the superior cervical ganglion (SCG) of rabbits. Its direct hyperpolarizing (HP) action was mimicked by norepinephrine and epinephrine, as well as by clonidine, phenylephrine, isoproterenol and ADTN. The HP responses by these agents were antagonized by phentolamine, dihydroergotamine and yohimbine, but not by prazosin, propranolol and antagonists specific to DA receptors. The second action of DA, a long-term modulatory enhancing effect on the muscarinic slow depolarizing (DP) response, was mimicked by ADTN and some other agents and was antagonized by haloperidol and butaclamol, but not by α- and β- adrenergic blockers. The agents capable of producing modulatory action were also found capable of stimulating ganglionic cyclic AMP synthesis and those capable of antagonizing modulatory action were also able to antagonize the cyclic AMP synthesis stimulated by DA. It seems thus probable that there are two independent neuronal receptors in the rabbit SCG which interact with DA. One is an α_2 type adrenoceptor which mediates HP response and another is a specific DA receptor linked with adenyl cyclase (now refered as D_1 type), the activation of which brings about an increase in cyclic AMP and may further produce the modulatory enhancing effect on the muscarinic slow DP response.

95

EFFECTS OF ACETYLCHOLINE ON THE PYRAMIDAL CELLS IN THE RAT PREPYRIFORM CORTEX IN VITRO.

HORI, N*., ffrench-MULLEN, J. AND CARPENTER, D. O.
NY State Department of Health, Albany, NY 12201 and Dept. of Pharmacology, Faculty of Dentistry, Kyushu Univ., Fukuoka*.

We have studied the responses of pyramidal neurons in brain slices of rat prepyriform cortex to ionophoretic application of acetylcholine (ACh), glutamate (Glu) and aspartate (Asp). Tangential slices including the lateral olfactory tract were cut by hand, submerged and perfused with oxygenated Krebs-Ringers at 35°C. A glass microelectrode was used to record action potentials, while transmitters were applied to various layers of the pyramidal cell through an independent multibarrel electrode. The apical dendrites were excited by Glu and Asp but not ACh. The basal dendrites showed a similar brief response to the amino acids but a prolonged excitation to ACh which was blocked by atropine (5×10^{-4}M) but not curare (10^{-3}M). Amounts of ACh subthreshold for discharge caused potentiation of the amino acid responses. We conclude that exitatory muscarinic receptors exist on basal but not apical dendrites while exitatory amino acid receptors exist on both dendrites of these neurons.

96

THE EFFECT OF ACETYLCHOLINE ON THE MEMBRANE POTENTIAL OF RAT ADRENAL CHROMAFFIN CELLS.

S. OZAWA, S. MIYAZAKI AND Y. KIDOKORO* (Dept. of Physiol., Jichi Med. Sch., and The Salk Institute*.)

The effect of acetylcholine (ACh) on membrane electrical properties was studied in cultured rat adrenal chromaffin cells by continuous recording of the intracellular potential. Application of 0.1 to 100 μM ACh produced a membrane depolarization with superimposing prominent potential fluctuations. The apparent reversal potential of the ACh-induced depolarization was -24 $\pm$ 4 mV (mean $\pm$ S.D. n=6). We studied the ionic mechanism of the ACh depolarization by changing external ion concentrations. It is likely that Ca ions as well as Na and K ions are contributing to the ACh depolarization. A linear relation was found between the mean amplitude of the ACh depolarizations and the variance of the potential fluctuations in a given cell. This finding suggests that the ACh depolarization and the superimposing potential fluctuation are due to a stochastic summation of an elementary potential change. The mean amplitude of the elementary potential was estimated to be 0.23 $\pm$ 0.06 mV (n=9) at the membrane potential level of -60 mV.

97

EFFECTS OF LIDOCAINE ON THE ISOLATED SPINAL CORD OF BULLFROG

KUNO, MIYUKI, HAYASHIDA, Y. & MATSUURA, S. Dept. of Physiol. Osaka City Univ. Med. Sch., Abeno-ku, Osaka

Spinal reflexes are depressed by local anesthetics. This study was aimed at clarifying the primary origin for the suppression of spinal responses by lidocaine. All experiments were carried out on the isolated, intra-arterially perfused spinal cord of bullfrog. When postsynaptic component of focal potential recorded at the motoneurone pool was almost totally depressed by lidocaine, presynaptic component was still remained almost not impaired. Intracellular recordings of motoneurones revealed that under application of lidocaine excitatory postsynaptic potentials elicited by stimulation of the lateral column or the dorsal root were depressed or abolished long before cessation of antidromic spike generation of the cell body. Changes in the response of ventral root to l-glutamate, GABA and substance P were not apparent at the low concentration of lidocaine used for depression of the synaptic transmission. From the results, mechanisms of the action of lidocaine on the synaptic transmission in the spinal cord were discussed.

98

EXCITATORY TRANSMITTER IN THE CRAYFISH NEUROMUSCULAR JUNCTION

TAKEUCHI, A., ONODERA, K. AND KAWAGOE, R. Dept. of Physiol., Sch. of Med., Juntendo Univ., Hongo, Tokyo 113

It has been shown in the previous reports that L-glutamate mimics the action of neurotransmitter at the crayfish neuromuscular junction and that the nerve stimulation causes a significant increase in the glutamate release into the bath fluid. If glutamate acts as the neurotransmitter, it is expected that glutamate is released in a quantal fashion. This point was tested by increasing the frequency of spontaneous miniature e.p.s.p. and by measuring glutamate release with a gas chromatograph-mass spectrometer (GC-MS). Addition of black widow spider venom (BWSV) caused an enormous increase in the miniature e.p.s.p. frequency which lasted several tens min after washing off the venom. The release of glutamate into the bath fluid was significantly increased by treatment with BWSV. However, the concentration of aspartate showed no significant increase. Similarly, nerve stimulation caused a significant increase in the glutamate release, but no significant change was observed in the aspartate release. Since the concentration of aspartate in the motor axon is higher than that of glutamate, above results suggest that the compartment in which releasable glutamate is stored is different from that in which aspartate is contained.

99

EFFECTS OF TETRODOTOXIN ON THE ACTION OF SOME MONOVALENT CATIONS ON THE PRESYNAPTIC MEMBRANE OF THE NEUROMUSCULAR JUNCTION.

TAKEUCHI, N. AND TAKIKAWA, Y. Dept. of Physiol., Sch. of Med., Juntendo Univ., Bunkyo-ku, Tokyo.

Tetrodotoxin (TTX) is a highly specific and potent blocker of the potential dependent Na-channel in excitable membranes. But no marked effect of TTX has been reported on the transmitter release at the neuromuscular junction. In our previous work, effects of several monovalent cations on the release of the spontaneous miniature end-plate potentials (m.e.p.p.) has been investigated. On these effects the influence of TTX was examined at neuromuscular junctions of the frog.

In the maintained increase in the m.e.p.p. frequency produced by 7-10 mM K or Rb, a slight decrease in the frequency was observed during the application of TTX (3 nM-1000 nM). When 60 % of Na in Ringer solution was replaced by Li, a gradual rise in the frequency with an exponential time course is observed. TTX of the same concentration range impeded the time course of the gradual increase caused by Li. These effects were dose-dependent and tended to increase by lowering the concentration of Ca. In 1 mM Ca the half-maximum point of the effect of TTX was around 10 nM. On the other hand TTX showed no effect on the increase in the m.e.p.p. frequency produced by a hypertonic solution (+ 44 mM glucose) or 0.5 mM theophylline.

100

THE MECHANISM OF EFFECTS OF Ca^{2+} ON THE ION CONDUCTANCE OF THE END-PLATE MEMBRANE

K. KUBA & S. TAKESHITA*. Dept. Physiol. Saga Med. Sch. Saga 840-01 and Lab. Comp. Anal.* Kurume Univ. Sch. Med. Kurume 830.

Using Nomarski optics, the quantitative ionophoresis of ACh to the end-plate membrane of frogs yielded a reliable dose-response relationship. This was compared with a thoeretical relationship computed by an integral equation considering the dimension of the end-plate and the location of an ACh pipette (Dreyer & Pepper, 1975). Increasing the Ca^{2+} concentration ($[Ca^{2+}]_o$) in Ringer to 7.2 or 18 mM reduced the maximum conductance by 20-40%, while it did not significantly affect the apparent dissociation constant and Hill number. An increased $[Ca^{2+}]_o$ decreased the elementary conductance obtained from the noise analysis, but unaltered the life time of the ion channel. Raising $[Ca^{2+}]_o$ shifted the reversal potential (E_{epc}) of the neurally-evoked end-plate current (EPC) to a more negative value and unaffected its half decay time. When ACh (414 μM) was perfused to the end-plate at a high $[Ca^{2+}]_o$, the E_{epc} shifted to a more negative value with unchanged half decay time of EPC, and the elmentary conductance unaltered or increased slightly without a change in the life time. These results suggest that Ca^{2+} decreases the conductance of the single ion channel without changes in its life time and in the affinity and cooperativity of the receptor, and that this Ca^{2+} action does not appear to be related to the facilitatory effect of Ca^{2+} on the desensitization mechanism.

101

SPINAL ASCENDING PATHWAY FOR SUPPRESSION OF THE JAW OPENING REFLEX INDUCED BY THE CONDITIONING A-DELTA FIBER STIMULATION IN THE PERIPHERAL NERVE OF THE RAT. K.KAWAKITA AND M.FUNAKOSHI, Dept.of Oral Physiology, Gifu College of Dentistry, Hozumi-cho, Gifu 501-02.

In Urethane anesthetized rats, the jaw opening reflex elicited by tooth pulp stimulation was strongly suppressed by the selective conditioing A-delta fiber stimulation in the common peroneal nerve with triangularly shaped stimulus pulse at 5 Hz for 15 min ($P<0.001$,t-test). This effect remained after the dorsal half and ipsilateral antero quadrant cordotomy at Th_{12-13} level. Evoked potentials provoked by the selective A-delta fiber stimulation were recorded from the contralateral anterolateral fasciculus region, and electrical stimulation of this area with a bipolar stimulating electrode (5 or 50 Hz, 0.1 msec, 40-80 μA) induced significant suppression of the jaw opening reflex ($P<0.001$,t-test) with long lasting after effect by 5 Hz, and rapid suppression was caused by 50 Hz for 10-20 sec stimulation. These results suggested that the A-delta fibers are mainly responsible for the suppression of the jaw opening reflex and their spinal ascending pathway is the contralateral anterolateral fasciculus.

102

ON THE SPINAL REFLEX IN THE NEWBORN RAT. KUDO, N. Dept. of Physiol., Inst. of Basic Med. Sciences, Univ. of Tsukuba, Niihari-gun, Ibaraki 305

The development of the monosynaptic reflex pathway was investigated by means of intracellular recording from triceps surae motoneurones in 0-8 days old rats in vitro. The isolated spinal cord with dissected muscle nerves was perfused with Krebs solution (25-27°C) boubled with $95\%O_2 + 5\%CO_2$. EPSPs were evoked by stimulation of a muscle nerve and of a dorsal root with latencies of 7.2-23.6 msec and 3.2-9.4 msec, respectively, depending on the age. In 0-3 days old rats, the latency of EPSPs measured from the arrival of primary afferent volleys in the motor nucleus was 0.3-0.9 msec, both in the case of EPSPs evoked from the muscle nerve and those from the dorsal root. In the latter case, IPSPs were also evoked but the onset of EPSPs always preceded that of IPSPs by 1.5-8.0 msec. These findings indicate that muscle afferent fibres are synaptically connected with motoneurones already at this stage. Comparison of monosynaptic EPSPs in rats of different age showed that the rise of EPSPs became steep at 6-8 postnatal days. This coincided with the time of appearance of large (above 1.5 mV) and fast time-coursed unitary EPSPs, or single fibre ones, as revealed by graded electrical stimulation of muscle nerves as well as stretch of muscles. The results are discussed in relation to morphological aspects of development of the stretch reflex arc.

103

Developmental changes in muscular potentials and their posttetanic potentiation in the rat gastrocnemius muscle. URAMOTO, I. AND KIYONO, S. Dept. of Physiol., Inst. Develop. Res., Aichi Prefectural Colony, Aichi 480-03.

With urethane anesthetized rats, muscular potentials (MPs) were evoked in the gastrocnemius muscle. MPs were of a biphasic wave with high amplitude, and MPs recorded at the medial head of one gastrocnemius muscle were larger in amplitude than those at the lateral head of the same muscle. Developmental changes in MPs and their posttetanic potentiation were investigated. Rapid changes in the course of maturation of MPs and posttetanic potentiation were found during the first few weeks of postnatal life. A remarkable difference in frequency histograms of times required to reach the peak of posttetanic potentiation was noted between rats of various ages, and delayed and long-lasting potentiation of MPs after tetanic stimulation was characteristic of younger rats. In addition, MPs were depressed during repetitive stimulation to greater extent in younger rats than in older ones. These findings were discussed in conjunction with replenishing mechanisms of acetylcholine available for release by prejunctional volleys and conspicuous alterations in the postnatal development of biochemical substances including choline acetyltransferase.

104

EFFECTS OF PENICILLIN ON THE GABA RECEPTOR OF CAT PRIMARY AFFERENT NEURONS.
INOKUCHI, H., HIGASHI, H. AND NISHI, S. Dept. of Physiol., Kurume Univ. Sch. of Med., Kurume

The effect of penicillin on the GABA-induced membrane current of cat dorsal root ganglion cells was studied by a voltage-clamp method. Penicillin (10 μM - 0.1 mM) depressed the GABA current dose-dependently without affecting the dissociation constant of GABA-GABA receptor interaction and without altering the cell membrane properties. The equilibrium potential for the GABA current was also unaffected by penicillin. This would indicate that penicillin at low concentrations acts specifically on the allosteric site or the chloride ionophores of GABA receptors and blocks the GABA current. At higher concentrations (0.1 mM - 1 mM) penicillin caused a slow depolarization of a few mV in amplitude. The depolarization was associated with an increased membrane conductance and had its equilibrium potential at approximately -50 mV. Deprivation of external sodium abolished the slow depolarization, while it was not significantly changed by a chloride-deficient solution. The result suggests that penicillin at high concentrations affects the ordinary cell membrane as well and increases its sodium and potassium conductance. This study was supported in part by a Grant-in-Aid for Scientific Research.

105

THE SITES OF ORIGIN OF THE EFFERENT FIBERS IN THE CAROTID SINUS NERVE
OKADA,J. and MIURA,M. Dept. of Physiol., 1st Div., Gunma Univ. Sch. Med., 3-39-22 Showa-machi, Maebashi 371

The existence of efferent fibers in the carotid sinus nerve (CSN) has been suggested electrophysiologically. Recently, with HRP method, we reexamined the sites from where these efferent fibers originate. Applying a small amount (0.5 mg) of HRP onto central cut end of the CSN, we found several HRP-labeled cells in the petrosal ganglion, but none in the medulla oblongata. However, when we applied over 1 mg of HRP onto the CSN, HRP-labeled cells appeared in the lamina VIII of the cervical cord, and the nucleus retrofacialis (Rf) of the medulla, suggesting a false positive finding. This result urged us to find out places where HRP could be incorporated. When a small amount of HRP was injected into the m. longus capitis, HRP-labeled cells were found in the lamina VIII. The same procedure was done in the m. digastricus, and we found them in the Rf and its surroundings. When HRP was applied to the m. constrictor pharyngis, we found them in the nucleus ambiguus. These results strongly suggest that the cell bodies of the efferent fibers may not exist in the medulla, but in the course of the CSN fibers.

106

PROJECTIONS OF SUPRASPINAL NUCLEI TO THE SPINAL CARDIOREGULATORY STRUCTURE : HRP STUDY IN THE CAT (THE SECOND REPORT)
MIURA,M., ONAI,T., TAKAYAMA,K. and OKADA,J. Dept. of Physiol., 1st Div., Sch. of Med., Gunma Univ., Maebashi 371

We used double concentric glass micropipettes. The inner pipette, filled with a saline solution, was used for stimulating neuronal structures within T2-T3 segment of the cat. The outer pipette, filled with a 15 % HRP solution, was used for injecting HRP by pulses of positive current ranging from 2 to 4 μA in a 3 msec-on/3 msec-off duty cycle. By presence of positive cardiac response to stimulation, we identified the sites of cardioregulatory structures in the intermediolateral nucleus wherein HRP was subsequently injected. Such procedures were repeated on 3-4 points with 1 mm intervals. After 2 days' survival animals were perfused transcardially and brains were processed histochemically. In a representative experiment, we found 1522 HRP-labeled cells in the supraspinal nuclei. They were distributed in the raphe nuclei (51%), lateral tegmental field (16%), surroundings of the ambiguus complex (13%), hypothalamic nuclei (9%) and nucleus locus coeruleus and subcoeruleus (6%).

107

ANALYSIS OF CODING PROCESS IN THE STRETCH REFLEX BY PROBABILITY OF SPIKE INITIATION.
HOMMA, S., NAKAJIMA, Y. AND HAYASHI, K. Dept. of Physiol., Sch. of Med., Chiba Univ., Chiba

Gastrocnemius and soleus muscles were stretched with a vibrator driven by triangular pulses with rising and falling time of 4 or 8 ms. The former is steep stretches and the latter slow stretches. Activities of alpha-motoneurons were recorded from the central cut end of the L7 ventral root filaments and then discharges of Ia and II afferent fibers were recorded from the distal cut end of the L7 dorsal root filaments. Cross-correlations between the triangular pulses and the motoneuronal spikes showed the prominent peak corresponding with the probability density distribution of the motoneuronal spikes. The peak appeared around 7 ms after the triangular stretches. But by slow triangular stretches with rising and falling time of 8 ms, an additional late peak was obtained around 12 ms after the stretches. On the other hand, cross-correlations between onsets of the triangular pulses and the Ia and II afferent spikes showed the similar peakes and since cross-correlations of the II afferent spikes showed late peak of around 10 ms, the motoneuronal spikes belonging to the late peak were probably elicited by the II spikes generated from the spindle secondary endings during slow stretches. The II afferent fibers may be monosynaptically connected to the alpha-motoneurons.

108

FICTIVE STEPPING EVOKED BY ELECTRICAL STIMULATION OF THE WHITE MATTER OF THE CERVICAL CORD IN DECEREBRATE CATS.
YAMAGUCHI, T. Inst. Basic Med. Sciences, Univ. Tsukuba, Niihari-gun, Ibaraki 305

To obtain a preparation exhibiting fictive stepping, we investigated conditions under which repetitive stimulation of C3 white matter produced rhythmic activities in forelimb muscle nerves, corresponding to stepping, in immobilized precollicular decerebrate cats with the lower thoracic cord transected. Mapping with microstimulation disclosed two distinct effective areas for evoking stepping rhythm, one located in the most dorsal and the other in the central part of the lateral funiculus. After spinal hemisection, rostral and ipsilateral to stimulation, rhythmic discharges, though rather irregular, were also evoked, suggesting that two areas contain paths essential to generate stepping rhythm. The generation of stepping and its frequency could be controlled by stimulus parameters, that is, amplitude, pulse duration and frequency of repetitive shocks. The reversible cold block of the lower thoracic cord proved that the transection at this level facilitated the generation of stepping rhythm. The fictive stepping as described above is producible in the immobilized state, controllable by stimuli directly applied to the spinal cord, and hence may be useful for detailed analysis of spinal mechanisms of stepping at the neuronal level.

109

NEURAL PATHWAYS MEDIATING DISYNAPTIC INHIBITION OF DORSAL SPINOCEREBELLAR TRACT NEURONS FROM GROUP I MUSCLE AFFERENTS IN CATS.
HONCO,T., JANKOWSKA,E., OHNO,T., SASAKI,S., YAMASHITA,M. AND YOSHIDA,K. Dept. of Physiol., Inst. of Basic Med. Sciences, Univ. of Tsukuba, Niihari-gun, Ibaraki

Dorsal spinocerebellar tract neurons in Clarke's column are disynaptically inhibited by group I (GI) muscle afferents. The disynaptic IPSPs from GI fibers were preserved after transection of the dorsal column (DC) or the lateral and the ventral funiculi (LF and VF) at the caudal end of L_4, indicating that the inhibition is mediated by interneurons located caudal to CC and sending axons through LF or VF, and also by those situated at the level of CC. The former pathway was subjected to further analysis in cats with DC transected. Neurons excited antidromically from CC and monosynaptically from GI afferents were found in laminae V-VI at L_{6-7}, where neurons labeled with HRP retrogradely from the ipsilateral CC were predominantly found. Conditioning stimuli to skin, joint nerves and the red nucleus facilitated the GI IPSP in CC neurons, indicating that interneurons mediating the GI IPSP receive excitatory inputs from these sources. Monosynaptic IPSPs were evoked in motoneurons by microstimulation of CC, and in CC neurons from motor nucleus. These findings are compatible with the hypothesis that the disynaptic IPSP is induced by the axon collaterals of interneurons mediating the autogenic inhibition to the spinal motoneuron.

110

RHYTHMIC BURST DISCHARGES IN THE SPINAL CORD. A POSSIBLE DESCENDING TRACT MEDIATING THE EXPERIMENTALLY PRODUCED SPONTANEOUS TREMOR IN MONKEYS,
OHYE,C., IMAI,S., MIYAZAKI, M., HIRAI,T., NAGASEKI,Y., TSUKAHARA,Y., WADA,H.,KAWASHIMA,Y, Dept. of Neurosurgery, Gunma Univ. Sch. of Med., Maebashi, Gunma.

In awake monkey with spontaneous sustained tremor induced by a mesencephalic ventromedial tegmental lesion, extracellular recordings were made from the spinal cord (C_1-C_2) to determine descending tract which may mediate rhythmic burst discharges from the higher center. In the previous study, it was shown that the rhythmic discharges that persisted after blocking neuromuscular transmission were found in the Rexed's VII layeripsilateral to the peripheral tremor. Further systematic trackings were made in recent two tremor monkeys. In addition to the previous findings, it was discovered another rhythmic burst discharges that persisted after temporal immobilization by Mio-block (pancronium bromide), in the anterior funiculus ipsilateral to the peripheral tremor. This could be traced rostrally up to the medullary junction, always locating in the same restricted region of the anterior funiculus. These findings suggested a descending tract. The pathway might be the pontine reticulospinal tract and the rhythmic burst discharges could be transmitted to the intermediate zone of Rexed's VII layer described previously.

111

ENHANCEMENT OF LINGUAL-HYPOGLOSSAL REFLEX DISCHARGES BY REPETITIVE STIMULI OF THE LINGUAL NERVE. M.TAKATA, Dept. of Oral-Physiology, School of Dentistry, Tokushima Univ., Kuramoto-cho, Tokushima

The properties of lingual-hypoglossal reflex discharges were investigated in nembutalized cats. Reflex discharges evoked in the hypoglossal nerve innervating retractor tongue muscles (R-fibers) by lingual nerve stimulation were built up enormously, by a factor of 4, at the stimulus-frequency of 10 and 20 Hz. However, no enhancement was observed on reflex discharges evoked in the hypoglossal nerve innervating protruder tongue muscles (P-fibers). Administration of strychnine enhanced reflex discharges in R-fibers enormously, with little change of reflex discharges in P-fibers. By studying postsynaptic potentials, it is suggested that retractor motoneurons responding with an excitatory-inhibitory postsynaptic potential (EPSP-IPSP) sequence to lingual nerve stimulation may contribute to enhancement of reflex discharges in R-fibers after the injection of strychnine. In the present experiment stimulation of the lingual nerve produced an EPSP-IPSP sequence in 136 out of 200 explored retractor motoneurons.

112

ROLES OF THE FACIAL AND AMBIGUUS MOTONEURONS FOR THE NEURAL MECHANISM OF ULTRASONIC VOCALIZATION IN RATS.
YAJIMA,Y.,HAYASHI,Y.AND YOSHII.N.,Dept.of Physiol.,Hyogo College of Med.

Electrolytic lesions placed in the facial nucleus severely disrupted ultrasonic vocalization in rats. No ultrasounds were detected following more caudal lesions extending to the nucleus ambiguus. Even unilateral transection of the cervical vagal nerve ceased the sound emission.Single motor units recorded from some laryngeal sound muscles began to discharge prior to the sound onset.Electrical stimulation of the cervical vagal nerve induced antidromic field potentials in the nucleus ambiguus with the mean peak latency of 1±0.1 ms. Seven out of 39 ambiguus motoneurons responded orthodromically to electrical stimulation of the dorsal part of the central gray matter, which we reported previously as a highly sensitive structure for ultrasound emission. The average response latency was 1.7±0.5 ms.These results suggest that impulses originating from the dorsal central gray matter and arriving at ambiguus motoneurons are responsible for ultrasound emission induced at least by stimulation of the former structure.

113

ON THE TRIGEMINO-FACIAL REFLEX PATHWAY IN THE CAT BRAIN STEM. TANAKA, T., ASAHARA, T. AND NISHIMURA, Y. Dept. of Physiol., Sch. of Med., Mie Univ., Tsu

Evoked responses in the facial nucleus (FN) of cats were recorded with microelectrodes extra- and intracellularly on stimulation of the trigeminal nerve branches, spinal trigeminal nucleus (SpN), main sensory trigeminal nucleus (VS), and ventralis posterior medialis of the thalamus (VPM). EPSPs and EPSPs with succeeding IPSPs were elicited in FN neurons by stimulation of the ipsilateral trigeminal primary afferents. The latencies of the EPSPs elicited by stimulation of the infraorbital nerve ranged from 1.6 to 2.7 msec (mean 2.1 msec, N=135). Stimulation of the ophthalmic and lingual nerves also induced EPSPs with similar range of the latencies. Considering the latencies of the EPSPs and their variation with changes in stimulus intensity, activation of FN neurons from the primary trigeminal afferents appears to be accomplished via disynaptic pathway. Stimulation of SpN produced EPSPs with the latency range of 0.6 to 2.0 msec, average being 1.2 msec. VS stimulation also elicited EPSPs in FN neurons. The latencies of the EPSPs ranged from 1.0 to 1.6 msec. These findings are strongly indicative of monosynaptic input from VS as well as SpN to FN neurons. Contralateral VPM stimulation was capable of inducing monosynaptic EPSPs (latency range 1.0-1.6 msec, mean 1.3 msec, N=24) in FN neurons, which suggests that the trigemino-facial pathway might be collaterals of the trigemino-thalamic fibers.

114

PERIPHERAL BRANCHINGS OF THE SPINDLE AFFERENT OF MASTICATORY MUSCLES. T. MORIMOTO, I. SAKAN, T. KATO & Y. KAWAMURA. Dept. Oral Physiol., Osaka Univ., Dent. Sch., Osaka.

Functionally isolated single fibres were prepared from the cut central ends of the masseter nerve of the cat. Not all the stretch-sensitive units of the nerve were alpha motor units and some were afferent units from muscle receptors. The latter well responded to the muscle stretch even under such a deep anesthetic state that masseteric e.m.g. activities induced by jaw opening were completely disappeared. They also responded to gentle pressing of the surface of either the masseter, temporalis or pterygoid muscles. Based on their responses to the ramp stretch, their ability to follow high-frequency vibration and the susceptibility to suxamethonium, the majority of them were identified as the primary or secondary spindle afferents. Furthermore, some of these afferents were activated by the muscle stretch even after dissection of the main nerve trunk of the masseter nerve close to the mandibular notch. A 'centre triggered averaging' method revealed that these units were recorded from the branch of the parent axon to muscle spindles in the masticatory muscles. In addition, some neurons in the trigeminal mesencephalic nucleus responded to electrical stimulation applied both to the masseter nerve and the temporal nerve. From these results, it is concluded that branchings of the spindle afferent of jaw-closing muscles occur outside the spindle capsule in the cat.

115

THE EFFECT OF CENTRAL AMYGDALOID STIMULATION ON THE TRIGEMINAL MOTONEURONS. SASAMOTO, K., MISHIMA, K. AND OHTA, M. Dept. of Physiol., Fac. Dent., Kyushu Univ., Fukuoka

Repetitive stimulation of the central nucleus of amygdala of rats induced rhythmical jaw movement or sustained jaw opening. To investigate the underlying mechanisms, the effect of amygdaloid stimulation was examined on bilateral mylohyoid and masseteric nerves as well as their motoneurons. About 65 % of jaw opening motoneurons received facilitatory effect from the contralateral central amygdala, on the other hand, about 40 % of masseter ones received inhibitory effect. In addition, EPSPs and IPSPs were recorded from some jaw opening motoneurons and masseter ones, respectively. The induced jaw movement was explained to be due to contralaterally dominant excitation of jaw opening (mylohyoid-anterior digastric) motoneurons and this facilitation began at 5 - 6 ms after amygdaloid stimulation, reached its peak in about 10 ms and gradually reduced to disappear in 20 - 30 ms after the stimulation.

116

INPUT-OUTPUT CHARACTERISTICS AND DISTRIBUTION OF NEURONS IN THE TRIGEMINAL SENSORY NUCLEI. SUMINO, R., HAYASHI, H*. AND SESSLE, B. J**., Sect. Physiol., Int. Stomatognathic Sci., Dept. Physiol*., Sch. Dent., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo 113 and Dept. Oral Biol., Fac. Dent., Univ. Toronto, Toronto, Canada**.

Based on anatomical organization, the trigeminal sensory nuclei are divided into the main sensory nucl.(Vms), subnucl. oralis(Vo), interpolaris(Vi) and caudalis(Vc) of the spinal nucleus. Response properties of peripheral inputs and projection sites of neurons in these nuclei were studied in chloralose-anesthetized cats. As searching stimuli, facial skin was stimulated mechanically and electrically. Tooth pulp and the masseter nerve were also stimulated electrically, as other noxious inputs. In order to test for antidromic activation of projection neurons, the contralateral VPM, the ipsilateral cerebellar peduncle and the C2 cord were stimulated electrically. Of mechanically activated neurons in the sensory nuclei, 65-80% were low threshold mechanoreceptive neurons(LTM), 14-44% were wide dynamic range neurons(WDR), and 4-15% were nociceptive neurons(NS). 5-44% were also activated tooth pulp and/or masseter nerve stimulation. Ratio of nociceptive to non-nociceptive neurons were least in Vc. 20% of neurons in Vms projected to the thalamus. 22% and 11% of neurons in Vi projected to the cerebellum and the cervical cord,respectively. Nociceptive neurons in Vi and Vc were mainly distributed in the marginal and deeper part of the nuclei and the adjacent RF.

117

NON-RECIPROCAL MONOSYNAPTIC EXCITATION OF TRIGEMINAL MOTONEURONS EVOKED BY STIMULATION OF THE PONTINE RETICULAR FORMATION OF THE CAT. KATOH, M., ENOMOTO, S., HIRABA, K. and NAKAMURA, Y. Sec. Physiol., Inst. Stomatognathic Sci., Tokyo Med. Dent. Univ., Tokyo

Single shocks applied to the region of the nucleus reticularis parvocellularis in the pontine reticular formation (PRF-pc) of cats anesthetized with α-chloralose evoked depolarizing potentials in ipsilateral jaw closer motoneurons with a latency of 0.6-1.1 msec (0.88±0.13 msec, n=35) as well as in ipsilateral jaw opener (anterior digastric) motoneurons with a latency of 0.6-1.1 msec (0.83±0.15 msec, n=6). The depolarizing potentials were increased and decreased in amplitude in response to intracellular hyperpolarizing and depolarizing currents, respectively. The effects of PRF-pc stimulation were essentially the same on both sides, although the threshold of the contralateral stimulation for evoking the depolarizing potential was usually definitely higher (0.1 msec, 170-180 μA) than that of the ipsilateral stimulation (0.1 msec, 120-130 μA) and often no effect was observed even at the highest intensity (0.1 msec, 300 μA) used in the present study. The depolarizing potential appeared in contralateral jaw closer and opener motoneurons after a latency of 0.6-1.0 msec (0.84±0.13 msec, n=8) and 0.6-1.1 msec (0.88±0.14 msec, n=8), respectively. Thus, it was demonstrated that stimulation of PRF-pc evoked monosynaptic EPSPs non-reciprocally in trigeminal motoneurons on the same side and occasionally also in those on the contralateral side.

118

UNIT ACTIVITY IN MONKEY LATERAL HYPOTHALAMUS AND PREFRONTAL CORTEX DURING BAR-PRESS FEEDING BEHAVIOR. ONO, T., NISHINO, H., SASAKI, K., FUKUDA, M., AND MURAMOTO, K-I. Dept. of Physiol., Toyama Med. and Pharmaceu. Univ., Sugitani, Toyama 930-01.

Unit activity in the lateral hypothalamus (LHA) and the prefrontal cortex (FC) were recorded during monkey bar-press feeding behavior which comprised three stages: i) discrimination of food ii) drive to obtain food and iii) ingestion reward. Results were: 1) Of 199 LHA neurons 23 responded only in the discrimination stage. 2) Thirty-three responded in the reward stage. These reward responses disappeared when either an aversive food was given, the monkey became satiated, or glucose or morphine was injected. 3) Thirteen neurons responded throughout the three stages, and 8 of these responded selectively at the sight of food but not to non-food items. 4) Of 167 FC neurons 28 responded in the discrimination stage. The percentage of neurons which responded selectively at the sight of food was almost the same as in the LHA (50%). 5) Twelve of the above mentioned neurons and sixteen others responded during the bar pressing drive stage. 6) Six neurons responded in association with reward anticipation. 7) Eleven neurons responded transiently when the second shutter opened and the animal took the food. The results suggest that the LHA is related to food discrimination, the drive to obtain it and reward perception; the FC is related to food discrimination, the drive to obtain it and reward anticipation.

119

UNIT RESPONSES IN MONKEY CAUDATE NUCLEUS DURING BAR-PRESS FEEDING BEHAVIOR. NISHINO, H., ONO, T., SASAKI, K., FUKUDA, M., AND MURAMOTO, K-I. Dept. of Physiol., Toyama Med. and Pharmaceu. Univ., Sugitani, Toyama 930-01.

Unit activity in the head of the caudate nucleus of the monkey was recorded during bar-press feeding behavior and the relations were investigated. The feeding paradigm consisted of three stages: i) food discrimination stage after an opaque shutter was opened; ii) bar pressing drive stage to open a second, transparent shutter; iii) ingestion reward stage after the second shutter opened and the animal received and ate food. Results were: 1) Of 400 neurons recorded, 106 responded in one or more stages of the feeding task. 2) Fifty-seven neurons (37, excitation; 20, inhibition) responded in the discrimination stage. 3) Of 45 neurons tested for both food and non-food items, 18 responded selectively at the sight of food, with different responses depending on the kind of food. 4) Latencies of specific responses for food were 150-250 msec, and less than 150 msec for non-specific responses. 5) Seven neurons changed firing rate during each bar-press movement, and 27 responded throughout all bar-press stages uncorrelated to bar press movement. 6) Sixteen neurons responded transiently when the second shutter opened. 7) Forty neurons responded during ingestion. The results suggest that the CD may be important in food or reward recognition and in motivation of behavior to obtain food.

120

AXONAL PROJECTION OF AND SYNAPTIC INPUTS TO EXCITATORY BURST NEURONS RELATED TO FAST EYE MOVEMENTS. SASAKI, S. AND SHIMAZU, H. Dept. of Neurophysiol., Inst. of Brain Res., Sch. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

Spike activity of excitatory burst neurons (EBNs) related to ipsiversive quick phases of horizontal vestibular nystagmus was recorded in the dorsomedial reticular formation immediately rostral to the abducens nucleus in encéphale isolé cats under local anesthesia. Postspike average of ipsilateral abducens nerve discharges triggered from spikes of single EBNs showed facilitation of motoneuronal activity with a monosynaptic latency, indicating that EBNs make monosynaptic excitatory connection with ipsilateral abducens motoneurons. By antidromic microstimulation in the wide area of the caudal brain stem, it was revealed that these EBNs sent their axon collaterals ipsilaterally to the dorsomedial reticular formation caudal to the abducens nucleus and the medial vestibular nucleus, where inhibitory burst neurons (IBNs) and type I and II vestibular neurons were located. Microstimulation confined to the EBN area excited IBNs and type II neurons monosynaptically and inhibited type I neurons. EBNs were activated in a burst fashion by stimulation of the superior colliculus and optic and vestibular nerves. It is likely that visual and vestibular inputs converge upon EBNs and that this convergence provides a neural basis for a common feature of both visual- and vestibular-induced fast eye movements by operating brain stem premotor mechanisms.

121

MORPHOLOGY OF INTRASPINAL BRANCHES OF ELECTROPHYSIOLOGICALLY IDENTIFIED RUBROSPINAL NEURONS IN THE CAT. SHINODA, Y., YOKOTA, J*, FUTAMI, T*. Dept. of Physiol., Tokyo Medical and Dental Univ., Bunkyo-ku, Tokyo, Dept. of Neurophysiol., Brain Res. Inst., School of Med., University of Tokyo, Bunkyo-ku, Tokyo.

Rubrospinal axons (RS axons) in the lateral column of the cervical spinal cord were penetrated and they were identified by direct responses to stimulation of the contralateral red nucleus. After electrophysiological identification of RS axons, 10% HRP in 0.05M Tris·HCL buffer (pH=8.5) with 0.2M KCL was injected iontophretically through a recording microelectrode. Using serial sections stained with DAB method, axonal trajectry of a single RS axon was reconstructed three-dimensionally. Axon collaterals from a stem axon ran medioventrally and entered the gray matter. Then, they ramified succesively and spread rostrocaudally or caudally in a delta-like fashion. This wide rostrocaudal extension of each axon collateral (1-5mm) is one of the characteristic features of RS branching. These branches spread in the intermediate zone of the gray matter (laminae IV to VII of Rexed). Terminal boutons were found not only in the lateral but also in the medial portion of the intermediate zone. In one case, terminal boutons were identified in lamina IX.

122

PREMOTOR NEURONS IN THE CAT MESODIENCEPHALIC JUNCTION CONTROLLING INFERIOR RECTUS MOTONEURONS DURING VERTICAL EYE MOVEMENTS. S. NAKAO AND Y. SHIRAISHI. Dept. of Physiol., Tottori Univ. Sch. of Med., Yonago.

Extracellular spikes of single neurons, which showed a distinct direction sensitivity related to vertical vestibular nystagmus and spontaneous eye movements, were recorded in the medial mesodiencephalic junction of cats anesthetized lightly with ketamine hydrochloride. These neurons were classified into 3 main groups according to their firing patterns during the eye movements. Spike-triggered averaging of inferior rectus nerve potentials demonstrated that most of the neurons controlled ipsilateral or bilateral inferior rectus motoneurons presumably with their monosynaptic excitatory or inhibitory connections. Histologically, they were mostly located in the small area ventral to the central gray and medial to the fasciculus retroflexus. Some of the neurons were also found within the ventralmost central gray and on the lateral border of the fasciculus retroflexus. This area approximately corresponds to the rostral iMLF (Büttner-Ennever, 1977) and nucleus of the prerubral field (Graybiel, 1977).

123

PROJECTIONS FROM THE VESTIBULAR NUCLEUS TO THE CAUDAL PART OF THE DORSAL NUCLEUS OF THE RAPHE IN CATS.

KAWASAKI, T., SATO, Y., Dept. of Physiol., Fac. of Med., Toyama Medical and Pharmaceutical University, Sugitani, Toyama.

Horseradish peroxidase (HRP) was iontophoresed into the cerebellar flocculus in cats. Labeled neurons were recognized in the caudal part of the dorsal nucleus of the raphe (DNR) bilaterally. Electrical stimulation (pulse width, 0.05 msec) of the flocculus elicited antidromic unitary responses in the caudal part of DNR of which the latency and the threshold current was 1.1 msec and 50 uA, respectively.

HRP was injected iontophoretically into the caudal part of DNR. Labeled neurons were located in the medial (MVN) and the superior vestibular nucleus (SVN) bilaterally. Electrical stimulation of MVN or SVN elicited field potentials in the caudal part of DNR bilaterally which were characterized by a negative potential occuring at a peak latency of 1-1.5 msec. The lowest threshold current to evoke the field potentials was 50 uA. Furthermore, electrical stimulation of the contralateral MVN or SVN elicited orthodromical unitary responses in the caudal part of DNR. These findings strongly suggest that the vestibular nucleus may project to the caudal part of DNR. These projections may be involoved in eye movement control.

124

PARTICIPATION OF A1 NEURONS OF THE MEDULLA OBLONGATA IN GONADOTROPIN SECRETION

KABA, H., SAITO, H. and SETO, K. Dept. of Physiology, Kochi Medical School, Nankoku
AKEMA, T. and KAWAKAMI, M. Dept. of Physiology, Yokohama City University School of Medicine, Yokohama

There is extensive evidence that noradrenaline(NA) in the medial preoptic area(MPOA) may regulate or modulate the release of gonadotropins during the estrous cycle in female rat. Recently Trevor et al. demonstrated that the NA innervation of the MPOA was derived solely from the A1 and A2 cell groups of the medulla oblongata. We were therefore designed to identify electrophysiologically the neurons of A1 area which projected to the MPOA, and furthermore to record the spontaneous discharges of their neurons for several hours under urethane anesthesia. Neurons of A1 area activated antidromically by MPOA stimulation were classified in two groups according to the conduction velocity and the shape of their action potentials. Type I cells had faster conduction velocities(average:1.8m/sec) and short spike durations. Type II cells had slow conduction velocities(average:0.39m/sec) and long spike durations similar to the noradrenergic neurons of locus coerulei. During the proestrus the units recorded from type II cells were faster firing rate than during the estrus or diestrus. These results suggest that the increased firing of type II cells at proestrus may be related to gonadtropin secretion.

125

SUPRAOPTIC NEUROSECRETORY NEURONS: AFFERENT PATHWAYS FROM THE CAROTID SINUS NERVE, THE AORTIC NERVE AND THE NUCLEUS TRACTUS SOLITARIUS IN THE CAT.

KANNAN, H. AND KOIZUMI, K.* (Dept. of Physiol., Univ. of Occup. Environ. Health Sch. Med., Kitakyushu, 807, *SUNY Downstate Med. Center, Brooklyn, N.Y., U.S.A.)

The effects of electrical stimulation of the carotid sinus nerve(CSN), the aortic nerve (AN) and the nucleus tractus solitarius(NTS) on spontaneous discharges of supraoptic neurosecretory neurons were examined in nembutal-anesthetized cats. Stimulation of the CSN produced excitation and inhibition of spontaneous discharge in 38 and 10 of the 78 units tested, respectively. Stimulation of the AN produced excitation in 6 and inhibition in 9 of the 35 units tested. About one-third of the units tested responded to each of CSN and AN stimulation. Stimulation of the NTS area, identified electrophysiologically as the site of termination of the CSN and AN, produced excitation in 45 and inhibition in 22 of the 133 units tested. The units responded to NTS stimulation could be divided into two groups with regard to the latency: those with a latency of 10-30 msec and those with a latency of 40-120 msec. The majority of units showed an excitation after a latency of 40-120 msec. These data suggest that both "fast" and "slow" pathways between the NTS and supraoptic neurosecretory neurons exist and impulses travelling through the latter pathway from the CSN or AN affect the large proportion of supraoptic neurosecretory neurons.

126

ADH NEURONES: SYNAPTIC INPUTS FOLLOWING AMYGDALA STIMULATION IN RATS

HAMAMURA, M. AND YAGI, K. Dept. of Physiol., Jichi Med. Sch., Tochigi

Stimulation of medial nucleus area (MA) of the amygdala in urethane-anaesthetized male rats excited 5 and inhibited discharge of 1 of the 15 phasically firing cells. Basomedial nucleus area (BMA) stimulation produced inhibition of discharge in 3 and no response in the remaining cells tested. In more than a half of the 68 randomly firing neurosecretory cells tested, stimulation of both amygdalar areas produced excitation or inhibition of firing. Stimulation of supraoptic area did not evoke antidromically conducted spike in the 25 units recorded in the medial amygdala. Since phasically firing neurosecretory cells in rats have been identified as ADH-secreting neurone, the present data clearly show that ADH-secreting neurones in the rat supraoptic nucleus receive synaptic inputs both from MA and BMA via polysynaptic pathways. The present finding that ADH cells receive predominantly excitatory inputs from MA agrees with the reported data on ADH release evoked by MA stimulation. The data obtained in randomly firing cells suggest the possibility that oxytocin-secreting neurones also receive synaptic inputs from the medial parts of the amygdala.

127

SPECIFIC UNIT ACTIVITY IN THE DIAFFERENTED HIPOTHALAMIC ISLAND (PART.II)

H.SAITO, H.KABA, A.USHIKOSHI, M.FUJITA & K.SETO
Dept. of physiol., Kochi Medical School, Nankoku

Long-term recording of the single unit activity in the Basal-medial hypothalamus(BMH), Medial preoptic area(MPO) and Supra-chiasmati uncleus(SCH) was studied in light urethan anaesthetised rats intact female, maintained in the constsnt illumination(CI), or previously operated for the complete or incomplete deafferentation of BMH and MPO. 1) Pulsatile Patterns of frequency fluctuation(impulses/30 seconds) have been exhibited in neurons of BMH, MPO and SCH under the intact or CI conditions. 2) In recording periods over 24 hours, these pulsatile cycle lengths of unit firing fluctuation showed various rages from 10 to 100 minutes and few activities of BMH neurons appeared being relatively constant cycle lengths of 40 minutes. 3) Some SCH neurons behaved phasically active firing for a brief period following the scilent phase over half an hour long without any relationship to intermittent changes of sleep-wakefulness. 4) After complate deafferentation of the BMH or MPO, most of those neural activities showed contanuously firing patterns without fluctuation. 5) Inthe case of incomplete deafferntation, most neurons of the BMH and MPO showed fluctuateless patterns, but small numbers of them behaved pulsatile ones 3 months after surgery. Results suggerst that pulsatile changes of frequency in BMH and MPO should be modified by the outside parts of BMH and MPO like the limbic area.

128

VAGAL AFFERENT FIBER PROJECTIONS TO THE DORSAL MOTOR NUCLEUS OF THE VAGUS NERVE.

NOSAKA, S., Dept of Physiol., Fukui Med. Sch., Fukui.

Electrophysiological studies on preganglionic neurons (PGN) in the dorsal nucleus (DN) of the vagus nerve (VN) are subject to considerable technical limitations. Conventional electrical stimulation of VN with cathodal square-wave pulses would activate afferent fibers which constitute more than 80 % of VN and part of the anticipated antidromic responses (AR) of PGN would be blocked by collision with earlier arriving orthodromic responses (OR) thus evoked. Analysis of mode of projections of the vagal afferent fibers to PGN is neither allowed with a conventional stimulation method. In the present study, a block method using anodal triangular stimulus pulses (ATSP, Accornero at al.) was employed in combination with collision testing to effectively eliminate such difficulties. 1. In chloralose-urethane anesthetized rats, unitary responses were recorded to electrical stimulation of VN. When OR were recorded to conventional stimulation, application of ATSP, which blocked the OR, revealed an AR. 2. Some units which produced AR to conventional stimulation, turned to show OR to spontaneous-spike triggered stimulation which blocked the AR due to collision otherwise masking the OR. Similar effects were obtained by application of ATSP. 3. OR, i. e., vagal afferent fiber projections were recorded in 37 % of the identified PGN, mostly due to C and only partly, A fiber activations. All these projections were of polysynaptic nature.

129

EFFECTS OF REPETITIVE STIMULI ON THE NEURONAL ACTIVITY IN THE VENTROBASAL THALAMIC NUCLEI.

AIKAWA, S., OHTA, K., AKITA, H., MEGURO, Y. AND KOBAYASHI, S* Dept. of Physiol. Sch. of Hygenic Sciences, Kitasato Univ., Sagamihara, Kanagawa and Dep. of Physiol., Seishin-Igaku Inst., Itabashi-ku, Tokyo*

Neuronal discharges in the ventrobasal thalamic nuclei of the cats were recorded extracellulary, using single or multi-microelectrod technique.

The recordings of spontaneous neuronal discharges were done without any exteroceptive stimulus, then repetitive electrical stimuli with various frequency were applied on the contralateral body surface through the bipolar electrodes thrust into the skin of the receptive fields of the neuron recorded or other regions.

In the experimental time course, changes of unitary firing rate and firing pattern were observed without any stimulus. Also, changes of latency and spike number of evoked unitary responses, waxing and waning-like phenomenon, to each stimulus were observed by long-time repetitive stimuli, both electric and natural.

130

FUNCTIONAL CONNECTIONS BETWEEN THE MESENCEPHALIC LOCOMOTOR REGION AND THE MIDLINE STRUCTURES OF THE PONS WHICH CONTRIBUTE TO THE SETTING OF POSTURAL TONUS IN THE LOCOMOTOR PREPARATION.

S. MORI, K. KAWAHARA, T. SAKAMOTO, T. TOMIYAMA* Dept. of Physiol., Asahikawa Med. Coll., Asahikawa; Dept. of Otolaryngol., Asahikawa Med. Coll., Asahikawa*

Stimulations delivered to the cuneiform nucleus (mesencephalic locomotor region, MLR) elicit presumably inhibitory and facilitatory effects upon the spinal stepping generator (Mori et al.,1980). For this two possibilities may be proposed. First is that such dual effects originate within the MLR or from the adjacent structures to it. Second is that dual effects are relayed through the dorsal (DTF) and the ventral (VTF) structures of the pons. These pontine structures have already been demonstrated to exert inhibitory and facilitatory effects upon the level of postural tonus (Mori et al.,1981). To further study these possibilities, systematic microstimulations in and around the MLR were delivered and the locomotor effects elicited were analyzed. At P2 to P3 level, stimulations to the dorsal structures of the MLR elicited controlled locomotion. Within the period of continued MLR stimulation, however, postural tonus of the animal gradually decreased and locomotion stopped. Electrolytic lesions of these stimulus sites partly corresponded to the position of the nucleus locus coeruleus (LC). Since DTF stimulations possibly activate passing fibers connecting the bilateral LC, the inhibitory MLR effect could be considered to be relayed through the LC to the spinal cord.

131

VESTIBULO-SYMPATHETIC RESPONSE FROM CEREBELLAR EFFECT.

T. ISHIKAWA, T. MIYAZAWA and T. FUJIWARA. Dept. of Physiol., Nihon Univ. Sch. Med., Itabashi, Tokyo.

Low intensity stimulation of the vestibular and cutaneous nerves in chloralose-urethan anesthetized succin immobilized cats was used to record the activity of the left renal nerve. The basilar artery was tied up at the trigeminal nerve level of the midbrain, bilateral carotid sinuses crushed, and carotid arteries clamped to produce anemic decerebration. The results of vestibular conditioning and cutaneous testing stimulation showed that under decerebration the recovery curve had the same form, but the recovery time was uniformally shorter, although this returned to almost normal a few minutes after the clamp was removed. Furthermore, when cerebellar stimulations using two fine iron electrodes were given simultaneously to the vermis of the posterior lobe and either the vestibular or cutaneous nerve, the longer inhibitory phase of the renal nerve response only showed a significant change in a few cases. Although strong cerebellar stimulation produced long inhibitory effects on the renal nerve response, this was almost certainly due to stimulus current spread, unless weak stimulus applied this was no longer observed after transection of the crus cerebelli. Effective cerebellar stimulation was consequently calculated to be accurate up to 500uA in this experiment.

132

ACTIVITY CHANGES OF SUPRAOPTIC NEURONS INDUCED BY ELECTRICAL CHEMICAL AND MECHANICAL STIMULATION OF MUSCLE AFFERENTS. YAMASHITA, H., KANNAN, H., INENAGA, K. AND KOIZUMI, K*. (Dept. of Physiol., Univ. of Occup. Environ. Health Sch. Med., Kitakyushu, 807, *SUNY Downstate Med. Center, Brooklyn, N.Y., U.S.A.)

Muscular exercise is known to cause an increase in the plasma ADH level. We examined reactions of neurosecretory neurons in the supraoptic nucleus(SON) to activation of the gastrocunemius muscle afferents by various stimuli in anesthetized, sinus-vagoaortic nerve sectioned cats. While electrical stimulation (3 pulses at 100 Hz) of group I fibers of the muscle nerve did not influence SON neuronal activities, activation of group III and IV fibers excited SON neurons after a latency of 80-100 msec. This excitation was followed by a long lasting inhibition. Injections of chemicals (4.5% NaCl, 7.5 mg KCl and 1.2 μg of bradykinin in 0.3 ml Locke's solution) into the artery to the gastrocunemius muscle excited SON neurons. The excitation disappeared after denervation of the muscle nerves. SON neurons were also excited by muscle contraction following electrical stimulation of the ventral lumbar roots after a latency of 80-100 msec. We conclude that when large numbers of small afferents in muscle are activated by chemical, mechanical and nociceptive stimuli during exercise, SON neurons are excited, leading to an increase in ADH secretion.

133

Properties of vestibular projecting neurons in the rostral midbrain of the cat. Fukushima,K., Ohno,M., Takahashi,K. and Kato,M. Dept. Physiol. Hokkaido Univ. Sch. Med.

Experiments were performed on cats anesthetized with α-chloralose to locate neurons in and around the interstitial nucleus of Cajal (INC) that project to the vestibular nuclei (VN) and to study labyrinthine inputs to these neurons. Vestibular projecting neurons were identified by weak stimuli applied in the VN and the strength of threshold currents for antidromic activation was too weak to spread to the nearest reticular formation or MLF. Lowest threshold points were within the VN when stimulating electrodes were moved dorsoventrally. Such neurons were found in the INC and reticular formation rostral, dorsal and caudal to the INC. Median conduction velocity of these neurons was estimated to be around 12 - 17 m/s. 20 % of these neurons were vestibular branching spinal projecting neurons. Stimulation of the contralateral and ipsilateral whole vestibular nerves excited 32 and 14 % of vestibular projecting neurons. Stimulation of contralateral individual semicircular canal nerves revealed that these neurons responded to stimulation of the vertical canals, but not the horizontal canal. Stimulation of the ipsilateral semicircular canals did not excite any cells tested; a few cells were inhibited by stimulation of vertical canals. Vestibular branching spinal projecting neurons rarely received labyrinthine inputs. These results suggest that vestibular projecting neurons may be involved in vertical vestibular reflexes.

134

INHIBITORY EFFECT OF CUTANEOUS STIMULATION UPON NOCICEPTIVE REFLEX. Y. YAMAGUCHI, W. YASUMO, A. NISHIGORI, M. KAWAMOTO and T. TSUJIMOTO*. Laboratory of Clinical Physiology, College of Biomedical Technology and Psychiatric Clinic of Health Administration Center*, Osaka University, 1-1, Machikaneyama-cho, Toyonaka, Osaka

The authors examined effects of cutaneous stimulation upon nociceptive reflexes, such as human blink reflex (BR) induced by supraorbital nerve stimulation and rat jaw opening reflex (JOR) evoked by tooth pulp stimulation. The reflex EMG's were recorded from the orbicularis oculi and digastric muscles, respectively. Cutaneous stimulation (CS) was single pulse electrical one and was given through needles inserted into the skin. 1) Late components of BR (latency at 20 - 40 msec) were inhibited by the preceding CS. The inhibition showed maximal effects at 80 - 150 msec after the CS and lasting for up to 1 - 2 sec. 2) JOR was suppressed completely at 50 - 100 msec after the CS and recovered in about 200 msec. 3) The inhibition was evoked from everywhere of the body surface, but the effects were more remarkable in fore- or hind-paw than belly or back stimulation.

It was suggested that the cutaneous inhibition of nociceptive reflexes played a role in so called acupuncture analgesia.

135

The afferent pathway of acupuncture analgesia(AA) was explored by 1) lesions of supposed acupuncture afferent pathways abolished AA, 2) stimulation of such pathways caused long lasting naloxone reversible analgesia exceed stimulation period and 3) evoked potentials were recorded from such pathways by acupuncture stimulation. As a result, A) the dorsal periaqueductal central gray(PAG), the anterior, posterior and lateral hypothalamus, the lateral septum, the cingulate bundle, the dorsal hippocampus, the habenulo-peduncular tract and the medial centromedian nucleus of thalamus were found as acupuncture afferent pathways. 0.5 mg/kg morphine analgesia was also abolished by lesion of these regions. Hypophysectomy abolished AA and 0.5 mg/kg morphine analgesia(MA) and stimulation-produced analgesia(SPA) of these regions. Lesion of the lateral centromedian nucleus of thalamus(l-CM) augemented AA, MA and dorsal PAG-SPA, and not augemented SPA caused by stimulation of other regions. Abolished AA and MA by lesions of above stated regions except anterior hypothalamus reappeared after lesion of l-CM, however those by lesion of the anterior hypothalamus did not appear. Stimulation of l-CM completely abolished AA, MA and dorsal PAG-SPA during stimulation in lesioned animals of these regions except anterior hypothalamus and partially abolished these analgesia in non-lesioned animals. These data indicate that there exist two kinds of acupuncture afferent pathways. One is inhibited, the other is not inhibited by analgesia inhibitory system. Endogenous analgesic peptides might be liberated from hypophysis.

136

Both acupuncture analgesia(AA) and dorsal periaqueductal central gray stimulation-produced analgesia(dorsal PAG-SPA) were completely blocked by naloxone, tetrabenazine or by lesions of both raphe magnus and reticular gigantocellular nucleus(NRGC) and were partially antagonized by methysergide or by lesion of raphe dorsalis, raphe magnus or NRGC. Ventral PAG-SPA and raphe magnus SPA were completely antagonized by methysergide. NRGC-SPA was completely abolished by intrathecally applied phentolamine. AA and 0.5 mg/kg intraperitoneally applied morphine analgesia were completely abolished by lesion of bilateral anterolateral tract(ALT) and by unilateral lesion of ALT when acupuncture stimulation was applied to the contralateral site. Analgesia caused by intrathecally applied 0.05 μg morphine was equal to that caused by 0.5 mg/kg intraperitoneally applied morphine in effective animals which were classified by a significant increase($P<0.05$) of tail-flick latency. Intraperitoneally applied morphine(0.5 mg/kg) analgesia was completely antagonized by intrathecally applied 0.2 μg naloxone. Analgesia caused by large amount of morphine(0.2μg intrathecal application) was not abolished by lesion of ALT completely. These data indicate that the ALT and the dorsal PAG are the afferent pathways and serotonergic and noradrenergic pathways originated from raphe magnus and NRGC respectively are the efferent pathways as descending pain inhibitory system. It was suggested that morphine analgesia of small dose was caused by activation of acupuncture afferent pathway originated in the spinal cord.

137

EVOKED POTENTIALS AND EXTRACELLULAR POTASSIUM ION ACTIVITY OF THE TRIGEMINAL NUCLEI FOLLOWING TOOTH PULP STIMULATION

SAKAGUCCI, M. AND SATOH, T. Dept. of Physiology, Sch. of Dentistry, Aichi-Gakuin Univ.

Electrical stimulation of the tooth pulp of the cat evokes a negative slow potential in the trigeminal sensory nuclei, and at the same time a positive slow potential in the trigeminal motor nucleus. Potassium ion-sensitive microelectrode was inserted into these nuclei under pentobarbital anesthesia. There was no obvious change in K ion activity during the occurrence of negative or positive evoked potentials. Only in rare occasions, however, a slight increase in K ion activity was observed during positive evoked potentials. The paucity of change in extracellular K ion level during evoked potentials would indicate (1) that the sensory neurons responding to tooth pulp stimulation are not compactly assembled together to allow extracellular accumulation of K ions which is detectable by the probe used, and also (2) that the IPSPs evoked in the jaw-closer motoneurons may not be caused by the permeability change for K ions.

138

RESPONSES OF TRIGEMINAL NEURONS WITHIN SUBNUCLEUS RETICULARIS VENTRALIS MEDULLAE OBLONGATAE TO PERIPHERAL STIMULI. YOKOTA, T. AND KOYAMA, N. Dept. of Physiol., Shiga

Trigeminal nociceptive neurons were found within subnucleus reticularis medullae oblongatae which is deep to subnuclei caudalis and reticularis dorsalis medullae oblongatae. These neurons were regularly excited by strong mechanical stimulation of the ipsi- or bilateral cornea. Many of them were also activated by noxious mechanical stimulation of the ipsi- or bilateral pinna, by tapping the ipsilateral nose and/or electrical stimulation of bilateral tooth pulp afferents. Some of them responded with spike discharges to firm pressure applied to the ipsi- or bilateral face. Antidromic stimulation of the contralateral posterior thalamus excited some neurons of this category. Neurons with similar receptive field characteristics were also found within lamina 7 of the first cervical segment of the spinal cord.

In conclusion, there are trigeminal nociceptive neurons within subnucleus reticularis ventralis medullae oblongatae. The present data suggest that medullary lamina 7 is located within this subnucleus.

139

REFLEX PATTERN OF THE SALIVATORY NEURONS BY THE STIMULATION OF THREE TRIGEMINAL NERVE BRANCHES IN THE CAT. MURAKAMI, T., YOSHIHARA, M., ISHIZUKA, K. AND UCHIYAMA, M. Dept. of Oral Physiol., Nippon Dental Univ., Niigata, Niigata

This study was undertaken to define reflex pattern of the salivatory neurons by the stimulation of three trigeminal nerve branches in urethan-chloralose anesthetized cat. A total of 71 salivatory neurons were identified by the antidromic stimulation of chorda tympani. The latency of these antidromic responses distributed from 4.2 msec to 15.6 mesc. These salivatory neurons were roughly classified into four types according to the responsiveness by electrical stimulation of the ipsilateral each three trigeminal nerve branches (the lingual, infraorbital and inferior alveolar nerve), which were non response type (28%), single projected type (8%), double projected type (17%) and triple projected type (46%). These antidromic response could not classified as regards its latency on the non response and each projected units. This result may be showen that these types were not due to the size of cell soma. These projected type neurons recieved the input from Aβ fibers (about 50%) and Aδ fibers (about 50%). We could not record from C fibers. Moreover, the triple projected neurons were tend to recieve similar kind of trigeminal sensory input.

140

THE ROLE OF THE INFERIOR OLIVE IN THE GENESIS OF CEREBELLAR "GROUPED POSITIVE WAVES"
SHIMONO, T., HATADA, K*. AND OZAKI, A. Dept. of Physiol. and Dept. of Psychiatry*, Fac. of Med., Kyoto Univ., Kyoto

In lightly nembutalized cats, the grouped positive waves recorded mainly in the intermediate part of the cerebellum are induced due to the spindles of the motor cortex. The neuronal pathway responsible for the waves was studied as follows. 1. The waves disappeared after ablation of the contralateral inferior olive or the ipsilateral inferior cerebellar peduncle to the recording side of the cerebellum. 2. Grouped unit discharges of the medullary pyramidal tract fibers were recorded in synchronization with the waves of the contralateral cerebellum and the spindles of the motor cortex. 3. Inferior olivary neurons projecting to the intermediate part of the cerebellum fired in a cluster to be coincident with the waves and the spindles. 4. Complex spikes (climbing fiber responses) of Purkinje cells increased their frequency during the waves, while simple spikes (mossy fiber responses) of them showed a tendency to be suppressed during the waves. Discharge patterns of other neuronal elements in the cerebellar cortex underwent little changes during the waves. These facts in addition to the depth analysis of the waves reported previously indicate that the grouped positive waves might be due to the synchronized climbing fiber excitation of Purkinje cells mediated by the pyramidal tract-inferior olive-cerebellar pathway from the motor cortex.

141

PLURAL FACTORS CONTROLLING BRAIN CIRCULATION MEDIATED BY CEREBELLAR FASTIGIAL NUCLEUS.
NAKAI, M. AND REIS, D.J.* Dept. of Cardiovasc. Dynamics, Natl. Cardiovasc. Ctr. Res. Inst., *Neurol. Cornell Univ. Med. College.

Activation of the fastigial nucleus (FN) produces a pressor response with active brain vasodilatation. The regionally different brain vascular responsivity and its responsible mechanisms are yet to be determined. A total of 59 anesthetized and ventilated rats were investigated for regional cerebral blood flow (rCBF) and glucose metabolic rate (rGMR) by uses of Kety's and Sokoloff's principles, respectively. Electrical stimulation of the FN caused a widespread but regionally uneven increase in rCBF. The response was not significantly affected by acute cervical sympathectomy and cordotomy at C_1 level. Disproportional and proportional increases in rCBF to increases in corresponding rGMR resulted under FN stimulation. The cerebral cortices showed an increase in rCBF with a negligible change in rGMR. In contrast the CBF responsivity of the thalamic nuclei was perfectly accounted for by an increase in rGMR. We conclude: (a) the sympathetic nerve and peripheral systems play a minor role in the brain circulation under FN stimulation; (b) the metabolic mechanism activated by stimulation predominantly drives the vessels in regions innervated by the monosynaptic projections from the FN; and (c) in the cortices the evoked vasodilatation is almost totally mediated possibly by the neurogenic control.

142

TAURINE : TRANSMITTER OR MODULATOR IN THE CEREBELLUM?
SAKAI, Y. AND OKAMOTO, K. Dept. of Pharmacology, National Defense Medical College, Tokorozawa, Saitama, 359.

The inhibitory action of taurine on spike discharges of Purkinje cells in guinea-pig cerebellar slices was studied in comparison with GABA, β-alanine and glycine. The possibility of taurine as a transmitter in stellate interneurons is discussed. 1) The frequency of spontaneous spikes(extracellularly recorded) of Purkinje cells was dose-dependently suppressed by taurine(ED50=1mM). Taurocyamine was about 6 times stronger than taurine(ED50=0.16mM) and hypotaurine was a half as potent as taurine(ED50=2.2mM) in inhibiting spikes, while L-cysteine sulfinic acid was excitatory. 2) The results obtained under modified ionic conditions suggested that taurine may change membrane permeabilities to Cl^-, K^+ and probably to Na^+. 3) The inhibitory action of taurine was antagonized by not only strychnine but also picrotoxin and bicuculline. 4) Iontophoresis of taurine onto cerebellar molecular layer showed most sensitive sites to taurine were situated at 60-80μm and 220-240μm and those to GABA were at 0μm and 160-180μm apart from the Purkinje cell body. 5) High external Ca^{++}potentiated the inhibitory actions of both taurine and GABA in apparently similar manners. 6) The uptake of $^{45}Ca^{++}$ by cerebellar P_2 fraction was suppressed markedly by taurine and weakly by GABA and L-glutamate. 7) The level of cyclic AMP in cerebellar slices was little affected by taurine.

143

THE ROLE OF THE CLIMBING FIBER INPUT IN CEREBELLAR DEPRESSANT ACTION ON RENAL SYMPATHETIC NERVE ACTIVITY IN RABBITS.

NISIMARU, N., NAGAO, S.* AND KAWAGUCHI, Y.* Dept. of Physiol., Miyazaki Med. Coll., Miyazaki and *Dept. of Physiol. Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

Stimulation of the medial zone of cerebellar anterior and posterior lobules (II, III_A, III_B, VIIa and $VIII_a$) produces a marked depression of sympathetic nerve activity to the ipsilateral kidney (Nisimaru, N. and Yamamoto, M.,1977; Nisimaru, N. and Shimoyama, I., 1979). In the present study, the effect of the climbing fiber input to this depressant action of cerebellar posterior lobules was studied by electrically stimulating the inferior olive nucleus in α-chlorarose-urethane anesthetized rabbits. The stimulation of the caudal part in the medial accessory olive elicited the climbing fiber responses on the A zone of contralateral cerebellar posterior lobules VII_a and $VIII_a$ as well as producing the depression of sympathetic nerve activity to the contralateral kidney. After ablation of cerebellar posterior lobules VII and VIII, the depression of sympathetic nerve activity to the kidney caused by the stimulation of the caudal part of medial accessory olive disappeared. These results indicate that the sympathetic renal nerve activity is inhibited by the Purkinje cells in the A zone of cerebellar posterior lobules VII and VIII, and at least a part of the input information to these Purkinje cells is mediated through the climbing fiber from the caudal part of medial accessory olive.

144

AXONAL REGENERATION OF AXOTOMIZED CEREBELLOTHALAMIC PROJECTION NEURONS IN KITTENS.

KAWAGUCHI, S., MIYATA, H., KAWAMURA, M. AND HARADA, Y. Dept. of Physiol., Inst. for Brain Res., Fac. of Med., Kyoto Univ., Kyoto

Regenerative capacity of axotomized cerebellothalamic projection neurons was examined morphologically and electrophysiologically in 24 kittens ranging in age from 3 to 66-day-old. In these animals, the decussation of the superior cerebellar peduncle was transected sagittally at the midline by a trilateral tungsten wire bearing an edged bottom and two parallel lateral sides. The tungsten wire was left in the brain, as it was, until histological examination. In each anaimal, after 10 to 125 postoperative days, HRP was injected into the lateral and interpositus nuclei of the cerebellum for anterograde labeling of cerebellothalamic projection fibers and terminals; and responsiveness of the cerebral cortex to stimulation of the cerebellar nucleus was examined 20-30 hours after the HRP injection. Fibers labeled with HRP were seen, in some cases, to cross over the midline area enclosed with the trilateral tungsten wire and to ascend the brain stem to terminate in the red nucleus and the thalamus. Marked cerebello-cerebral responses were evoked in these animals. The results proved that axonal regeneration with functioning synapses on the thalamocortical projection neurons can occur in the axotomized cerebellothalamic neurons.

145

LOCALIZATION OF CEREBELLAR PURKINJE CELLS RELATED TO WRIST TRACKING MOVEMENT IN RHESUS MONKEY.

MANO, N. and I.KANAZAWA* Dept of Neurophysiol., Tokyo Metropolitan Inst. For Neurosci. * Dept. of Neurosurg., Med. Sch., Tokyo Univ. , Tokyo

Discharges of about two hundred Purkinje cells (P-cells) were recorded from one cerebellar hemisphere, during the performance of visually guided wrist tracking movement. Of these cells, sixty P-cells were selected as response-locked cells by timing analysis of their simple spike frequency modulation in relation to the wrist flexion or extension. The locations of recorded P-cells were estimated by reference lesions made during the experiment. Almost all the response-locked P-cells were located in lobule V. P-cells recorded in lobule IV and VI did not change their spike frequencies in temporal coupling to wrist movement. The response-locked P-cells in lateral hemisphere changed their spike activity 40 to 50 msec. earlier than the P-cells in intermediate zone and the EMG activity change of wrist flexors or extensors. All P-cells in lateral hemisphere and about 90% of P-cells in intermediate zone changed their simple spike frequency in non-reciprocal fassion in association with opposite direction of wrist movement; flexion and extension from a neutral position. All four P-cells, which changed their simple spike frequency in reciprocal fashion with wrist flexion and extension, were located in intermediate zone. Based on these results, we discussed the functional difference between lateral and intermediate parts of cerebellar hemisphere.

146

FUNCTIONAL ROLE OF EXTRAOCULAR MUSCLE AFFERENTS IN THE CONTROL OF EYE MOVEMENTS IN RABBITS.

Kimura, M., Takeda, T. and Maekawa, K. Dept. Physiol., Jichi Med. Sch., Minamikawachi-machi, Tochigi, 329-04

Purkinje cells in the cerebellar flocculus have been demonstrated to receive mossy fiber activation from extraocular muscle afferents and to transfer velocity, direction and position signals of eye movements. To study their functional role in the control of eye movements, the afferent nerve (trigeminal nerve) activity was either temporarily blocked using a cooling device in encéphale isolé rabbits or surgically transected in chronic rabbits and changes of eye movements induced by the nerve block were analysed. Horizontal eye movements were elicited either vestibularly by sinusoidal head rotation (0.01-0.5Hz, p-p 60°) and caloric irrigation or optically by striped drum rotation (0.5-40°/sec). 1) The gain of the vestibulo-ocular reflex and the eye velocity in both slow and quick phase of the vestibular nystagmus were significantly reduced by 20-40% of the control value, particularly in the ipsilateral eye and at a rotation of high frequency (0.5Hz). 2) These effects were eliminated after the ipsilateral flocculectomy. 3) Eye velocity in slow phase of the optokinetic nystagmus was reduced at a drum rotation of high speed (more than 10°/sec). These findings strongly suggested that extraocular muscle afferent activity may serve through the flocculus to improve the temporal characteristics of eye movements in high speed range.

147

RESPONSE CHARACTERISTICS OF FLOCCULUS PURKINJE CELLS TO VESTIBULAR MOSSY FIBER INPUTS IN RABBITS, AND THEIR MODIFICATION BY CONJUNCTIVE CLIMBING FIBER STIMULATION.

ITO, M., SAKURAI, M. AND TONGROACH, P. Dept. of Physiol., Fac. of Med., Univ. Tokyo, Bunkyo-ku, Tokyo 113

Spikes were recorded extracellularly with microelectrodes from Purkinje cells of the flocculus in decerebrate rabbits. Repetitive stimulation of a vestibular nerve at 20/sec for 2.5 sec evoked either a facilitation or a depression in discharge of simple spikes, at about equal rates. Application of sinusoidally frequency modulated pulse trains (frequency, 0.1 Hz; mean rate, 20/sec, amplitude, ± 12/sec) to a vestibular nerve modulated simple spike discharge sinusoidally either in-phase or out-phase with the stimulus waves, corresponding to the facilitation or depression by constant rate pulse stimulation. Conjunctive stimulation of a vestibular nerve, either ipsi- or contra-lateral to the flocculus under observation, at 20/sec and the contralateral inferior olive at 4/sec, for 25 sec, caused a drastic reduction, or even conversion to a depression, of a facilitation evoked from the vestibular nerve involved in the conjunctive stimulation. This effect diminished in about ten minutes after a conjunctive stimulation.

148

INTERLIMB COORDINATION IN CAT LOCOMOTION INVESTIGATED WITH PERTURBATION: A STUDY ON LIMB MOVEMENTS AND CORRELATES IN DEITERS' NEURONES.

MATSUKAWA, K., MINODA, K. AND UDO, M. Dept. of Biophys. Enginr., Faculty of Enginr. Sci., Osaka Univ.

During locomotion of decerebrate and awake walking cats, perturbation (mechanical tap) was applied to the paw dorsum of the left forelimb (LF). When the tap (strength, 50-550gr-wt) was applied during LF stance phase, the duration of the ongoing LF stance phase was shortened by 10%; in the right forelimb (RF), the duration of the concomitant swing phase was shortened by 32%. Cinematographic analysis showed that the shortening of RF swing phase was related mainly to acceleration of extension movement in the late swing phase. An electromyographic (EMG) analysis revealed that, by this tap, EMG activity in RF extensor started well before onset of the elbow extension movement to place down the limb; without the tap, the extensor activity started after onset of the extension. Closely related to changes in phase durations of each forelimb, the period of bisupport where both forelimbs were in stance, was always retained. Deiters' neurones on the right side projecting their axons to the ipsilateral cervical, but not down to the lumbosacral, spinal cord (C-Deiters' neurones), identified antidromically, showed a marked enhancement of impulse discharges by the tap with the shortest latency of 25 ms. This enhancement of C-Deiters' neuronal activity in the RF swing phase manifested a close time relation to, and may contribute to, the earlier onset of RF extensor activity which plays an important role in maintaining bisupport phase after perturbation.

149

VISUAL SIGNALS TO FLOCCULAR PURKINJE CELLS DURING PURSUIT EYE MOVEMENT IN VISUAL ENVIRONMENT.
WARABI, T. AND NODA, H. Dept. Neurosurgery and Neurology, Hokkaido Univ. Sch. Med., Sapporo and Brain Research Inst. Univ. Calf. Los Angeles, USA.

Anatomical data indicate that the flocculus is closely related to eye movement systems. The purpose of this experiment was to examine the activity of floccular Purkinji cells (P-cell) associated with pursuit eye movement (PEM) in visual environment. When the monkey fixate or pursuit a target, multi-spots background (BG) was stational or was moved horizontally. During these performances simple spike activity of floccular P-cell was analized. Two different visual signals related central and peripheral retinal image motion were recognized. The facilitatory signals due to central retinal image motion was converged by the suppressive signals of peripheral retinal image motion. When PEM was performed on the BG, P-cells activities were facilitated to one direction of eye movement, and their modulations were distinguished into two types (phasic type and tonic type). They responded vigorusly to the direction changes of eye movement. The visual signal of peripheral retinal image motion was implied as a feedback signal of eye movement during PEM in visual environment. (Supported by NIH EY-01051)

150

SIGNAL CONTENT OF PURKINJE CELL RESPONSES IN RABBIT'S CEREBELLAR FLOCCULUS TO OPTOKINETIC STIMULI.
MIYASHITA, Y. and NAGAO, S. Dept. of Physiology, Fac. of Medicine, Univ of Tokyo, Tokyo, Japan.

The cerebellar flocculus in rabbits may use feedforward visual signals and/or feedback eye velocity signals to improve dynamic characteristics of optokinetic eye movement responses (OKR). Relative contributions of these inputs were examined by recording from flocculus Purkinje cells (FL P-cells) related to horizontal eye movements. Elimination of visual mossy fiber afferents by chronic, unilateral destruction of nucleus reticularis tegmenti pontis reduced the OKR gain in the contralateral eye to one-third of the control (tested with sinusoidal light slit movement at 0.1Hz by 2.5° peak-to-peak). Concomitantly, the amplitude of simple spike modulation in FL P-cells was reduced to less than one-third of control values. Bilateral lesions of the rostral half of the medial vestibular nucleus reduced the OKR gain to less than one-third of the control, but did not affect simple spike modulation in FL P-cells significantly. These results suggest that feedforward visual signals play a major role in floccular contributions to optokinetic eye movements.

151

THE LONG-LASTING INHIBITION RECORDED FROM THE LATERAL NUCLEUS OF THE AMYGDALA USING BRAIN SLICE TECHNIQUE

TAKAGI. M. AND YAMAMOTO. C. Dept. of Physiol., Faculty of Medicine, Kanazawa Univ., Kanazawa.

Potentials evoked by stimulation of either stria terminalis or the lateral nucleus of the amygdala(LN) were recorded in vitro from thin amygdaloid sections. When two shocks were applied at short intervals, the second response was suppressed. The suppression lasted for about 1 sec in the potential recorded from the LN, whereas it lasted only for 0.1 sec in the pre-striatal area. The inhibitory postsynaptic potentials lasting for 0.3-1 sec were observed in the LN with intracellular recording. Glutamate-induced firing of the neurons in the LN stopped for 0.3-1 sec after stimulation. This long-lasting inhibition was blocked by bicuculline. Therefore, this inhibition was thought to be mediated by gamma-aminobutyric acid.

152

INHIBITORY INTERNEURONS IN THE PIRIFORM CORTEX OF THE RABBIT.

SATOU, M*, MORI, K., TAZAWA, Y. and TAKAGI, S.F. Dept. Physiol., Fac. of Med., Gunma Univ. Maebashi, *Zoological Inst., Fac. Sci., Tokyo Univ., Tokyo.

In principal neurons in the rabbit's piriform cortex (PC) two types of inhibitory postsynaptic potentials (IPSPs) are evoked by volleys from the four different structures in the basal forebrain (olfactory bulb (OB), lateral olfactory tract (LOT), anterior commissure (AC) and deep-lying structures of the PC (DPC)). They are the fast and the slow IPSPs, the former lasting for shorter duration than the latter. Since the fast IPSPs start after relatively long latencies (5.5 $\pm$ 1.3 msec (OB), 5.1 $\pm$ 0.7 msec (LOT), 5.1 $\pm$ 1.8 msec (DPC), 5.8 $\pm$ 1.5 msec (AC)), and since spatial facilitation occurs among the fast IPSPs evoked through the four different pathways, existence of an inhibitory interneuron and convergency of the excitatory synaptic inputs from the four different pathways onto this inhibitory interneurons is suggested. Search for the presumed inhibitory interneurons revealed that they are located in the layer III of the PC, mostly in its deeper part. From these results neuronal circuits responsible for the fast postsynaptic inhibition in the PC are proposed.

153

RESPONSE PROPERTIES OF CORTICAL TASTE NEURONS RELATING THE CORTICAL MECHANISMS OF TASTE PERCEPTION.

YAMAMOTO, T., *YUYAMA, N. AND KAWAMURA, Y. Dept. of Oral Physiol., Osaka Univ. Sch. Dent., Osaka, *Dept. of Oral Physiol., Kanagawa Dental College, Yokosuka

A total of 111 cortical neurons responding to the 4 basic taste solutions (1M sucrose, 0.1M NaCl, 0.03M HCl and 0.01M quinine-HCl) and 8 other taste solutions were isolated between 0.25 and 1.27 mm deep to the cortical surface in Wistar rats. The mean rate of spontaneous discharges of total units was around 2.5 imp./sec and the mean response rate to the 4 basic taste solutions ranged from 3.3 to 6.4 imp./sec. About 90% of these neurons responded to only 1 or 2 of the 4 basic tastes.

A spatio-temporal pattern of neuronal activity has been proposed as a cortical quality coding mechanism, which involves both the differences in response magnitude across neurons and the spatial localization of these neurons in the cortical gustatory area. Correlation coefficients between the responses to a pair of taste stimuli based on the spatio-temporal patterning satisfactorily explained behavioral results obtained by experiments involving a conditioned taste aversion technique.

154

THE SYNAPTIC ORGANIZATION OF THE ANTERIOR OLFACTORY NUCLEUS IN THE RABBIT

TAZAWA, Y., MORI, K. AND TAKAGI, S. F. Dept. of Physiol., Sch. of Med., Gunma Univ.

The anterior olfactory nucleus (AON) receives an afferent projection from the olfactory bulb and projects to ipsilateral- and contralateral-olfactory bulb and several olfactory cortices. In order to study the synaptic organization of the AON, we have recorded extracellular field potentials and intracellular synaptic potentials from the AON following stimulation of the lateral olfactory tract (LOT), the ipsilateral olfactory bulb (IOB) and the anterior commissure (AC) in the urethane anesthetized rabbit. The LOT stimulation elicited an EPSP which was followed by two types of inhibitory potentials. The first type of the inhibitory potential was relatively brief (about 60 msec) and accompanied with an increase in the Cl^- conductance (fast IPSP). In about 60% AON neurons, this fast IPSP was followed by a hyperpolarizing potential with a large amplitude and a very long duration (several hundred msec). The OB stimulation sometimes elicited an antidromic spike superimposed on the same sequence of the synaptic potentials (EPSP-fast IPSP-slow IPSP). These synaptic potentials were quite similar to those reported in the piriform cortex neurons.

155

PROJECTING PATTERN OF THE ORAL TACTILE SENSE AND ITS INDIVIDUAL VARIATIONS IN THE CAT'S FIRST SOMATOSENSORY CORTEX.

K. TAIRA, N. MATSUMOTO, T. SATO AND T.A. SUZUKI. Dept. of Oral Physiol., Sch. of Dent., Iwate Med. Univ., Morioka, Iwate.

As reported previously, tactile sensation of the oral structures projected bilaterally on the anterior coronal gyrus as an inverted image of the mouth, i.e., this projection area was distinguished functionally into two parts of the caudal side (contralateral) and rostral one (ipsilateral) by a mid-line (X) and also divided into the medial side (mandibular) and the lateral one (maxillary) with an approximate parallel line (Y) to the coronal sulcus. In the present paper, the intersecting angle (Ψ) between the coronal sulcus and line X and the cross angle (Θ) between the line X and the line Y were measured as an index of the projecting distortion. Distance (Z) was also measured from the intersecting point of the line X and the coronal sulcus to the cross point of the extended cruciate sulcus and the coronal one, as an index of the positional deviation of the oral projection area. These mean values in 10 adult cats were as follows: $\Psi = 99 \pm 24.6°$; $\Theta = 105 \pm 18.6°$; $Z = 3.4 \pm 1.4$ mm, thus the individual difference was not insignificant. The oral projection area was also studied cytoarchitectonically in 5 cats, after iontophoretical injection of fast green FCF at the recording sites. It was confirmed that the ipsilateral projection area was found in the area 3b.

156

FUNCTIONAL COLUMNS OF NEURONS IN THE FIRST SOMATOSENSORY CORTEX(SI) STUDIED IN CONSCIOUS MONKEYS.

IWAMURA, Y., TANAKA, M., HIKOSAKA, O. AND SAKAMOTO, M. Dept. of Physiol. Toho Univ. Sch. of Med., Omori, Otaku, Tokyo.

The receptive field properties of neurons in the crown of the postcentral gyrus representing hand and fingers were studied. These properties were compared among neurons recorded along each of 22 nearly vertically oriented penetrations. In the majority of these penetrations, neurons of various submodality types such as skin, nail, deep, joint manipulation etc were found one after another along the same electrode track. Sometimes neurons without receptive fields, but activated only during monkey's active tactile performance were mixed. We found that each of these neurons was specified to a particular aspect of hand and finger movements. In some dominantly skin tracks the majority of neurons responded to the moving stimulus and had the directional selectivity. These observations suggest that the columns of neurons in this region of SI are organized functionally to detect particular stimulus features or to signal certain aspects of palpatory behaviors.

157

EFFECT OF OPTOKINETIC STIMULATION ON NEURONS IN THE POSTERIOR PARIETAL ASSOCIATION CORTEX OF THE MONKEY

KAWANO, K. and SASAKI, M. Dept. of Neurophysiol., Inst. of Brain Res., Sch. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

Single neuron studies were made in the posterior parietal association cortex (area 7a or PG) of the behaving monkeys. A vertically striped cylinder, which enclosed the animal, was illuminated from inside and rotated sinusoidally or at constant velocity for optokinetic stimulation. A class of neurons, which did not respond to smooth pursuit eye movement in the dark but responded to optokinetic stimulation, was found and named optokinetic neurons. During optokinetic stimulation, their activities were increased or decreased, depending on the direction of stimulus motion, not only when optokinetic nystagmus was elicited but also when optokinetic nystagmus was suppressed by fixating a visual target. Their response to optokinetic stimulation in the preferred direction was increased when the stimulus velocity was faster (up to 90 deg/sec). Their increased activities during optokinetic nystagmus returned to the control level when the light was put off to induce optokinetic after-nystagmus. The firing rate was not modulated by vestibular stimulation in complete darkness. The results indicate that optokinetic neurons did not receive vestibular input and that their response to optokinetic stimulation was not mediated by the vestibular nuclei.

158

PYRAMIDAL TRACT NEURONS IN THE PRECENTRAL AND SUPPLEMENTARY MOTOR CORTEX NEURONS: RESPONSES TO MULTIMODAL SENSORY SIGNALS.

TANJI, J. and KURATA, K. Dept. of Physiol. Hokkaido Univ. Sch. Med., Sapporo, 060

Three monkeys were trained to perform quick wrist extension and flexion in response to presentation of visual, auditory or somatosensory signals. Recordings were made transdurally from forelimb areas of the precentral motor cortex (MC) and supplementary motor cortex (SMA) of each animal, using a large diameter recording chamber attached to the skull. Magnitudes of movement-related activity of fast PTNs were much larger than those of slow PTNs in MC, regardless of modality of sensory signals (the differences were statistically significant). No significant difference was found in response latencies of fast and slow PTNs. Response magnitudes of PTNs in SMA were smaller than those of PTNs in MC.

159

CORTICAL CELL ACTIVITY DURING TYPE II EEG SPINDLES

EZURE, K. AND OSHIMA, T. Dept. Neurobiol., Tokyo Metropolitan Inst. for Neurosci., 2-6 Musashidai, Fuchu-city, Tokyo 183

In the precruciate cortex of unanaesthetized encéphale isolé cats, intracellular potentials were recorded from neurones of all the cortical laminae when Type II spindle bursts, composed of surface negative and deep positive waves, occurred spontaneously. The polarity of these bursts reversed its sign at depths around 0.2 mm below the cortical surface, indicating superficial current-sink and deep source. The intracellular potentials of most non-PT cells showed depolarizing waves closely in phase with surface negative bursts. These cells were distributed in all of the cortical laminae. Slow and fast PT cells also showed depolarization in phase with the surface negative spindles. These depolarizing potentials were compared with those observed during the surface positive-negative spindles known as Type I which were assumed to be initiated by the excitatory input to deep layer cells. The depolarizing potentials of PT cells and some non-PT cells during Type II spindles were smaller than those occurring during Type I spindles. These results were compatible with the notion that Type II spindles were induced mainly by excitatory synaptic actions on the superficially located neural elements such as dendrites and somata.

160

INCORPORATION OF RADIOACTIVE GLUCOSE INTO THE MONKEY'S BRAIN DURING THE VOLUNTARY WRIST MOVEMENT. MATSUNAMI,K., KAGEYAMA,T. AND KUBOTA,K. Dept. of Neurophysiol.& Biochem., Primate Res. Inst., Kyoto Univ., Inuyama.

Radioactive deoxyglucose method was applied to map the active sites in the monkey's brain in relation to wrist extension-flexion movement for 45 minutes. Two monkey performed the task and one was a control monkey, sitting in a chair quietly. The following locations were densely labeled in the experimental animals; the hand and foot areas of the motor cortex, their counterparts in the SI area, the primary auditory and visual cortices, the striatum, the anterior nucleus of the thalamus, the corpus and flocculus of the cerebellum, the inferior colliculus, the vestibular nuclei and the motor nuclei of the cranial nerve (IV,V,VI,VII). The prefrontal, premotor and orbital cortices were also well stained bilaterally, the contralateral side to the used forelimb being dominant. In these areas, activated sites appeared in vertically oriented patches, suggesting a presence of a columnar organization. The width of the patch was in the range of 0.5-2mm. The subthalamic nucleus, the substantia nigra were moderately labeled. The motoneurons in the cervical cord were little stained.

161

VISUAL NEURONS IN THE MONKEY PREFRONTAL CORTEX. AZUMA, M. AND SUZUKI, H., Department of Physiology, Hirosaki University Faculty of Medicine, Hirosaki.

For examining visual properties of monkey prefrontal neurons, we presented a light spot (RF spot) at various locations of the visual field, while a monkey kept his gaze straight ahead. Many prefrontal neurons, especially located in superficial layers of the cortex, responded in phasic and/or tonic activation to the RF spot illuminating a limited extent of the visual field. We called them as visual neurons.

The visual neurons were found to be distributed widely in the inferior dorsolateral and prearcuate areas with receptive field (RF) located in the visual field contralaterally to the hemisphere of unit recording. The neurons showed great variety of RF size and retinal eccentricity: in laterally distributed ones, RFs were usually small and located near the foveal region. Large RF neurons were found at more medial loci, and more posteriorly located neurons had more eccentric RFs.

Despite a variety of RF size and retinal eccentricity, all neurons showed similar neuronal reactions to relatively large RF spots and on a saccadic movement to a light spot within RF.

162

MONKEY PREFRONTAL NEURON ACTIVITY DURING GO/NO-GO TASK WITH COLOR CUES KOMATSU,H. and KUBOTA,K. Dept. Neurophysiol., Primate Res. Inst., Kyoto Univ., Inuyama City, Aichi, 484.

Neuron activity of the ventral prefrontal cortex (VFC) were recorded while two monkeys were performing a color discrimination GO/NO-GO task. A yellow lamp was illuminated to start a trial. Then green or red cue lamp was turned on. After the cue lamp, the go signal was turned on. The monkey released (GO) or kept pressing the lever (NO-GO) to obtain the reward juice. In a total of 102 task related neurons, 33 neurons exhibited a gradually developing increase of activity before cue lamp (N=19), yellow lamp (N=15), or reward (N=7). Seven of them showed changes before both lamps, and only one before both reward and a lamp. If event onset was delayed in neurons with changes before lamps, activity increase sustained as long as it was delayed. These neurons may be related to the detection of the light stimuli. If the reward was omitted in neurons with changes before reward, 2 showed a steeper decrease of activity than in reinforced trials. In addition to these, 7 neurons showed discharges after reward, 5 after reward omission. Activity change before reward may be important in recognizing the result of the response.

163

DIFFERENT CENTRAL MECHANISMS FOR SELF-PACED AND VISUALLY INITIATED HAND MOVEMENTS IN ONE AND THE SAME MONKEY AS REVEALED BY DIFFERENT PREMOVEMENT CORTICAL FIELD POTENTIALS.
KAZUO SASAKI, HISAE GEMBA and JUNKO ITO Dept. of Physiol., Inst. Brain Res., Fac. Med., Kyoto Univ., Kyoto

As recorded with chronically implanted electrodes, monkeys trained to perform self-paced hand movements showed slowly increasing, surface negative - depth (2.5-3 mm) positive premovement potentials in bilateral premotor and contralateral motor and somatosensory cortices, whereas those to perform the same hand movement in reaction to a visual stimulus revealed early surface positive - depth negative and late surface negative - depth positive premovement potentials at latencies of about 40 and 120 ms respectively from the onset of light stimulus in the contralateral forelimb motor cortex, the early potentials being recorded also in bilateral premotor and ipsilateral motor cortices (1, 2). Such different premovement potentials were recordable in one and the same monkey, after the monkey had been enough trained, first for either of self-paced or visually initiated movements and then second for the other. It is inferred that the central nervous mechanisms for those types of movements with a common motor performance are much different, and that different central programs can be independently utilized after they have been established with learning processes for one after another. (1) Gemba et al., Neurosci. Lett. 20, 159 (1980). (2) Sasaki et al., Brain Res. 205, 425 (1981).

164

Retinotopic organization of the posterior half of the lateral suprasylvian (LS) area (anterior 1.0 to the most posterior region) was eamined by characteristic distribution of receptive field (RF) of 236 neurons. Our findings were in principal agreement with those of Palmer et al. (1978). However, site and overlap of RF were much larger and congested, so that it could not draw a detailed retinotopic map in this part of cortex. The medial bank of the posterior LS area near the corner of the suprasylvian sulcus (SSS) represented the central visual field, while the lateral bank was mainly the peripheral field. Neurons in frontal region apart from the corner of SSS had also the peripheral visual field. In the most posterior part of the LS area, the anterior bank of SSS cortex represented the ipsilateral central visual field and the posterior bank represented the widely extended contralateral central visual field. These physiological results were ascertained by HRP methods applied in various parts of LS cortex. The distribution of cells of origin of thalamic afferents exhibited a considerable topical arrengement in close relation to the representation of the visual field. This study was done partly with O.D.Creutzfeldt and R. Guedes in Max-Planck-Institute for biophysical Chemistry, Goettingen, Germany.

165

EFFECT OF COOLING OF THE CEREBELLAR PEDUNCLE ON THE LENS ACCOMMODATION EVOKED BY CEREBRAL STIMULATION.
BANDO,T., TSUKUDA,K., YAMAMOTO,N., MAEDA,J. and TSUKAHARA,N., Dept. Physiol., Yamanashi Med. Sch., Tamaho, Nakakoma, Yamanashi 409-38, Dept. Biophys. Engineering, Fac. Eng. Sci., Osaka Univ., Toyonaka, Osaka 560 and National Institute for Physiological Sciences, Okazaki, Aichi 444.

The correlation of cortical neuronal activities with lens accommodation was found in a visual association cortex, the Clare-Bishop area in cats. Since cerebellar participation has already been reported in the control of lens accommodation, a possibility was considered that the Clare-Bishop area exerts its influence through the cerebellum. A cooling probe (Tsukahara et al, 1978) was inserted in the superior cerebellar peduncle. The effect of cooling was reversible; accommodation responses evoked by cerebellar nuclear stimulation disappeared several minutes after the onset of cooling, and they recovered completely about ten minutes after the cessation of cooling.

Accommodation responses evoked by cortical stimulation was sampled for 8-minute period before, during and after cooling and compared by using the off-line computer data-processing. No appreciable change was found by cerebellar cooling in the cortically-induced accommodation responses, whereas interposate nuclear-induced accommodation responses was completely abolished. It is suggested that the Clare-Bishop area has the output pathway independent of the cerebellum.

166

INTRACORTICAL INHIBITION OF CAT'S VISUAL CORTEX STUDIED IN VITRO.

KATO, H., OGAWA, T. AND ITO, S. Dep. of Physiol., Akita Univ. Sch. Med., 1-1-1 Hondo, Akit 010.

Intracortical inhibition was studied by recording evoked field potentials and intracellular potentials in slices obtained from cat's visual cortex. Field potentials evoked by stimulation of the white matter were demonstrated to consist of early pre-synaptic and late post-synaptic components by substituting a standard medium with low Ca^{2+} and high Mg^{2+} medium. The post-synaptic component was characterized by a prominent positive wave followed by a slow negative wave when recorded in layer III. It was reduced in amplitude by as much as 20% for as long as 50msec when preceded by a conditioning response evoked by the same stimulus. Such an inhibitory effect was abolished in a medium containing bicuculline(1 μM). The positive wave of the post-synaptic component was prolonged and enhanced, sometimes with multiple spikes on it when recorded in a Cl^- free medium. Intracellular recordings revealed that bicuculline depressed IPSPs and their associated shunting effects without detectable changes in membrane potential. The results are consistent with the concept that IPSP is mediated by GABA and related to Cl^-.

167

HOW THE X AND Y CELLS IN THE LATERAL GENICULATE NUCLEUS CONNECT TO THE CORTICAL SIMPLE CELLS IN THE CAT?

K. TANAKA NHK Broadcasting Science Research Laboratories, 1-10-11, Kinuta, Setagaya, Tokyo

In the previous study, the cross-correlational analysis of the spike activities recorded simultaneously from the lateral giniculate and visual cortical (area 17) cells made it sure that X as well as Y giniculate cells have excitatory connections with the cortical simple cells. The present study aims to determine whether an individual simple cell receives excitatory inputs from both X and Y cells or either of them.

Visual responses of simple cells were compared with those of geniculate cells. Characteristic responses of X cells are sustained responses to flashing slits, whereas those of Y cells are large responses to a diffuse flashing and to a rapid ($400^{\circ}/s$) movement of slits. Most simple cells did not show these responses in the normal state. When a GABA antagonist, bicuculline, was applied iontophoretically to the recorded cells, 10 out of 17 simple cells showed the X-characteristic responses, 6 cells the Y-characteristic responses, and only one cell both of them. These results suggest that almost all simple cells receive excitatory inputs from a single type of geniculate cells.

168

HUMAN STUMBLING CORRECTIVE REACTION: A COMPENSATORY REACTION TO MAINTAIN EQUILIBRIUM.

SUZUKI,S., WATANABE,S., MIYAZAKI,M*. AND HOMMA,S**. Dept. of Physiol.,kyorin Univ. Sch Med., *Division of PE. Waseda Univ. and **Dept. of Physiol., Chiba Univ. Sch. Med.

This study was performed to see the phasic influences on the EMGs of human extensor and flexor muscles when the subject, connected to a rope around his torso, was allowed ca. 5 sec. of strenuous forward "loaded" running, overcoming the backward pull of 10-20 kg by the experimenter, and then was abruptly released from this pull to induce the compensatory movements which may be called "stumbling corrective reaction(SCR)."

During the "loaded" running the characteristic EMG pattern of the tibialis anterior (TA) and gastrocnemius (G) muscles showed considerable co-activation in the stance phase. The basic reflex pattern and movements of the SCR are: Although the release was applied to both the swing and stance phases, the TA muscle showed extra burst activity in the swing phase, and a "double burst pattern" just after release, which induced an additional flexion movement. However, the activity pattern of the G muscle showed only single burst activity, and only during the stance phase whenever the release occured. Enhanced activity was found occasionally, depending on the timing of release. These findings substantiated the exsistence of functional differences in motor control between TA and G muscles during SCR.

169

JAW OPENING REFLEX AFFECTED BY THE VIBRATORY STIMULUS AND THE JAW OPENING LEVEL.

M. WATANABE, Y. MUNAKATA, A. KANUMA, T. TABATA* and K. KARITA* Dept. of Prosthet. Dent. and *Dept. of Physiol., Tohoku Univ. Sch. of Dent., Sendai.

Mechanical stimuli applied to the periodontal membrane of the cat anesthetized with α-chloralose evoked two different jaw opening responses recorded from the mylohyoid nerve, early response(ER) and late response(LR). We have already clarified they were produced from different receptor origins. The purpose of this study is to clarify the difference of response characteristics between ER and LR affected by the vibratory stimuli and the jaw opening levels. Results obtained were as follows. 1) ER and LR themselves were not affected by the jaw opening levels. 2) Vibratory stimuli applied to the mandible suppressed ER effectively at the frequency between 50-130 Hz and were ineffective at more than 250 Hz. Vibratory stimuli suppressed LR at 40-250 Hz and were ineffective at more than 350 Hz. 3) Time course of the suppression by the sustained vibratory stimulus was also different between ER and LR. ER was tonically suppressed from 80 msec after the beginning of the stimulus to the removal of the stimulus. On the other hand, LR was phasically suppressed between 20-60 msec. 4) The suppression of ER by the vibratory stimulus was affected in proportion to the jaw opening levels. However, that of LR was not affected. These results suggested that ER and LR were different not only in the receptor origin but also in the function.

170

OSCILLATORY BODY SWAY AND DEPRESSION OF THE SOLEUS MUSCLE ACTIVITY INDUCED BY CIGARETTE SMOKING.

HASHIMOTO,M.,TAKANASHI,Y.,SUZUKI,N.,TAKEGAMI,T.,KOYAMA,H.,YAMAMOTO,Y.,UCHIDA,T. AND IWASE,Y. Dept. of Physiol., Kyoto Prefect. Univ. Med., Kyoto.

Smoking a cigarette induced 0.5-1.0 Hz antero-posterior body oscillation. The amplitude of this body oscillation measured as the displacement of the center of gravity reached 6 cm at maximum and the tonic soleus activity changed to a phasic one after smoking. Investigation of the recovery of H reflex in the soleus studied with double stimuli on the tibial nerve while standing before (control) and after smoking disclosed the following results. In control the test H response evoked at 200 ms after conditioning stimulus recovered fully. This H response depended on the soleus activity, higher soleus activity giving greater test H response. After smoking, the test H response, obtained in a state of the body supported lightly in order to eliminate the body oscillation, began to reduce in amplitude within 1 min and reached 20 % or less of the control value at 2 min. The period of this H response depression coincided with that of the sustained body oscillation. The degree of the test H response reduction varied, depending on the difference of standing position. In a body position inclined forward, the H response depression was less than that in normal standing. The prolongation of the recovery process of H reflex after smoking is thought to be caused by a increased recurrent inhibition on the soleus motoneurons.

171

MECHANISM OF THE INITIAL CATCH-UP REACTION ON VISUO-MOTOR TRACKING MOVEMENT IN MAN. TANAKA,-R. Dept. of Neurobiol., Tokyo Metropol. Inst. for Neurosci., Fuchu, Tokyo.

An ability of motor control in catch-up movement was analysed by visuomotor elbow tracking movement in normal subjects as well as patients with cerebellar and tabetic ataxia. A vertical strip was displayed on both upper and lower halves of a TV screen. The upper strip (target) was moved horizontally by a ramp voltage at random intervals. The lower strip (control cursor) was moved in proportion to the angular displacement applied to the handle. The subject's task was to make the lower strip match the target movement by controlling the handle with elbow movements. The target velocity was any of 7.5, 15 and 30 deg/sec in terms of the elbow's angular movement. The initial angle of the elbow joint was 90°. In normal subjects the initial peak velocity (IPV) for catch-up reaction to a starting target was attained within a few hundred msec and the pattern was stereotyped. The IPV changed its amplitude linearly according to the error, i.e. distance between target and handle position, at the onset of tracking reaction. The linear relation between IPV and error at the onset of reaction was maintained in Tabes dorsalis, in which somatic sensation was specifically damaged, but weakened in cerebellar disorders without sensory disturbances. The initial catch-up reaction may be centrally programmed.

172

EMG PATTERNS OF DOUBLE-JOINT MUSCLES REFLECTING DYNAMIC FEATURES IN DOUBLE-JOINT MOVEMENTS. KUMAMOTO, M. Coll. of Liberal Arts, Kyoto Univ., Kyoto 606.

The subjects employed in the experiments were seven healthy male adults and were in supine position with the hip and knee joints kept at right angles. Electromyograms(EMGs) were recorded from the Vastus medialis(Vm), the Rectus femoris(Rf), the Biceps femoris (Bf) and the Gluteus maximus(Gm) with conventional method during simultaneous hip and knee joint extensions under isometric condition with maximal effort. In such movement, dynamic analysis showed that the resultant force exerted at the sole was not to be the sum of the individual joint forces and was limited by the weaker joint force. EMGs of the Rf and Bf, the double joint muscles, showed reversed patterns when the total leg extensions were performed in distinctly different directions, whereas EMGs of the Vm and Gm, the single joint extensors, remained unchanged. When the discharge of the Rf was remarkable and that of the Bf was depressed, the resultant leg extension force was limited by the knee joint force. However, if the discharge of the Rf was depressed and that of the Bf was remarkable, the resultant leg extension force was limited by the hip joint force. In the latter case, the patella tendon tap experiments revealed an existence of an inhibitory input to the α-motoneuron pool innervating the Rf. In the arm push movement, exactly the same results were obtained as in the leg extension.

173

CALCIUM UPTAKE BY FRAGMENTED SARCOPLASMIC RETICULUM IN DIFFERENT FIBER TYPES FOLLOWING EXHAUSTIVE EXERCISE. I. Hashimoto. Exercise Physiology Laboratory, The National Institute of Nutrition, 1 Toyamacho, Shinjuku-ku, Tokyo 162, Japan

The Ca^{++}uptake by fragmented sarcoplasmic reticulum (FSR) isolated from cardiac and skeletal muscles of untrained female rats killed at rest and after motor driven treadmill running at 21.5 m/min to exhaustion for a mean of 233 min was studied by using $^{45}Ca^{++}$as a tracer. Colonic temperature following exercise increased to above 40.7°C at exhaustion. Glycogen stores of myocardial and skeletal muscle and liver were decreased about 68, 92 and 98%, respectively. Ca^{++}uptake rates by FSR isolated from soleus, a mixture of red gastrocnemius and red vastus lateralis and white gastrocnemius (WG) of exhausted rats were reduced about 68, 26 and 25%, respectively($P<0.05$). A trend in Ca^{++} uptake by FSR in different fiber types was about same as that of crude homogenates. The Ca^{++}stimulated ATPase activity of FSR from WG was not changed by exhaustion. Thus, these data suggest that the decreased calcium transport by FSR following exhaustive exercise may provide one mechanisms for contractility of both cardiac and skeletal muscle.

174

VARIATION OF H-reflex ON PLANTAR FLEXION

NAKAHARA,Y. Dept.of Ex.Physiol.,Faculty of Physical Education,Kokushikan Univ.,Tokyo,Japan

This study aimed to clarifying the variation of antagonist muscles' H-reflex on plantar flexion is caused by active change of motorneurons or not. Normal subjects were tested by lying on one's face position. H-reflex were leaded by m.gastrocnemius(GA) and m. tibialis anterior(TA) on left foot. Surface EMG of the same named muscles and tension were measured by right foot.

At holding initial level(Rest, 10% 15% 20%MVC),an increasing rate of GA H-reflex were +5.06%, +12.67% and +17.4% for Resting value,but TA were not clear. Although GA H-reflex were so enlarge(+40- +140% for Control) except 80 - 100msec prior of manifestation of tension, TA were not clear especially on 0% and 10%MVC.

These results should be suggested the upper center was participated to send some inhibitory discharge to motorneurons and effects of reciprocal inhibition.

175

NATURE AND ORIGIN OF THE SILENT PERIOD OF THE SOLEUS MUSCLE PRIOR TO BODY INCLINATION.

UCHIDA,T., TAKANASHI,Y., HASHIMOTO,M., SUZUKI,N., KOYAMA,H., TAKEGAMI,T., YAMAMOTO,Y. AND IWASE,Y. Dept. of Physiol., Kyoto Prefect. Univ. Med., Kyoto.

The silence in the soleus muscle preceding a light-guided inclination in man has been believed to occur due to a centrifugal inhibition on the soleus motoneurons. The duration of this silence was inversely proportional to the premotional gradient of the lower leg axis from the vertical and also to the premotional soleus activity. This suggests that the length of the silent period in soleus may be determined on the basis of premotional somatosensory informations from the lower limbs.

A warning sound stimulation given at 1-5 s prior to the light signal for inclination reduced the onset latency of the silent period. The warning stimulation induced a negative slow potential shift in the averaged EEG record which developed gradually and lasted a few seconds. This negative potential shift measured just before the light signal was maximum in amplitude at 1 s of the interstimulus interval at which the decrease in onset latency of the silence was also maximum. The topographical study showed that the amplitude of the negative potential obtained in 2 s interstimulus interval recording was the highest at the vertex (Cz), the next highest at Pz, considerably lower at C_3 and C_4 than at Cz and the lowest at Fz. These facts support the interpretation that the silence in the soleus at inclination is caused by a central program.

176

THE RELATION BETWEEN THE VOLUNTARY ISOMETRIC FORCE DEVELOPMENT AND INTEGRATED EMG.

A.ISHIDA,T.YONEDA & K.OISHI. Dept.of Physiol. Sch. of Physical Edu. Juntendo Univ.,Fujisaki,Narashino,Chiba.

The relation between the voluntary isometric force of abductor pollicis brevis muscle and its integrated e.m.g on 7 normal men were investigated. The levels of force were set from 300 to 3000 g. Times to peak of forces were in the range of scores to 500 msec, so these contractions were ballistic or fast ramp contraction.

As the results : 1) The e.m.g activity was related to the amount of force. This relation might be seemed linear, although the gradients of regression line were not same for trials and subjects. 2) More than 150 msec time to peak contractions, the amount of discharge increased linearly with time to peak, but varied differently within 150 msec time to peak contractions. 3) The force rate (g/msec) reached to maximal and limited values at each force level. Discharge rate (mv/msec) could be correlated with force rate, but not linearly.

177

INFLUENCE OF UREA ON THE ELECTRICAL PHENOMENA IN THE CENTRAL NERVOUS SYSTEM. YASUHARA, M., NAITO, H. AND YOSHIDA, H. Dept. of Physiol., Kansai Medical Univ., Moriguchi, Osaka

In the attempt to clarify the pathophysiology of uremia, electrophysiological experiments were carried out. Urea(10-1500mg/kg) was injected intravenously in the rabbit and the following observed. 1. There was a rise in the thresholds of the arousal reaction and evoked muscular discharge on stimulation of the brain stem reticular formation and a reduction in the frequency of the spontaneous unit discharge of the brain stem reticular formation. 2. A rise in threshold of the evoked muscular discharge on stimulation of the cerebral cortex but that on stimulation of the hippocampus declined. 3. The amplitude of the late component of the afferent average evoked potential due to stimulation of the sciatic nerve decreased but the amplitude of the early component(N_3) increased. 4. The amplitudes of the nociceptive reflex muscular discharge and H-wave increase with administration of a small amount. 5. There was an acceleration of intestinal movement and an increase in the blood flow volume of the common carotid artery and the femoral artery.

178

CORTICAL RESPONSES EVOKED BY DENTAL PULP STIMULATION AND THE INHIBITION. KIMURA,H. AND SUDA,H. Dept. of Endodontics, Faculty of Dentistry, Tokyo Medical and Dental University.

The tooth pulp of the canaine of cats was stimulated electrically and the cortical evoked potentials (C.E.Ps) were recorded from the somatosensory area of the cortex. A comparison was made between the C.E.Ps evoked by the stimulation of the dental pulp without conditioning stimulation and those with conditioning stimulation.

The amplitude of the C.E.Ps produced by dental pulp stimulation was remarkably inhibited after the conditioning stimulation to the facial area (including other tooth pulp) when test-conditioning stimulation interval was 30-40 msec. On the other hand, the inhibition was slightly observed by the conditioning stimulation to the hand or shoulder. The amplitude of the C.E.Ps was scarecely inhibited irrespective of C-T intervals when the conditioning stimulation was delivered to the foot or near the back bone.

179

CONTINGENT NEGATIVE VARIATION (CNV) FOR THE INFORMATIVE STIMULUS. 1) ATTENTION FOR A VISUAL STIMULUS. NAGEISHI,Y. and SHIMOKOCHI,M. Dept. of Behav. Physiol., Fac. of Human Sciences, Osaka Univ., Suita, Osaka.

It is the purpose of the present investigation to show that the late CNV is attributed not to preparation of movement but to attention of informative stimuli. We employed a S1-S2-S3 paradigm of a reaction time task and examined the slow potential preceding S2 and S3. The subjects were instructed to press a key as soon as a visual S3 was presented, which was given in a half of the total trials. Two kinds of S1 prescribed the two types of the trials in a session: in the one types of trials (COR), each S2 of two auditory stimuli was correlated with the presence or absence of S3, but in the other trials (UN) it was uncorrelated. Consequently, in COR trials, S2 was informative for the occurrence of S3 but not informative in UN trials.

1) The CNV preceding S2 was larger in COR trials than in UN trials. Since S3 was informative only in UN trials, the CNV preceding S3 was larger in UN trials.

2) The Principal Component Analysis of these potentials provided two independent components (the late CNV factors for S2 and S3) and supported the above observations.

3) There was no differences in amplitude of the CNV between COR and UN trials before S2, but before S3 it was larger in UN trials than in COR trials.

180

PHYSIOLOGIC PROPERTIES OF PHONICALLY EVOKED LID POTENTIAL CHANGES WITH SPECIAL REFERENCE TO THEIR ORIGIN AND SIGNIFICANCE. HOSHINA,Y., TAKEO,T., SASAKI,S., OZAKI,T., SASAKI,D.* and IGARASHI,K.** (Dept. of physiol., Hirosaki Univ. Sch. of Med., Hirosaki, Dept. of Internal Medicine, Hirosaki Univ. Sch. of Med.*, Hirosaki and Dept. of Pediat., Hirosaki Univ. Sch. of Med.**, Hirosaki)

The potential changes elicited in the eyelids by phonic stimulation to both ears were obtained with the summation technique and their origin was investigated polygraphically in healthy subjects with eyes closed. In awaked resting state, the average lid potential changes evoked by phonic stimulation to both ears were usually characterized by the early rapid components and late slow one. In various physiologic conditions, the early and late components were observed to appear corresponding to the early components of the average lid MV responses and the EOG respectively. In patients with an artificial eyeball, on the other hand, the late component of the average lid potential changes in the side of an artificial one almost completely disappeared, whereas the early components of them were observed, although being considerably decreased in amplitude.

These results suggest a close relationship between the late slow component of the average phonically evoked lid potential changes and the EOG, which were both caused by phonic stimulation.

181

DEVELOPMENTAL PROPERTIES OF THE AUDITORY EVOKED POTENTIALS IN RELATION TO THE BACKGROUND EEG

KOIKE,T.*, SUZUKI,H., KATADA,A., AND OZAKI,H. *Dept. of Educational Pscychol., Tohoku Univ. Sendai, and Lab. of Physiol. for the Developmentallly Handicapped, Ibaraki Univ., Mito.

Developmental properties of the main negative(N) components in auditory evoked potentials (AEP) were examined in relation to the main frequency components of resting EEGs.

Subjects were 27 normal children ranging from 6 to 13 years of age. EEGs were led from 6 points along the midsagittal line of the scalp with reference to the linked earlobes. Tone-pips(1000Hz, 60dBSL) were presented to the right ear. The averaged AEPs and auto power spectra of the resting EEGs were obtained through the digital computer.

Single N component with a latency of about 100 msec was identifed in many subjects. The amplitude of this component was maximum at the central region of the scalp. In such cases, frequencies of the dominant EEG components were within the alpha band in the spectra. Furthermore, additional N component with a latency of about 150 msec was also noticed in some children. Such long latency N component appeared most significantly at around the anterior part of the brain. In some younger children, only the latter N component was observed. In the cases showing the long latency N component in the AEPs, their EEG spectra were characterized by multiple peaks within the alpha and theta bands.

Considering these results, maturational aspects of the brain might be inferred from the frequency components of the background EEG and also from the main N components in the AEPs.

182

PARTICIPATION OF THE PINEAL IN CIRCADIAN LOCOMOTOR RHYTHM OF LAMPREY, Lampetra japonica.

MORITA, Y. AND TABATA, M. 1st Dept. of Physiol., Hamamatsu Univ. Sch. Med., Handa-cho Hamamatsu

Pineal organ of lower vertebrate has functional multiplicity such as photosensory and secretory activity. In addition, recent studies of teleosts revealed the pineal contribution to the circadian locomotor rhythm of the animal. In the present study, we demonstrated that the pineal organ of lamprey is also highly associated with the circadian locomotor rhythm.

The lamprey was kept in a tube (10cm dia., 60cm length) inside the experimental tank. Lamprey's movement was detected by the FD-pick up as the displacement of the tube. All the fishes kept in LD cycle (12L:12D) displayed short term activity at the begining of light phase and long lasting frequent activity during dark phase. Such movement was not altered by the removal of lateral eyes (pineal intact). In continuous darkness, 14 out of 25 intact fishes displayed circadian locomotor rhythm (τ=21.6±2.63~23.1±1.94 hrs.) with relatively long lasting activity. In 31 fishes without lateral eyes 13 showed apparent rhythm in continuous darkness (τ=21.7±0.87~22.7±0.77 hrs.). However, pinealectomy completely abolished the circadian locomotor rhythm in all the fishes (11) examined. These results strongly suggest that the pineal organ of lamprey might be a major oscillator of circadian locomotor rhythm.

183

ENTRAINMENT OF CIRCADIAN RHYTHMS BY TEMPERATURE CYCLES.

TOKURA, H. AND ASCHOFF, J. Max-Planck-Institut für Verhaltensphysiologie, 8131 Erling-Andechs, Germany

The study aims to see whether temperature-cycles are effective as Zeitgeber for synchronization of circadian rhythms in homeotherms. Pig-tailed macaques, Macaca nemestrina, and squirrel monkeys, Saimiri sciureus, served as experimental animals. Locomotor activity was continuously recorded by means of infrared photocell systems. Circadian rhythms in about one third for M. nemestrina, and in about two third for S. sciureus were synchronized by high(32°C)-low(16°C) temperature-cycles. Variation of phase-angle differences between activity onset/end and temperature cycles was greater than that of phase-angle differences between activity onset/end and light-dark-cycles; the precision of synchronization is only about half so good under temperature-cycles as that under light-dark-cycles. Variation of phase-angle differences between activity end and Zeitgeber (temperature-cycles, light-dark -cycles) was greater than that of phase-angle differences between activity onset and Zeitgeber(temperature-cycles, light-dark-cycles), which is consistent with the usual rule of synchronization.

184

MAZE LEARNING IN MICROCEPHALIC RATS DUE TO PRENATAL X-IRRADIATION AND 'ENVIRONMENTAL THERAPY'

SEO, M., KIYONO, S. AND SHIBAGAKI M. Dept. of Physiology, Institute for Developmental Research, Aichi Prefecture Colony, Kasugai, Aichi

Pregnant rats (Sprague-Dawley strain) received 150 R of X-irradiation on day 17 of gestation. The male offspring were fostered by normal mothers. The normal (n = 46) and the microcephalic (n = 34) rats were differentially reared in enriched, standard colony and impoverished conditions for 30 days after weaning. Then the Hebb-Williams maze test was carried out. Analysis of variance revealed that the effects of both X-irradiation and Environment were significant, suggesting that the behavioral deficits due to prenatal X-irradiation could be alleviated by the 'environmental therapy.'

185

ANALYSIS OF THE DREAM CONTENTS BY REMP-AWAKENING TECHNIQUE. YAMANAKA, T., MORITA, Y. AND MATSUMOTO, J. Dept. of Physiol., Sch. of Med., Univ. of Tokushima, Tokushima

The present study was performed on 21 college students (male 11, female 10) aged from 19 to 21 years using REMP-awakening technique. The contents of 77 dreams were collected at the laboratory and analyzed according to the Hall-Van de Castle scale. The results are as follows: 1. The percentage of dream recall was 85.5 and the value at the first REM sleep was low (70.0%). 2. The incidence of dreams with the past experience was 64.9 % and bizzare, irratipnal dream was 28.8% and dream concerning the experiment was 11.7 %. 3. The percentage of the incidence of dreams with emotional elements was higher in the female students (72.2) than in the male students (41.5). 4. Color dreamer in the female was 70.0% and in the male 36.4%. 5. The female dreamers tended to be victim in aggressive dreams compared with the male dreamers. 6. The students dreamed significantly more about food, drinking ($P<0.05$) and the proportion of movement activity was significantly less ($P<0.01$) than those in the report of Hall and Van de Castle. From the polygram, following results were found: 1. Verbal activity in a dream was accompanied by increase of EMG activity. 2. Positive relation between pulse rate variability and emotionality in the dreams. 3. Positive correlation between numbers of dreams and the amount of the body movements in one REM sleep. 4. Positive relation between eye movement density during REM sleep and salience of dream content.

186

Indoleamine metabolites and learning performance of tryptophan deficient rats

Masahiko NOMURA, Masataka OHTSUJI and Yutaka NAGATA
Department of Physiology, School of Medicine, Fujita-Gakuen University. Toyoake, Aichi 470-11, JAPAN.

Newborn rats were fed on tryptophan deficient corn diet for 3 months. The increase of body and brain weight was decreased, but their physical growth recovered after addition of tryptophan to the tryptophan deficient diet.Three months old rats were subjected to a brightness discrimination learning test using an operant procedure.The correct response ratio of learning scores of tryptophan deficient rats did not exceed 80 % until 30th session. Addition of tryptophan rats scored more than 85 % on 25th session, whereas normally fed rats scored more than 85 % on the 19th. The addition of tryptophan to the corn diet exceeded the scores. Another learning performance of Fixed Ratio 50 showed remarkable close responses between normal and tryptophan rats. Tryptophan deficient rats showed very hyperresponse on FR 50.Low concentration of indoleamine in the rat brain and lower scores of correct response ratio of brightness discrimination and higher response of FR 50 were correlated.

187

CONTROLLING FACTORS OF DORSAL LIGHT TILT REACTION IN THE CARP.
MITARAI, G., TAKAGI, S., TAKABAYASHI, A. AND MORI, S. Dept. of Aerospace Physiology, Res. Inst. Environment. Med., Nagoya Univ., Chikusa-ku Nagoya 464.

E. von Holst (1935) distinguished between an equiliblium and an optic component in the light tilt reaction of fish. To elucidate the contribution of these two components to the posture center, the cerebellar activity (EEG) linking to the tilt was studied with normal and labyrinthectomized carps. The tilt was induced by alternating white light illumination from above and lateral to the fish cage. The normal carp responded with a detectable tilt to the light of 2 lux, and increased its angle with intensity up to 200 lux, resulting in 20 to 25 degrees. The tilt velocity, however, was almost constantly 3 to 4 deg/sec, independently to the intensity, suggesting that the tilting is controlled by the motor center activated secondly. The labyrinthectomized carp, even after readapted to swim normally, showed over-shooting tilt with much high velocity and large angle. The EEG during the dynamic phase of tilting appeared to be characterized by pronounced slower components. The power spectrum of EEG derived that these slow components were of 2 to 4 and 5 to 10 Hz in the normal carp, which was supposed to be an increased synchronization of neural activity during movement, while less synchrony in the labyrinthectomized carp. The vestibular deafferentation also seemed to be reflected on the reduction of activity in higher frequency range than 20 Hz.

188

LONG-TERM NEURAL CHANGES CORRELATED TO AN ASSOCIATIVE BEHAVIORAL MODIFICATION IN HERMISSENDA CRASSICORNIS. *T. TAKEDA & D.L. ALKON Lab. Biophysics, NINCDS, NIH, MBL, Woods Hole, MA, U.S.A. and *Dept. Physiol., Jichi Med. Sch., Minamikawachi-machi, Tochigi

In a gastropod mollusc Hermissenda crassicornis, the photopositive behavior is depressed significantly after training consisting of pairing of light and rotation stimuli and the behavioral modification lasted for several days (Crow & Alkon, 1978). Present study with intracellular recording showed long-term changes in light response patterns in both sensory and motor cells. In the lateral type B photoreceptor, the firing rate after light step significantly increased after 3 day's training and lasted for at least 2 days in paired group but no significant change in unpaired group. In the P1 cells which were found recently to innervate cerata and foot, the firing rate after light step significantly decreased in paired group. The interaction experiment with simultaneous recording of the lateral type B photoreceptor and the P1 showed depressive effect of the former activity upon the latter, which is consistent with the reciprocal change in firing rates for these two cells after paired training. Resting potentials, firing rates and input resistances in the dark in type B photoreceptors and P1 did not change in trained animals compared to untrained animals. It is suggested that long-term changes in light response pattern in type B photoreceptors and P1 cells are presumably the neural mechanism underlying the associative behavioral modification in Hermissenda.

189

EFFECTS OF FOOD RESTRICTION ON CIRCADIAN RHYTHMS OF EATING AND DRINKING BEHAVIOR. KUBOTA, A. and KAWAMURA, H., Physiol. Psychol. & Neurophysiol. Labs., Mitsubishi-Kasei Institute of Life Sciences. Machida, Tokyo.

Influences of food restriction on the circadian rhythm of eating and drinking behavior were examined in Wistar strain male albino rats. Eating and drinking were measured in a two-bar Skinner box with nest under variable interval (VI) schedule of reinforcement. Food and water were given after pressing individual bar. After transition from light and dark schedule (LD 12:12) to constant darkness, the free-running periods of both behavioral rhythms were only slightly longer than 24hr. However, starvation for one whole day significantly lengthend the period to much longer than 24hr. Eating, usually followed by drinking, was entrained by food restriction with 24hr period. Severe food restriction (three hours / day) caused earlier and more marked anticipatory bar pressing. After releasing from food restriction, most of the animals showed a shorter circadian period than before. In one animal, however, activities split and then fused together approximately in 10 days.

These data suggest a possibility that the period of the eating rhythm may be influenced by food restriction either through a feedback from the periphery to the circadian pacemaker or by a learing mechanism in the brain.

190

CROSS-CORRELATION ANALYSIS OF THE MIDBRAIN RETICULAR FORMATION NEURON PAIRS DURING SLEEP AND WAKEFULNESS. EGUCHI, K. AND SATOH, T. Dept. Physiol., Fac. Dent. Med., Aichi-Gakuin Univ., Nagoya 464.

Temporal cross-correlation of firing of 97 neuron pairs of cat's midbrain reticular formation was examined during different states of sleep and wakufulness. There was no correlogram suggesting cascade connection between a neuron pair. However, 29 pairs showed synchronous firings with mean interval of 1.23 sec. This rhythmicity was most accentuated during slow wave sleep. The synchronous discharge was quite often encountered in the pairs between the adjacent neurons picked up with a single electrode. Neuron pairs located along medio-lateral direction showed the synchronization more often than the caudo-rostral pairs did. Sharring of the afferent innervation might be the mechanism responsible for the synchronization. A small number of the raphe and the solitary tract neurons was examined for the cross-correlation with the midbrain neurons, but no positive relationship was found.

191

UNIT ACTIVITY OF THE RED NUCLEUS NEURONES ASSOCIATED WITH CLASSICAL CONDITIONING IN THE CAT. ODA, Y., NOTSU, T., KUWA, K., TSUKAHARA, N., Dept. of Biophysical Eng., Fac. of Engineering Science, Osaka University, Toyonaka, Osaka.

We examined unit activity of the red nucleus (RN) neurones before and after establishment of classical conditioning. A conditioned stimulus (CS) was applied to the cerebral peduncle in cats with lesion involving the corticofugal fibers caudal to the RN. The unconditioned stimulus (US) was an electric shock to the forearm skin. In this paradigm, after pairing CS and US for 10 days, an initially ineffective CS was found to give rise to the elbow flexion. Association of CS and US was critical for acquisition of the conditioned response (CR), because extinction of the CR was achieved by the presentation of CS alone or backward pairing of US-CS and because neither US alone nor pairing CS with US at random intervals produced any increase in the effectiveness of the CS. Unit discharges of RN neurones were recorded extracellularly in the alert conditioned and control animals. The RN neurones in the conditioned cats discharged slightly more frequently ($P<.05$) to CS than those of unconditioned and random controls pairing CS with US at random intervals. Although the difference was scanty, but this suggested that there is a correlation between the RN neurone activity and behavioral modification in associative learning mediated by the cortico-rubro-spinal system.

192

INTERFERENCE OF MOVEMENT BETWEEN RIGHT AND LEFT HANDS
WATANABE,T. Nippon Univ. KAWAHARA,Y. Japan Women's Univ.

We investigated how movement of one hand influences or interferes with that of the other when the right and left hands are moved simultaneously or at short intervals(300,600,900,1200,1500msec.) between both movement. A subject was asked to push the key in response to 2 light stimuli given simultaneously or at intervals of 300-1500msec. between them, and the reaction time was measured. The reaction time of bilateral hands was longer than in the colateral hand movement. The reaction time to the first of 2serial stimuli was prolonged. The response to the second stimulus was most delayed when two stimuli were given at an interval of 300msec. However, it occurred rather faster than the response to the first stimulus did when the intervals between both stimili were longer. In case of simultaneous movement the reaction time was longer with bilateral hands than with colateral hand. When simultaneous movement was included in the systems in which movement of either right or left hand was preceded, the response of the preceded hand occurred faster. In the system in which the preceded hand was selected at random there was no difference in reaction time between both hands, but the reaction time was longest.

193

EMG RESPONSES BY TIBIAR NERVE STIMULATION IN STANDING.
A.MIYAKE, R.HAYASHI, S.WATANABE, K.YAMAJI. Inst. Equilibrium Res. Gifu Univ. Sch. Med., Gifu

While subjects maintained a standing position, leaned forward and backward or balanced on a seesaw, H- or M-responses were evoked by tibiar nerve stimulation. Stimuli were given every 1 or 3 sec.

The position of center of gravity at the moment of stimulation and the peak-to-peak amplitudes of H- and M-responses were measured automatically and analized. In upright position H- and M-responses recruited in the same order as in recumbent position. In the leaning movement, for the fluctuation of M-responses could not be eliminated, we regarded M-response amplitude as the effective stimulus intensity and evaluated H-response recruitment curve. H-responses increased when body was leaning forward and decreased when body was leaning backward. The oscillatory discharges (7-10Hz) in soleus muscle were observed following M- and H-response. The latency of the first of these discharges from the stimulation was 140-190msec and it was shorter when body was leaning forward and when stimulus was stronger.

194

EFFECTS OF SLEEP-PROMOTING SUBSTANCES ON NOCTURNAL SLEEP PATTERNS OF NORMAL MALE RATS. HONDA, K. KOMODA,Y. AND INOUÉ, S. Inst. Med. Dent. Engineering, Tokyo Med. Dent. Univ., 2-3-10 Kanda-Surugadai, Chiyoda-ku, Tokyo 101.

Cortical EEG, neck EMG and locomotor activity were continuously recorded in normal male Sprague-Dawley rats, 70-80 days old, weighing 300-350 g, and kept under LD 12:12 in an air-conditioned sound-proof room. Saline solution was steadily infused into the third ventricle through a chronically implanted cannula (20 μl/h). During the dark phase (2000-0800), these rats regularly exhibited total time of slow wave sleep (SWS) for 219.4±6.8 min and of paradoxical sleep (PS) for 33.2±4.6 min. The frequency of SWS and PS was respectively 52.7±2.8 and 14.3±1.8. Infusion of active fractions of sleep-promoting substances for 10 h (1900-0500), extracted from the brainstems of 24-h sleep-deprived rats, caused changes in the nocturnal sleep pattern. SWS: an increase in total time (312.1±21.6 min, $P<.001$) and in frequency (75.3±6.5, $P>.05$); PS: a decrease in total time (30.0±11.7 min, $P>.05$) but an increase in frequency (16.2±5.3, $P>.05$). Locomotor activity was largely suppressed, showing only ca. 50 % of saline-infused night.

195

Cancellation effect of sleep-promoting substance (SPS) on PS-inhibition provoked by protein synthesis inhibitors

NAGASAKI, H. , KOMODA, Y. and UCHIZONO, K. Tokyo Metro. Inst. Geron. , Inst. for Med. Dent. Engine. Tokyo Med. Dent. Univ., National Inst. for Physiol. Sci.

The physiological effect of the sleep-promoting substances (SPS) was investigated in paradoxical sleep mechanism that the amounts of paradoxical sleep in inbred strain of mice (C57BL/6) was believed to be a genetically determined standard value.

(1) The SPS cancelled a paradoxical sleep (PS)-inhibition provoked by both chloramphenicol and cycloheximide for 2 hours following administration of each drug.

(2) This cancellation effect of SPS on PS-inhibition may correlate with an amount of slow wave sleep, that is, the suppression of slow wave sleep resulted into a less cancellation effect.

(3) There were two different type of SPS, one of which activity was pronase-sensitive and another was pronase-resistant. Thus one of SPS may be peptide.

196

REM SLEEP ORGANIZATION IN KINDLED CATS.

FUJITANI, Y., HOSOGAI, M. AND OIKAWA, T. Dept. of Physiol., Tottori Uiv. School of Med., Yonago

A longitudinal study of kindling effects on sleep-wakefulness cycle, especially on REM sleep was done by comparing polygraphic records during 24 hrs between before and after establishment of the kindling effect on the same 2 cats. Amygdaloid kindling was attained after stimulations of 26 and 28 days, respectively. Sleep-wakefulness states were classified into 4: waking stage (W), light slow wave sleep stage, deep slow wave sleep stage and REM sleep stage (R). The analysis was confined to the data of the 3rd day through continuous 3 days recording. Tanaka and Naquet in 1975 stated that amygdaloid kindling resulted in reducing REM sleep and increasing W time, but their comparative study was done only in 5 hrs period of a day between control cats and different group of kindled cats. Our results show that diminution of R and increase of W stage were showed in several hrs period, e.g. 4:00 to 8:00, but not in all the day. However, REM density (occurrence ratio of rapid eye movements during REM stage) was decreased significantly through 24 hrs in kindled cats.

197

APPEARANCE OF REM SLEEP IN CATS AFTER THE COMPRESSION TO 51ATA, HELIOX, N_2-TRIMIX, Ar-TRIMIX, AND 26ATA, NITROX

SEKI, K. AND NAKAYAMA, H. Labaratory of Hyperbaric Physiology. Japan Marine Science and Technology Center. Yokosuka. Kanagawa

SEKI et al., 1980 (28th IUPS P.693) previously reported the modifications of sleep under hyperbaric Heliox environment in cats. Six cats, 1-3 years of age, 3.5-5.5 kg weight, kept under LD 12-12 in NASA level 100,000 by barier system, were implanted with the electrodes of EEG, neck EMG, EOG, ECG, microvibration and cortical temperature. There are four simulated dives in this study; 51ATA (Heliox, PO_2=0.4bar, N_2-trimix, PN_2=5.0bar, PO_2=0.4bar, Ar-trimix, PAr=2.0bar, PO_2=0.4bar) and 26ATA (Nitrox, PO_2=0.6bar). The duration of compression to 51ATA was 4 hours. The result show that after arrived at 51ATA and 26ATA, there appeared the stage of REM sleep in 20 hours (Heliox), 6 hours (N_2-trimix), 3 hours (Ar-trimix) and 2.5 hours (Nitrox). This suggests the factor of acceleration and inhibition of REM sleep. Further work is necessary to determine the factors involved in the appearence of REM sleep during and after the hyperbaric environment.

198

FUNCTIONAL ROLE OF ANTERIOR FOREBRAIN ROOF ON IMPRINTING BEHAVIOR IN DUCKLINGS.

K.TAKAMATSU and Y.TSUKADA, Dept.of Physiol., Keio Univ.Sch.of Med., Shinanomachi, Tokyo

A series of experiments has implicated medial hyperstriatum ventrale (MHV) in imprinting, and we have confirmed these findings using ^{14}C-2-deoxyglucose method. The present study was conducted to examine the ability of ducklings to follow a moving object after brain lesion or cycloheximide (CHX) injection into MHV. Bilateral lesion were made in MHV of one duckling, the other served as a sham-operated control. On the next day, the control still showed a strong preference for moving object, but MHV lesioned duckling showed no attention to the object. However, on brightness discriminative learning ability, there was no difference between controls and lesioned ducklings. When CHX (20μg) in 1μl was injected into MHV bilaterally at 30min before, immediately or 1hr after the first exposure to moving object, the following responses were significantly impaired. But, when CHX was injected at 2hr or 4hr after the exposure, the following responses were slightly impaired, and when CHX was injected at 24hr after the exposure duckling behaved normally. On the other hand, injection of 20μg of CHX into other brain regions at immediately after the exposure did not affect on the responses. It was proved biochemically and autoradiographically that protein synthesis on MHV after CHX injection was considerably inhibited, but not on other parts of the brain. From these results, it was posturated that MHV was closely inked with imprinting and that formation of imprinting depended on protein synthesis in this area occurred within 1hr after the first exposure to moving object.

199

THE EFFECT OF MATERNAL HYPERPHENYLALANINEMIA ON THE BEHAVIOR OF THE OFFSPRING RAT

TAKAGI, Y., KANAMATSU, T., ASOU, H. AND HIRANO, S.
Dept. of Physiology, Toho Univ. Sch. of Med., Ohmori, Tokyo, Japan

Two experimental groups of Wistar albino rats (A,B), divided according to every 5-day of early gestation period in which each mother was compulsorily given per os L-phenylalanine (Phe), were examined in order to investigate the effects of maternal hyperphenylalaninemia on the postnatal brain development and the behavior changes of the offspring.

Learning abilities of experimental groups, tested by operant discrimination learning, were reduced. At 15 days after birth, acid phosphatase activity was significantly decreased in group B. In this group, which was loaded with L-Phe during the second experimental period from the 5th to 9th day of gestation, 2',3'-cyclic nucleotide 3'-phosphohydrolase activity was significantly decreased compared to the control, but there was no difference in the activity of glycerol-3-phosphate dehydrogenase. The learning ability of group B, by Hebb-Williams'maze, was also reduced. There were some differences between the control group and group B in the emotional behavior by both the open-field test and the runway test.

200

VISUAL PURSUIT IN THE MENTALLY RETARDED CHILDREN STUDIED BY ELECTRO-OCULOGRAM.
MITSUKA, Y., SUZUKI, H. and OZAKI, H. Lab. of Physiol. for the Developmentally Handicapped, Ibaraki Univ., Mito, Ibaraki.

In relation to the handicap of the cognitive function in the mentally retarded child, characteristics of the eye-movement during a visual pursuit were explored. Three groups were subjected to the experiment: mildly retarded children (experimental), normal children and adults (control) groups. They were instructed to track visually the sinusoidal movements of the target (0.2-2.0 Hz) in the horizontal direction. EOG was led from bilateral sites posterior to the lateral ocular angle. While a periodic pursuit was possible in wide frequency ranges in control groups, repose periods interposed between periodic movements steeply increased in lower frequencies in the retarded group than in the other groups. So far as the pursueing period was concerned, both frequency response characteristics and the time relations to the target in the retarded group were essentially similar to those of the control groups except for the decrease in the gain at lower frequencies than that of the adult group. As for the saccadic movement in the retarded group, it occured more frequently during the repose period than during the pursueing period, that was contrast to the control groups, in which it was very few in the repose period. In the retarded group, phase of the occurence of saccadic movements within one cycle of the target was rather invariant even for lower frequencies. This pattern was observed only in the higher frequency ranges in the control groups.

201

EFFECTS OF MINOR TRANQUILIZERS UPON EEG CHANGES IN THE CONSCIOUS RAT DURING IMMOBILITY INDUCED BY PSYCHOLOGICAL STRESS.
IWATA, N., MIKUNI, N. AND TONOHIRO, T. Cent. Res. Lab., Sankyo Co.

After conditioning the rat to expect an electroshock when placed in the test box, the rat assumed a catatonia-like immobility when placed in the box even though the electroshock was not applied. While in this state relative brain wave activity over the range 7.5-13.0 Hz significantly increased in the cortex and the dorsal hippocampus, but not in the ventral hippocampus, amygdaloid and caudate nuclei, thalamus and reticular formation. The immobility accompanied by the EEG changes disappeared when the animal was returned to the home cage and immediately reappeared after the rat was retransferred to the test box. Minor tranquilizers such as diazepam (higher than 5 mg/kg, p.o.) and mexazolam (higher than 2 mg/kg, p.o.) suppressed significantly the augmented activity under the same stress condition. Chlorpromazine required a large dose in order to suppress the activity and antidepressants did not suppress the activity.

202

HUMAN COMMON CAROTID BLOOD FLOW DURING SLEEP.
MASUDA, M., HASEGAWA, H., IKEDA, M. AND *UCHINO, K. Dept. of Physiol., Jikei Univ. Sch. of Med., Minato-ku, Tokyo, *Yokohama National Univ. Faculty of Student Health Center, Yokohama

The common carotid arterial blood flow was measured during all night sleep in two human subjects. A recently described ultrasonic quantitative flow measurement techinique (QFM) was used to measure flow in the common artery.

Mean common carotid flow during REM sleep was lower than waking level before sleep and higher than NREM sleep level. But common carotid flow during the first appearing REM sleep was elevated above waking level, even though this response was phasic. The vessel diameter of common carotid artery was nearly same or lower than waking level : i.e. vasoconstriction in the common carotid artery was produced during sleep. The flow velocity was decreased during sleep except the first appearing REM sleep.

These results suggest that it would be produced redistribution of flow in both the carotid arterial and the vertebrobasilar systems in sleep.

203

Thirty-one patients with cardiac arrhythmias(ventricular premature contraction(VPC)10, supraventricular premature contraction(SVPC)7, paroxysmal atrial fibrillation(PAf)3, paroxysmal supraventricular tachycardia(PSVT)3, atrio-ventricular(A-V) block 8 cases) were examined using continuous polygraphic recordings for one full night after oral administration of diazepam(4 mg). They were 24 men and 7 women, whose average age was 51.8 years ranged from 12 to 83 years.

Paroxysmal tachyarrhythmias(PAf 3, PSVT 3) appeared most frequently during REM sleep ($P < 0.05$). However,there were no significant relationships between sleep stages and VPC, ventricular tachycardia and SVPC. The improvements of A-V block were observed during REM sleep in the case of first-degree A-V block(3 cases), in the case of second-degree A-V block(Wenckebach type)(2 cases), in the case of advanced A-V block(1 case) and in a patient with implanted permanent pacemaker, although in the case of complete A-V block the improvement was not observed at all in any sleep stages.

The phasic changes of RR interval and frequent appearance of sleep-induced apnea with a significant depression of SaO2 were observed during REM sleep. In addition,significant relationships were observed in a patient with VPC between bigeminy due to VPC and K-complexes, and between sleep spindles and sinus tachycardia.

These results suggest that there are individual differences in the degree of influences by sleep states and that an analysis in each patient is necessary for the investigation of the mechanism of arrhythmias.

204

THE AROUSAL THRESHOLD BY ELECTRICAL STIMULATION TO THE NUCLEUS VENTRALIS POSTERO-LATERALIS THALAMI IN CATS

SANO, A., ISHIKAWA, N. AND MATSUMOTO, J. Dept. of Physiol., Sch. Med., Univ.Tokushima

Several earier studies have demonstrated that arousal threshold by reticular or peripheral sensory stimulation was elevated during paradoxical sleep (PS) compared with other stages of sleep. In the present study, arousal thresholds by electrical stimulation to the nucleus ventralis posterolateralis thalami (VPL) were determined under the various conditions in 10 cats. The arousal thresholds during PS were significantly higher and more variable than those found during light and deep sleep. Especially, the thresholds in the PS periods accompanied with eye movements were significantly higher compared with PS periods without eye movements. In addition, when a PS period was divided into three parts (first, middle, last period) according to time course from PS onset, the threshold in the last period was significantly lower compared with other two periods. Finally, we also investigated the changes of arousal thresholds by the stimulation, when it was employed as the conditional stimulus in Pavlovian alimentary conditioning. After the establishment of conditioning, the arousal thresholds by the stimulation in PS and light sleep periods became significantly lower compared with those before conditioning.

205

NEURONAL RESPONSES DURING OPERANT FEEDING BEHAVIOR IN THE MONKEY PREFRONTAL CORTEX AND THE ROLE OF PUTATIVE NEUROTRANSMITTERS.

OOMURA, Y., AOU, S.,* INOUE, M.,* SIKDAR, S.K.,* YAMABE, K.,* NODA, T.,* NISHINO, H., ONO, T.,** SASAKI, K.,** FUKUDA, M.** National Inst. for Physiol. Sci., Okazaki., Dept. of Physiol. Fac Med., Kyushu Univ., Fukuoka*, Dept. of physiol., Fac. Med., Toyama Med. and Pharmaceutical Univ. Toyama.**

Unit activity was recorded in the dorsolateral area of the prefrontal cortex in the monkey. The correlation between the effect of putative transmitters and the response to the events of the feeding task was examined. More than 60% of the recorded neurons responded to at least one event (cue lamp, bar press, cue tone, eating etc.). The action of NA was mainly inhibitory, especially on the neurons which responded to cue. These responses were suppressed during the continuous application of NA. Application of ACh produced excitation on the majority of neurons but did inhibit a few. The continuous application of ACh blocked the decreasing responses during the bar press period in some neurons. This effect was in contrast to the inducing action of glutamate, which induced clearer event related responses in silent, as well as spontaneously active neurons. Morphine had an excitatory effect on some neurons which increased in activity during reward period. These results suggest the possibility that ACh and glutamate act on different sites of cortical neurons, and that NA may influence neurons involved in the integration of sensory information at the cortical level.

206

CHAINGES IN THE MAXIMUM NUMBER OF BINDING OF NICOTINIC ACETYLCHOLINE RECEPTOR IN THE NUCLEUS INTERPEDUNCULAR FOLLOWING LESIONS OF THE HABENULA

SUNAYASHIKI,K Dept. of Physiol., Sch. of Med., Ehime Univ., Shigenobu-cho Ehime

Binding assay for [^{125}I]-α-bungarotoxine ([^{125}I]-α-BGT) was carried out on nucleus interpeduncular (IPD) crude synaptosomes to obtain independent evidence for presence of specific nicotinic Acetylcholine receptor (nAChR) *in vitro*. (1) Using a stereotaxic apparatus and a DC stabirized source, bilateral electrolytic lesions were formed in the habenula of male rats under Nembutal anethesia. (2) After allowing survival 10 days or 60 days in good conditions, the operated rats were decapitated and then IPDs were removed in the cold (5°C). (3) The activity of choline acetyltransferase in the same IPD was assayed essentially by a radiochemical method with the following slight modification. (4) A Scatchard analysis of saturation data, carried out on the IPD of the habenula lesioned, revealed that the elevation of specific [^{125}I]-α-BGT binding in the IPD was characterised by 176% increase in maximal [^{125}I]-α-BGT binding (Bmax) at 10 days after operation. But at 60 days after operation the Bmax of specific nAChR falled to nearly sham control (17.7±0.6 pmoles/g protein). Such a finding suggests the development of denervation supersensitivity of specific nAChR on the IPD deprived of their associated presynaptic terminals by destruction of the cell body.

207

THE INHIBITORY EFFECTS OF TUNICAMYCIN ON GLYCOPROTEIN SYNTHESIS IN PERIPHERAL NERVE MYELIN. UYEMURA,K.,HORIE,K.,KITAMURA,K. & SUZUKI,M. Dept. of Physiology,Saitama Medical School,Moroyama,Irumagun,Saitama.

Membrane fractions of chick peripheral nerve at myelination showed active transfer activity of mannose from UDP-mannose to lipid intermediates and glycoproteins in vitro. This transfer activity was stimulated by exogenous dolichol monophosphate(Dol-P) and UDP-N-acetyl glucosamine(GlcNAc). Molecular weights of glycoproteins labeled were consistent with those of two myelin glycoproteins,P0 and PASII. Addition of Tunicamycin (TM) [1μg/0.1ml] inhibited mannose transfer into oligosaccharide lipids and glycoproteins,although TM showed no effect on its transfer into Dol-P-mannose. TM addition also caused 50% inhibition in GlcNAc transfer from UDP-GlcNAc to Dol-PP-GlcNAc and oligosaccharide lipids,and 30% inhibition in it to glycoproteins. For in vivo studies, chick embryos at 16 days were injected with TM [0.2-20μg/animal] and were sacrificed after 3 days incubation. No significant differences in body,brain and sciatic nerve weights were observed between control and experimental groups. However myelin glycoproteins,P0 and PASII,in the sciatic nerve decreased in inverse proportion to the amount of TM injected. These results indicated that TM inhibited glycoprotein synthesis and,as consequence,myelination of the peripheral nerve.

208

DEVELOPMENTAL CHANGES IN ACTIVITIES OF CHOLINE ACETYLTRANSFERASE AND GLUTAMIC ACID DECARBOXYLASE IN GUNN RAT'S BRAIN OHNO, TAKUO Dept. of Physiol., Ehime Univ. Sch. Med., Shigenobu, Ehime 791-02

The activities of choline acetyltransferase and glutamic acid decarboxylase, markers of cholinergic and GABAergic terminals, were measured in Gunn rats, which possess an autosomal recessive gene for jaundice or kernicterus, during postnatal growth. It is the aim, whenever possible, to correlate these changes with the structural and physiological maturation of the brain. Male heterozygous (phenotype, normal) and homozygous (phenotype, jaundiced) Gunn rats raised in this laboratory were used. The brains were analyzed at 1, 2, 3, 5 and 8 weeks after birth. Under ether narcosis, the rats were decapitated, whole brains were immediately removed, and divided into 4 regions: the cerebral cortex, olfactory bulb, hippocampus and neostriatum. Immediately after excision, tissues were weighed and homogenized with 0.1 ml of 0.1% Triton X-100 solution for the analysis of the enzymes by radiochemical tracer experiments. In the hippocampus and neostriatum from the animals with kernicterus, the development of the cholinergic pathways is delayed, but by the adult stage it is normal, while there is practically no action on the innervation by GABAergic neurons, at least as indicated by the chemically measured parameters. However, it is difficult to see how the delay in the development of these cholinergic pathways correlates with the neurological defect.

209

MODULATION OF THE MYELINATION IN THE CEREBELLUM OF RATS TREATED WITH CYTOSINE ARABINOSIDE IN THE NEONATAL PERIOD.
TAMARU, M., HAYAKAWA, Y., NAGAYOSHI, M. AND MATSUTANI, T.
Dept. of Dev. Physiol., Inst. for Comprehensive Med. Sci., Fujita-Gakuen Univ., Sch. of Med., Toyoake, Aichi, 470-11.

Effects of the cerebellar hypoplasia caused by the inhibition of cell division in the external granular layer of rats with cytosine arabinoside(ara-C) in neonatal period on the myelination were investigated on 60-day-old rats. Body weights of rats treated with ara-C(30mg/kg/day, s.c.) at 4,5,6,7 days after birth(ara-C rats) reduced by 50% of control. Cerebellar weights of ara-C rats reduced by 30% of control and a severe ataxia was observed. The cerebellar concentration of DNA reduced by 30% of control. Specific activities of CNPase in the cerebellar homogenate of ara-C rats elevated by 140% of control. Simultaneously, the myelin content estimated as protein per gram tissue of the cerebellum in ara-C rats also elevated by 170% of control. Patterns of SDS-polyacrylamide gel electrophoresis in the cerebellar myelin protein of ara-C rats unchanged as compared with control. It was considered that elevations of specific activites of CNPase and myelin content per gram tissue were due to the reduction of granular cells. But, since total activities and content of these markedly reduced, it was suggested that the cerebellar hypoplasia caused by the reduction of granular cells in ara-C rats was accompanied with the dysmyelination.

210

NEUROCHEMICAL STUDIES ON DILUTE-LETHAL MICE (d^1).
T.SUGISAKI, T.NOGUCHI, AND Y.TSUKADA.
Dept. of Physiol., School of Medicine, Keio Univ., Shinjuku-ku, Tokyo.

Dilute-Lethal mutant mice (d^1) are characterized by neurological symptoms; ataxia, opisthotonus and clonic-tonic convulsion. At 20 days of age, the activity of 2',3'-cyclic nucleotide 3'-phosphohydrolase as a marker for myelinogenesis was found to be exceedingly reduced in the cerebrum, brain stem and medulla oblongata ($p<0.01$), slightly in the cerebellum and cervical spinal cord ($p<0.05$), but not in the thoracic spinal cord and the optic nerve. The free amino acids contents in the different parts of the brain were measured, and it was found that aspartic acid content tended to increase and glutamine and tyrosine contents tended to decrease only in the cerebrum ($p<0.05$). Furthermore, the amount of radioactivity incorporated into glutamine from (U-14C)-glucose injected subarachnoidally was found to be reduced to one-half of the normal control only in the cerebrum. These results may indicate that Dilute-Lethal mutant mice have poor myelination and disorder of amino acid metabolism in the central nervous system.

211

DUAL EFFECTS OF L-GLUTAMATE ON CYCLIC AMP LEVELS IN SLICES FROM DIFFERENT AREAS OF RAT CEREBRAL CORTEX WITH IRON-INDUCED CHRONIC FOCUS.
HATTORI, Y., INABA, K., UEZU, E., NISHIDA, N., YASUHARA, H. and HORI, Y. Dept. of Physiol., Okayama Univ. Med. School, Okayama 700

A chronic focus not resulting in generalized convulsions was induced by a single intracortical microinjection of $FeCl_3$ solution into the left frontal cortex of rats. Animals were sacrificed after confirming the appearance of epileptic discharges in the ECoG in early(8-10 days after injection) or late(30-60 days after injection) stages. The cerebral cortex was dissected into four parts, i. e., left anterior, left posterior, right anterior and right posterior quarters. Each quarter of cortex was sliced and incubated in Krebs-Henseleit Ringer bicarbonate buffer. The level of cyclic AMP was increased by the addition of L-glutamate in slices from the quarter of cortex with the focus (left anterior) in both early and late stages. The addition of L-glutamate resulted in decreased level of cyclic AMP in slices from the most remote quarter of cortex(right posterior) in the late stage.

212

MONKEY BRAIN SUBSTANCE P INACTIVATING ENZYME. M. HAYASHI, K. OSHIMA Dept. of Physiol., Primate Res. Inst., Kyoto Univ., Inuyama, Aichi

The enzyme which inactivates substance P (SP) was investigated in the various regions of the monkey brains (Macaca fuscata fuscata) using a bioassay of guinea pig ileum contraction. One unit of the enzyme activity was defined as the enzyme amount that hydrolyzed 1 μg of SP per 1 min. The specific enzyme activities of various regions of three monkey brains were as follows: cerebral cortex (324±24 mU/mg protein), hippocampus (300±21), amygdala (325±15), posterior hypothalamus (237±36), anterior hypothalamus (248±16), substantia nigra (275±23), reticular formation (280±30), cerebellar cortex (279±33), and spinal cord (237±27). The results indicate that the enzyme is distributed uniformly throughout the monkey brain and its distribution did not correlate with that of endogenous SP. In order to characterize the enzyme, it was partially purified from monkey whole brain by DEAE-cellulose chromatography. The molecular weight of the enzyme was estimated 64,000 by gel filtration (Sephadex G-100) and pH optimum of the enzyme activity was 7.5-8.0. Of various inhibitors, *p*-chloromercuriphenylsulphonate, diisopropyl phosphorofluoridate and *o*-phenanthroline showed strong inhibitory effects. These results suggest that the enzyme is a metal enzyme and that -SH and -OH residues represent essential functional groups of the enzyme.

213

SIGNIFICANCE OF THE UNEVEN DISTRIBUTION OF GABA(γ-aminobutyric acid) IN THE CNS(central nervous system). OKADA, Y., Dept. Neurochemistry, Tokyo Metropolitan Institute for Neurosciences, 2-6, Musashidai, Fuchushi, Tokyo

The regional GABA distribution in the rat CNS was studied together with that of GAD(glutamate decarboxylase), GABA-T(GABA-transaminase) activity and glutamate in the same sample dissected from each single region. Furthermore, GABA concentration in each region after decapitation method(DM) was compared with that after fixing the brain by microwave method(MW). High concentration of GABA was found in substantia nigra, medial forebrain bundle, olfactory tubercle, superior colliculus and hypothalamus(60-80 mmol/kg prot.). The distribution of glutamate and GABA-T activity did not coinside with the pattern of GABA distribution. The GAD distribution was in good agreement with that of GABA. GABA concentarion of the whole brain measured after DM was 130% of that after MW. The regional GABA distribution obtained by DM did not agree with the distribution pattern by MW. It was found that both GAD and GABA-T activity in each region must be considered for the explanation of this discrepancy namely, for the post-mortem change of regional GABA distribution.

214

DISTURBANCE OF INTRA-AXONAL TRANSPORT OF PROTEINS IN A STRETCHED AXON OF APLYSIA. H. KOIKE & K. OHTA, Dept. Neurophysiol., Tokyo Metropolitan Institute for Neurosciences, Fuchu City, Tokyo.

Aplysia nerve can be stretched up to about 5 times of its resting length with full ability to conduct axonal impulses. At comparable conditions of nerve stretching, intra-axonal transport of proteins was examined. [^{3}H]proline was injected into a cell body of a giant neuron of Aplysia, and the neuron was cultured for up to 10 hours at 25°C. Following the culturing, the cell body and the axons sectioned at 1 mm length were homogenized in ice-cold 10% TCA solution. The radioactivity recovered from TCA precipitate represents the amount of proteins newly synthesized in the cell from the [^{3}H]proline, and that from TCA solute represents the free amino acid. The proteins moved down the axon at their apparent maximum speed of 2-3 mm/hr, when the nerve was cultured at its resting length. With gentle stretching to remove zigzagging of the axon in the nerve sheeth, the apparent velocity increased to about 3-4 mm/hr, and it remained at the same value in the nerve overstretched up to 2 times of its resting length. Further elongation of the axon seriously injured both the speed and amount of protein transport.

215

SPATIO-TEMPORAL RECEPTIVE FIELD IDENTIFICATION OF CATFISH RETINAL NEURONS.
HIDA, E. National Institute for Basic Biology, Okazaki, 444.

Spatio-temporal receptive fields of channel-catfish, Ictalurus punctatus, retinal neurons were identified by cross-correlating the light input, the spatio-temporal white noise, with the cells' response to the input. The spatio-temporal white noise was the TV snow seen on unused television channel and cross-correlation between the input (TV snow) and output (cells' response) was performed photographically.
Main conclusions drawn are:
1) Bipolar cells, both on- and off-center types, had a simple and almost circular receptive-field center which had the (maximum) diameter of about 400 microns.
2) Both types NA and NB (amacrine) cells had a large, elliptic receptive-field center whose major axis was parallel to the fish's field of view.
3) Ganglion cells, both on- and off-center types, were classified into two types, one with a small receptive-field center and the other with a large center.
The center of the small field cells was similar to that of the bipolar cells and the center of the large field cells was similar to that of the type N cells.

216

MUTATIONS AFFECTING ERG AND STRUCTURE OF THE OPTIC GANGLIA IN *DROSOPHILA*.
ISONO,K., TSUKAHARA, Y. AND MIZOGUCHI,J.* Res.Ctr.for Appl.Inf.Sci., Tohoku Univ. and *Dept.of Anat., Yamagata Univ. Sch. of Med.

Two X-linked ERG mutations, both affecting morphology of the optic ganglia were studied with gynandromorphic head mosaics. $rdgA^{LS4}$ causes severe retinular cell degeneration with elimination of ERG response and, in addition, large vacuolar structures are found in the external plexiform layer of the lamina and the distal medulla. Another mutation, rof^{H43}, causes a typical ERG abnormality without evident retinular structural change but with cell degeneration in the lamina monopolar cell layer and the cortex of the optic lobe. By examining various types of head mosaicism it was shown that the degeneration in *rdgA* develops from the retina to the optic ganglia, being primarily determined by the genotype of the retinular cells. However, in *rof* mosaics, ERG and the structural abnormality did not correspond to the genotype of the retina, suggesting an autonomous expression of the gene in the optic ganglia.

217

THE EFFECT OF EFFERENT FIBERS IN THE OPTIC NERVE ON THE RETINAL GANGLION CELLS OF A MARINE TELEOST, NAVODON MODESTUS.
NAGAI, Y., SUZUKI, H. and TASAKI, K. Dept. of Physiol., Tohoku Univ. Sch. of Med., Sendai

The optic nerve of a file-fish, Navodon modestus, consists of numerous fine bundles which can be separated by simple operation with fine forceps. Recordings from proximal stumps of the cut nerve bundles showed that efferent fibers are spontaneously discharging and can be activated by visual stimulation of the ipsilateral eye. In some cases illumination of the contralateral eye produces a weak response. The most effective stimulation to elicit the efferent discharges is to touch the skin. The sensitive skin areas to tactile stimuli (tactile receptive fields) explored with a Frey's hair over the body wall were found to localize around the ipsilateral eye, most densely aggregating in the dorso-ventral quadrant. Many distal stumps respond to diffuse illumination at "on" and "off" of the stimulus only transiently, and light-elicited afferent discharges are greatly enhanced when the tactile receptive fields are continuously stimulated. It was also observed that the responsiveness of an intact bundle to photic stimulation is markedly decreased by cutting the nerve centrally. From these observations it was concluded that the effect of the retinal efferent fibers in the teleost optic nerve is predominantly excitatory.

218

The amplitude of ERG of the Limulus lateral eye increases at night and decreases during day time, whereas the frequency of the spontaneous optic nerve discharges becomes less at night than during the day. These circadian rhythms are mediated by the activity of efferent fibers in the optic nerve trunk (Barlow et al., Science, 197, 86-89, 1977). The efferent signals to the lateral eyes either under normal circadian clock or electrical stimulation of the optic nerve trunk increase the amplitude of the photoreceptor response to light and decrease the frequency of descrite potential fluctuations in the dark (Kaplan and Barlow; Nature, 286, 393-395, 1980).
We report here that cutting the optic nerve at night reverses the action of the circadian clock on the photoreceptor and eccentric cell activities. After nerve section the frequency of the spontaneously occurring discrete waves increases and the amplitude of the receptor potential decreases. The signal-to-noise ratio of the retinular cells is thereby improved. No consistent changes in cell resting potential were detected after nerve section. Spontaneously occurring nerve impulses recorded from eccentric cells in situ were triggered by discrete fluctuations in membrane potential; impulses caused by injury (nerve section) were not. The potential fluctuations of eccentric cells arise from discrete waves of retinular cells via electrical coupling of the retinular cells to eccentric-cell dendrite. The origin of spontaneous optic nerve activity in situ can thus be traced to the photoreceptors.

219

GASTROPOD RETINA AND THE DUPLICITY THEORY. SUZUKI, H., NAKAYE, T. and TASAKI, K.
Dept. of Physiol., Tohoku Univ. Sch. of Med., Sendai.

Retinae of thirteen species of gastropods were examined by an electron microscope and were classified into two groups. The retina of two species of marine snails have only one type of photoreceptor. On the contrary, the retina of five land snails, two slugs, one freshwater snail and three marine snails composed of two types of photoreceptors. The dark adaptation curve and the response-log I relation were obtained from the ERG and spike discharges recorded by a suction electrode. The retina which has only one type of photoreceptor showed a simple sigmoid curve, indicating the presence of a single process. On the other hand, a clear break, which might correspond to the Kohlrausch's kink in the vertebrate retina, was shown in the dark adaptation curves obtained from the retinas which consist of two types of photoreceptors. The response amplitude-log I relation also showed a complex curve which suggest to be composed of two components with different sensitivities. These results were consistent with those of intracellular recording analyses of photoreceptor sensitivities and morphological observations. Thus the duplicity theory can be extended to the terrestorial gastropods and some of the marine species.

220

CATECHOLAMINE-ACCUMULATING CELL DENSITIES IN THE RETINA OF DIFFERENT SIZED GOLDFISH. NEGISHI, K. Dept. of Neurophysiol., Neuroinformation Res. Inst., Sch. Med., Univ. Kanazawa, Kanazawa

The morphology, cell density and distribution pattern of catecholamine-accumulating (CA-) cells were studied by means of histofluorescence technique with retinal flatmounts from different sized goldfish (Carassius auratus), ranging from 4.4 to 20.5 cm in body length (tip-to-tip). The characteristics found commonly in all fish of different size were as follows; the CA-cell density (number/mm^2) is higher in the periphery than elsewhere; the size of CA-cells is smaller the higher their density; large cells extend 3-5 dendrites irregularly in the inner plexiform layer, while small cells in the periphery extend 2 dendrites in a direction parallel to the retinal margin. The CA-cell density was higher (x2.6) in small fish than in large ones; the average density reduction was 38% with fish growth. The CA-cell number/retina, on the other hand, increased at a rate of approximately 800 cells/cm of body length, accompanied by an increase (x10) of the total retinal area. In parallel with the above changes in growth, the somata of CA-cells became larger in size, the arborization of their dendrites wider, and the cellular arrangement in radial rows, seemingly fanning out from the optic disc towards the retinal margin, appeared to become more defined.

221

The effects of GABA on the on-center bipolar cells in the carp retina.

Shimoda, Y.* Watanabe, S.-I. and Murakami, M. *Dept. of Physiol. Kyorin University, Dept. of Physiol. Keio University.

In our previous reports, it was concluded that H1 cell had negative feedback synapses mediated with GABA onto cones. A role of this feedback synapses on the mechanisms of the antagonistic receptive field of the on-center bipolar cells was studied in the isolated carp retinas. The on-center bipolar cells used in this experiment were classified into three classes, that is, the red cone type, the mixed type having both red cone and rod inputs and the rod type. When the retina was perfused with GABA, the spectral responses of both red cone and mixed types were modified by selective suppression of the responses to red light, but GABA had no effects on the rod type bipolar cells. Applying cobalt known as a synaptic transmission blocking ion, the bipolar cells were depolarized and the photic responses were ceased. As GABA was administered in addition to cobalt, there was no more effects on the bipolar cells, suggesting that the on-center bipolar cells had not receptive site of GABA. Consequently, in the red cone and mixed types of bipolar cells, the peripheral photic responses were transmitted through the H1 cells to the cone at the center with reversing polarity, then transmitted to the on-center bipolar cells.

222

THE EFFECTS OF STRYCHNINE AND BICUCULLINE UPON THE RESPONSES OF X- AND Y-CELLS OF THE ISOLATED PERFUSED EYE-CUP PREPARATIONS OF THE CAT.

SAITO, H. NHK Broadcast. Sci. Res. Labs., Kinuta, Setagaya-ku, Tokyo

The effects of strychnine and bicuculline, the respective antagonists of glycine and GABA, upon the inhibitory responses of X- and Y-type retinal ganglion cells of the cat were studied using isolated and perfused eye-cup preparations. The surround inhibition of the on-center X-cell was blocked by strychnine. On the other hand, that of the on-center Y-cell was blocked by bicuculline. In the off-center X/Y-cells, bicuculline blocked both of the center and the surround responses, but strychnine did not. These drugs also affected the background firing of the ganglion cells differently. In the on-center X/Y-cells, both strychnine and bicuculline had the effects to increase the background discharge rate. In the off-center X/Y-cells, strychnine increased, but bicuculline decreased the background discharge rate. These facts suggest that several kinds of inhibitory interneurons may be involved within the neuronal networks which characterize the discharge patterns of the ganglion cells. At present, it could be said that the on-center X-cell might have a glycine interneuron and the on-center Y-cell a GABA interneuron in the neuronal path of the surround mechanism.

223

VISUAL EXCITATION AND INTRACELLULAR CALCIUM

YOSHIOKA, T., HORI, H. AND TAKENAKA, T. Dept. of Physiol. Sch. of Med. Yokohama City Univ. Minami-ku, Yokohama

Membrane fraction of microvilli was isolated from the retina of squid and octopus and subjected to the membrane phosphorylation experiment. A continuous light irradiation and the addition of Ca-ionophore, A23187 to the incubation solution containing ^{32}P ATP, accelarated the incorpoation of ^{32}P into rhodopsin, retinochrome and 17,000 dalton protein, selectively. Polyphosphoinositide, DPI and TPI, were phosphorylated simultaneously, under the same condition. The time course of the phosphorylation of the two, protein and phospholipids, were identical. Furthermore, ^{32}P incorporation into these proteins and lipids were reduced in the presence of phosphodiesterase inhibitor, 3-isobutyl-1-methylxanthin (IBMX). The electrophysiological responses to the effect of A23187 and IBMX were also compared with these biochemical responses. By the addition of these drugs to the retina, the dark adaptation process was markedly inhibited. These observations led to the idea that photoreception triggered the breakdown of PI and phosphorylated T(D)PI and protein.

224

TEMPERATURE DEPENDENCE OF STATIC PHASE OF PHOTORECEPTOR POTENTIAL

KIKUCHI, R. & HIROSE, T. Department of Physiology, Tokyo Women's Medical College
Kawada-cho, Shinjuku-ku, Tokyo 162

The static phases of the photoreceptor potentials recorded from the retinular cells of the horseshoe crab in response to long illumination have been studied at different temperature ranging between 10°C and 23°C. Their amplitude was temperature dependent as reporded previously. Their temperature coefficient was positive and dependent upon the intensity of illumination, and the lower the intensity the smaller the coefficient. However, even their high values were smaller than those of dynamic phase but larger than those of the receptor potential of Paccinian corpuscles.

The membrane potential in the dark was also temperature dependent, and larger dependency was found after prolonged strong illumination. The temperature coefficient of the spike amplitude was longer than that of other spike potentials. Less values of these temperature coefficients were obtained when these potential changes were recorded from the eccentric cells. It was suggested that the changes in the chemical process of the photopigment, the electrogenic Na-pump and the attenuation factor due to temperature alteration are responsible for the higher temperature coefficients of this photoreceptor than those of other receptors.

225

INTERCONNECTION BETWEEN PHOTORECEPTORS AND HORIZONTAL CELLS IN THE TURTLE RETINA (GEOCLEMYS REEVESII).

OHTSUKA, T. Dept. of Information Physiol., National Inst. Physiol. Sci., Okazaki 444

Contacts between photoreceptors and two types of horizontal cells (HC) were studied by morphological analysis of HRP-injected HCs. In flat-mounted preparations, the types of photoreceptors above each HRP-filled HC could be identified by the color of their oil droplets, and as well the HRP-filled cells, particularly their fine dendritic processes, could be drawn with the aid of a camera lucida and oil immersion objectives. Since the diameters of the photoreceptors exceed those of the HC dendritic terminals, then superimposed tangential views can illustrate the patterns of interconnections between them. The observations are summated as follows (with numbers indicating the ratio of number of each type of contact: number of total contacts)

	rod	red cone	double cone	green cone	blue cone
H1CB	0	35	33	27	5
H1AT	17	26	38	10	8
H2	0	43	4	11	42

(H1CB: L-type HC cell body; H1AT: L-type HC axon terminal: H2, biphasic C type HC)
These results are consistent with the hypothesis that differences in connections between photoreceptors and HCs produce different postsynaptic responses.

226

SYNAPTIC ORGANIZATION OF THE OUTER PLEXIFROM LAYER IN THE CATFISH RETINA

SAKAI, H. National Institute for Basic Biology

Electron microscopic observations were made on the HRP injected horizontal and bipolar cells to reveal their contact patterns with receptor terminals. Horizontal-cell dendrites were lateral processes in the triads at the synaptic ribbons. All the bipolar cells penetrated into the terminal invaginations. Dendrites from the off-center bipolar cells made contacts with the ribbons, taking central positions over 1 μm along the apex of the synaptic lamella, and dendrites from the on-center bipolars did not make direct contacts with the ribbons. This suggests that the direct synaptic ribbon contacts could be the site of sign non-inverting and the indirect synaptic ribbon contacts the site of sign inverting synaptic transmission from the receptors to the horizontal and bipolar cells in catfish.

The morphological counterparts of functionally suggested feedback synapses from horizontal cell to receptors were chemical synapses with aggregation of spherical synaptic vesicles and the membrane thickenings on the pre- and post-synaptic sites. They were made onto the telodendria of cones.

227

CONNECTIONS BETWEEN CONES AND HRP-INJECTED CONE HORIZONTAL CELLS OF THE DACE. UEKI, K. and HASHIMOTO, Y. Dept. of Physiol., Tokyo Women's Medical College, Shinjuku-ku, Tokyo 162

The dendritic contacts of HRP-injected cone horizontal cells were examined in the electron microscope. Two different types of cone terminals may be distinguished with respect to the shape and localization of their synaptic endings. The one type is small and ovoid in shape containing only one synaptic ribbon and located close to the rod nucleus in the outer plexiform layer. This type will be referred to as the small type. The other type, referred to as the large type, is characterized by a large conic-shaped terminal containing many synaptic ribbons which is more complex than former type. This terminal is located close to the horizontal cells in the outer plexiform layer. These morphological differences of cone terminals are corresponded to α - and β - type of rod synapses in guinea pig and rabbit retinas described by Sjöstrand (1953).

The dendrites of the L-type horizontal cell invaginate into the large type cone terminals forming spinules of Wagner (1980) as the lateral elements of synaptic ribbon complex (triad). It was unable to find the dendrites to the central elements of the triad.

The dendrites of the C-type horizontal cell invaginate into the small type cone terminals forming spinules as the lateral elements of the triad. Again, we could not find the dendrites to the central elements of the triad. In this case, the dendritic field was more than 50 um in diamenter and the total terminal number which the dendrites invaginated was more than 90.

228

INTERACTION OF HORIZONTAL CELLS AS THE BASIS OF OPPONENT-COLOR PROCESSES TOYODA, J., FUJIMOTO, M. AND KUJIRAOKA, T. Dept. of Physiol., St. Marianna Univ. Sch. of Med., Kawasaki

It has been suggested that the interaction among horizontal cells including a negative feedback to cones plays an indispensable role in the transduction from a trichromatic to an opponent-color process. To test this hypothesis, two horizontal cells were recorded simultaneously in the carp retina and the effect of polarization by current of one of them on the other was studied. Hyperpolarization of an L-type cell elicited a depolarizing response in an RG-type cell, and depolarization of the same L-type cell a hyperpolarizing response in the latter. Polarization of RG-type cells, on the other hand, did not elicit a detectable potential change in L-type cells. The same type of interaction was observed between RG- and RGB-type cells. The effect of polarization of L-type cells was also observed in some cones. The results are consistent with the model of Stell and Lightfoot on the goldfish retina in which the depolarizing response of RG-type cells to red light is mediated by a feedback from L-type cells to green cones and the depolarizing response of RGB-type cells to green light is mediated by a feedback from RG-type cells to blue cones.

229

ACTIVATING AND DEPRESSING EFFECTS OF LIGHT ILLUMINATION ON THE GANGLIONCELL AND THE B-WAVE OF THE FROG RETINA. ANDO, H. and HANAWA, I. Dept. of Physiol., Kobe Univ. Sch. Med., Kobe, 650.

A prolonged weak adapting illumination increases the amplitude of the PIII response from the dark adapted frog retina. Using the ganglion cell spikes and the b-wave of the bullfrog retina as indicators of higher-order neurons' activity, effects of a prolonged weak adapting illumination were studied. This curious effect of the adapting light was also observed from a part of the preparations. In 33% of the cases, the amplitude of the b-wave was increased temporarily by the same adapting light which increased the PIII response. In 12.2% of the ganglion cells, the estimated magnitude of the input signal to them was increased after the adapting illumination. Findings suggest that the weak adapting light has at least two relatively independent effects on the dark adapted retina. One is well known suppressing effect and the other is the enhancing effect which has its origin in the enhancement of the receptor response and is transmitted through the higher order neurons in the retina.

230

FREQUENCY ANALYSIS OF E-RESPONSES IN THE CARP RETINA.
UMINO, O., KATAGIRI, Y. AND WATANABE, K. Dept. of Physiology, Tokyo Women's Medical College, Tokyo

E-response evoked in the horizontal cell by transretinal electrical pulse stimulation can be treated as an impulse response of the system receptor terminal→horizontal cell. The waveform of E-response depends on the following parameters, i.e., strength of the current pulse, intensity and the pattern of the retinal illumination, etc. The Fourier transform of each E-response was calculated to obtain the power and the phase spectra. Generally, the power spectrum of E-response shows characteristics of a low-pass filter with a cutoff frequency at 2-20Hz, above that the power decreases at a rate from 10 to 20db/decade, and the cutoff frequency lowers with the increase in the electrical stimulus strength. Under annular or field illumination, an inflection or a dip was observed arround the peak of E-response in the time domain. In the case of field illumination, E-response showed a considerable phase-lag in the frequency domain up to 50Hz, while in the case of annular illumination, an extreme decrease in power occurred arround 50Hz. In a preliminary experiment, application of bicuculline produced depolarization of horizontal cell with slightly increased hyperpolarizing response to light, but the effect of the agent on E-response was not clear.

231

SPATIAL PROPERTIES OF S-POTENTIAL COMPONENTS IN CARP RETINA. TERANISHI, T., KATO, S. AND NEGISHI, K. Dept. of Neurophysiol., Neuroinformation Res. Inst., Sch. Med., Univ. Kanazawa, Kanazawa

Intracellular recordings of horizontal cells were made in isolated carp (Cyprinus carpio) retina. The area-response amplitude relation and the potential decay with distance were explored on each component of S-potentials induced by appropriate monochromatic lights. The response amplitude was increased linearly as the spot diameter was increased from 0.5 to 5.1 mm, except for scotopic L-type response, which was increased exponentially. The potential decay curve for each component of S-potentials, explored with displacement of a 0.5 mm light spot in a range of 5 mm length over the retinal surface, was found to vary with different type cells and different components of a given C-type cell. The potential decay of the hyperpolarizing responses of scotopic L-, photopic L- and C-type cells formed a monomodial curve; the maximal amplitude response was obtained at the recording point. On the other hand, the potential decay of the depolarizing and second hyperpolarizing response of C-type cells drew a bimodial curve, in which the amplitude of response at the recording point was slightly smaller than those obtained at some distances on the bilateral sides. The results indicate that different components of S-potentials differently spread laterally along even a given C-type cell layer.

232

RESPONSE PROPERTIES OF EXTERNAL HORIZONTAL CELLS IN THE GOLDFISH RETINA IN VIVO.
TAUCHI, M., YANG, X.-L. AND KANEKO, A. Dept. of Information Physiol., National Inst. Physiol. Sci., Okazaki 444

The types of photoreceptors converging to external horizontal cells were identified and their interaction was studied by analyzing the responses recorded intracellularly in the live, immobilized goldfish. Under dark-adapted conditions, responses to flashes of short wavelength (below 550 nm) showed a waveform with initial transient, decay to a plateau and quick return to baseline at the light offset. Responses to flashes of long wavelength (above 600 nm) had a slow rise-time and slow return to baseline. The slopes of the intensity-response amplitude curves at short wavelengths were steeper than those at long wavelengths. Spectral sensitivity peaked at between 550 and 600 nm. These findings suggest that the external horizontal cells receive inputs from green-sensitive and red-sensitive photoreceptors.

These two inputs did not simply add to each other: (1) the green input cannot be isolated by selective adaptation and (2) green (502 nm) and red (706 nm) flashes given simultaneously evoked significantly larger response amplitudes than either the sum of responses evoked by each flash alone or the response amplitude predicted from independent red and green inputs. We speculate that the two types of inputs facilitate each other at the presynaptic level.

233

SENSITIVITY CHANGES DURING LIGHT- AND DARK-ADAPTATION IN INTERMEDIATE HORIZONTAL CELLS OF THE GOLDFISH RETINA IN VIVO.

FUKUROTANI,K. AND KANEKO, A* Dept. of Electronic Engineering, Toyama Univ., Takaoka 933, and *Dept. of Information Physiol., National Inst. Physiol. Sci., Okazaki 444

Intracellular recordings were made from intermediate horizontal cells (MHC) of live, immobilized goldfish, under conditions which produced light- and dark-adaption. We sought to study changes in the sensitivity of the rod system, because MHCs are generally thought to be driven solely by rods. In the presence of a background which produced a 20 mV hyperpolarization (half saturated response), the threshold (determined as the light intensity required to produce 0.5 mV criterion response) was elevated by 0.25 log units promptly, stayed at a steady level and returned to the control value within a minute after the termination of background illumination. With nearly-saturating background intensity, the threshold rose rapidly by about 2 log units, but sagged to a lower plateau. By 3 min after removal of the background, the sensitivity of the MHC returned to its dark-adapted value. The time course of dark adaptation increase with the intensity of the background light. Furthermore, the recovery after a strong background displayed early and late phases. During the recovery phase, the threshold showed a linear relationship to the membrane potential.

234

TRANSRETINAL CURRENT APPLICATION AND THE ERG: ITS CHANGES IN THE EYE CUP AND ISOLATED PREPARATIONS.

SASAKI YUTAKA. Dept. of Physiol., Tokai Univ. Sch. of Med., Isehara, Kanagawa, 259-11.

Using eye cup preparation and isolated inverted retina of the bullfrog, changes of the ERG by the locally applied transretinal direct current were studied. In the eye cup preparation, the current passed in the vitreous-negative direction between a current pipette and an indifferent Ag-AgCl plate enhanced b- and d-waves of the ERG which was recorded near the site of current application on the surface of preparation, while the current in the vitreous-positive direction depressed the PII component resulting in two negative transient deflexions at 'on' and 'off' of each photic stimulus. When the vitreous-negative current was strong, however, the PII component was rather depressed, instead of enhanced and the configuration of the ERG became a sustained negative wave during illumination. In the isolated inverted retina, changes observed were essentially the same as in the eye cup but in reversed polarity. Transretinal current application also had its after-effects on the ERG. In the eye cup preparation, the amplitude of the ERG was smaller after cessation of the vitreous-negative current, and it was larger after the vitreous-positive current than the control response before current. In the isolated inverted retina, however, the after-effect, if any, seemed to be different from those found in the eye cup preparation and was difficult to describe in a definite way.

235

RELATIONSHIP BETWEEN THE SLOW PIII RESPONSE AND POTASSIUM ION IN THE ISOLATED BULLFROG RETINA.

MATSUURA, T. AND WADA, T. Dept. of Physiol., Sch. of Med., Kinki Univ. Osaka

Relationship between the aspartate-isolated slow PIII response and light-induced decrease of extracellular potassium ion concentration, $[K^+]_o$, in the photoreceptor layer was studied using isolated bullfrog retina. A pair of K^+ microelectrode and conventional micropipette electrode, which was set in parallel and close together in their tips, was inserted into the photoreceptor layer and fixed at the region where maximal light-induced $[K^+]_o$ decrease was observed. A close correlation between the slow PIII response and the $[K^+]_o$ decrease was found for all variations in the stimulus parameters, and in the case of the application of 0.5 mM barium chloride in perfusate which slowly diminished slow PIII response in amplitude and lengthened its peak latency. These results provided direct evidences to support the hypothesis that the slow PIII response is produced by the Müller cells as they hyperpolarize in reponse to the $[K^+]_o$ decrease around photoreceptors.

236

RECONSTRUCTION OF ROD RESPONSES IN FROG RETINA. YAMADA, M. Applied Optics Sec., Electrotechnical Lab., Ministry of International Trade and Industry, Umezono, Sakuramura, Niihari-gun, Ibaraki.

Intracellular responses of rod in frog retina were reconstructed by solving differential equations, which described visual excitation model of rod, using a digital computer. The reconstructed curves were compared with the time courses of the responses recorded from red rod in bullfrog (Rana catesbiana) retina. The calculation of the simultaneous differential equations of the eleventh order was treated by Euler-Romberg method. Most of the parameters in these equations were modified those of Cervetto et al. (1977). The model was constituted of chemical reaction processes controlling concentrations of blocking molecules which block ionic channels of the membrane, and equivalent circuit of the rod membrane. It had two parallel non-linear conductances such as light dependent conductance and voltage-and-time dependent conductance. The reconstructed responses simulated the light responses observed from rod to various intensities of photostimuli very well. Damped oscillatory responses to photostimulus under light adapted condition were also simulated by the model without introducing feedback from secondary neurons.

237

INTERCELLULAR COUPLING AND SPONTANEOUS DARK NOISE IN RODS OF THE BULLFROG RETINA. NAKATANI, K. AND TANAKA, I.* Dept. of Physiol. Tokyo Women's Medical College Shinjuku-ku, Tokyo, *Nat. Rehab. Center for the Disabled, Tokorozawa, Saitama.

Intracellular responses to a flash of 510 nm light were recorded from red rods of the bullfrog retina. In order to study electrical coupling between the rods, the spatial profile of rod response to a 30 μm spot of light were determined. The peak response amplitudes (E_x) were found to decline along the distance (x) from the centered position, and Ex was expressed as a modified Bessel function, $ak_0(x/\lambda)$. Where, the mean length constant (λ) was 30 μm. A square grid model of ohmic electrical coupling was applied to the results. Using the measured values of length constants, input resistances and interrods distances on the preparation, the plasma membrane resistance of each rod at the resting potential and the coupling resistance were calculated as about 4000 MΩ and 170 MΩ for the square grid model respectively. Intracellular recording from the rods revealed that in darkness the potential fluctuated spontaneously about its mean level. The magnitude of random noise was several hundred μV and varied from cell to cell. These time courses were similar to that of the response to a very weak flash of light. The fluctuations were reduced during and just after bright illumination, but were independent upon the membrane potential to a certain extent.

238

SIGNAL TRANSMISSION AMONG CATFISH RETINAL NEURONS
SAKURANAGA, M.* and NAKA, K-I., * Dept. of Physiol., Nippon Medical School, Bunkyo-ku, Tokyo, 113 National Institute for Basic Biology, Okazaki, 444

White-noise modulated current was injected into the horizontal cells and resulting responses were recorded from other interneurons in the retina of channel catfish, Ictalurus punctatus. Evoked responses were crosscorrelated with the input to produce the first and second order Wiener kernels. Characteristics identifications of neuron chains leading from the horizontal cell to other interneurons were established: The kernels from horizontal-to-bipolar cell neuron chain indicated that the signal was transmitted in a quasi-linear fashion through either sign-noninverting (BA: on-center type) or sign-inverting (BB: off-center type). This reinforced that the signal within the S-space, lamina formed by horizontal cells, should be recognized as neutral rather than either excitatory or inhibitory. On the other hand, characteristic nonlinearities appeared in the signal transmission from the horizontal cells to the proximal cells. In the type NA, NB and ganglion cells the component of the second order kernel was almost comparable to that of the first order, whereas in the type C cells the former far exceeded the latter. We conclude that signal transformation in the outer retinal layer was essentially linear and nonlinearities appeared when the signal in the layer was transmitted to the inner layer.

239

RELATION BETWEEN BRIGHTNESS SENSATION OF THE POLARIZED LIGHT AND THE ROTATING DIRECTION OF THE LIGHT.

TSUKEDA, K. Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Tokyo.

The monochromatic, linearly polarized light oscillating to upper and lower sides in the geomagnetic field was received perpendicularly at the fovea of the complete dark-adapted eye. The brightness sensation was measured with grey filters and the obtained values were compared between the left and right foveas. Red light was felt brighter the left eye than the right, and blue light was felt slightly brighter the right eye than the left. And almost no difference in brightness was noticed between two eyes with white light. Physically it is known that the absorption coefficient of the left rotating light is greater than that of the right rotating light,and the left rotating light is longer wave side of the absorption spectra. And the lamella of cone cells at fovea is about 2000 Å thick. Therefore it can be noted that red light is received like left rotating wave, blue light is received like right rotating wave, and the reception of white light is thought to be result of cancellation between left rotating red-light and right rotating blue-light. The rotating direction described here is respectively that of light under way.

240

Influence of Hepatic Function on the Riboflavin Content of the Choroid in Frogs

FUJISHITA, S. Dep. of School Nurse, Osaka Kyoiku Univ., Hirano-ku, Osaka.

The choroidal riboflavin content was estimated to be in a wide range between 70 and 1,300 μg/g. The riboflavin content of the frog choroid can be expressed as a function of L and M, where L and M are FAD content (μg/g) of the liver and of the femoral muscle (M. quadriceps femoris) of frogs, respectively. It was suggested that L and M represented the activity level of the liver and the nutritive condition riboflavin in the whole body, respectively.

241

Rod outer segments and retinal pigment epithlium of the developing rat: Effects of continuous light or dark on shedding rhythm and fine structure.

M. Tamai and T. Yagi Dept. of Ophthalmol., Tohoku Univ. Sch. Med. Sendai, 980 Japan

The diurnal and circadian rhythm in the rod outer segment (ROS) shedding and phagocytosis are established at 15 days of age when the rat is raised in the 12 hours-12 hours (LD) cyclic lighting condition (Tamai and Chader, 1979). In the present experiment we examined whether or not these biorhythms still develop even if the animal were raised in continuous light (LL) or dark (DD) from five days after birth. Fine structure of ROS and retinal pigment epithelium (RPE) of each group of animals were also examined by electron microscopy. When the animal was raised in LL or DD, no diurnal changes in the synchronous shedding and phagocytosis were encountered untill 45 days of age. Minimum number of phagosomes (less than 10 phagosomes per 200um length of RPE) were found at every stages of development. ROS were well developed even if the animal was raised in the LL and DD without synchronous shedding of ROS. The number of discs per one micron did not change at the proximal and distal part of rod, but was different by lighting conditions. It was the largest in LL (35.8±1.4 per μ) and almost the same in outhers (LD: 31.0±1.0, DD: 31.8 ±1.5). Fine structure of RPE showed marked difference in these conditions. Mitochondriae were located near the basal infolding in DD but scattered in the soma in LL and LD.

242

SPATIO-TEMPORAL RECEPTIVE FIELD OF GANGLION CELL IN DEVELOPING RETINA

SHINGAI, R. Dept. of Inform. Sci., Fukui Univ., Fukui, 910

The spatio-temporal receptive field (STRF) of ganglion cells in retina of tadpole and frog was measured using spatio-temporal white noise stimulus and cross correlation method. The STRF of tadpole retina was round. Most of them were mono- or diphasic on the latent period, and rarely triphasic. The STRF of frog were round, eliptic or distorted shapes. They were mono-, di-, or triphasic. Latent period of tadpole was larger than that of frog. In some ganglion cells, the STRF obtained by this method was unclear and/or invisible. Those cells were scarcely found in tadpole retina, but frequently found in frog retina. This fact shows ganglion cells of frog have more non-linear part of response than tadpole retina.

243

PHOTOTACTIC BEHAVIOUR IN RELATION TO RECEPTIVE FIELD PATTERNS OF FLY PHOTORECEPTORS

MIMURA, K. Fac. of Liberal Arts, Nagasaki Univ., Nagasaki 852

In order to examine whether the peculiar receptive field patterns which are determined electrophysiologically in photoreceptors of flesh-fly Boettcherisca peregrina contribute to fly behaviour, the phototactic behaviour in response to eight kinds of illuminated targets including those having the same shapes as the receptive field patterns were studied.

Discrimination of the visual patterns being tested was clearly demonstrated by the preference experiment. The angle between the longitudinal body axis of the fly and the direction to the target at the turning point, where the walking fly changed its direction towards the target, showed correlation with the distribution of photoreceptors having the peculiar receptive field patterns within the compound eye (Mimura, J. Comp.Physiol., 141, 349-362, 1981). The role played by sensory processing within the photoreceptors in the first step of pattern discrimination was discussed.

244

PHOTOEXCITIVE NEURONS IN THE BRAIN AND EFFERENT NEURAL CONTROL ON THE EYES OF ORB WEAVING SPIDERS.

YAMASHITA, S. AND TATEDA, H. Dept. of Biol., Fac. of Sci., Kyushu Univ., Fukuoka 812

Efferent spikes were recorded from the optic nerves of the orb weaving spiders, *Argiope bruennichii* and *A. amoena*. Frequency of efferent optic nerve spikes showed a duirnal periodicity which is maintained in constant darkness. In addition it was increased by illumination of the brain in which certain neurons must therefore be light activated. When the brain was bathed in cobalt-containing saline, efferent spikes under the dark were completely lost. They, however, were elicited by illumination of the brain showing that the efferent neurons themselves were photo-excitive. Efferent spike rates decreased during illumination of the eyes, but they greatly increased shortly after the intensity of the illumination was made slightly lower. Resting potentials of the photo-receptor cells of the eyes were rapidly hyperpolarized by such increased efferent discharges. At the same time their saturated photoreceptor potential amplitude increased. In addition increased efferent spike rate more slowly augment the receptor cells' sensitivity to light stimulation, i.e. lower their thresholds.

245

PINEAL PHOTORECEPTOR RESPONSE TO SINUSOIDALLY MODULATED LIGHT.
SEGI,K., NAKAMURA,T. & MORITA,Y.* Grad.Sch.Electr.Sci.Technol., Shizuoka Univ., Hamamatsu, *1st Dept. of Physiol., Hamamatsu Univ. Sch. Med.

The pineals of the lower vertebrates are direct photosensitive. In the present study, the frequency transfer properties of the pineal photoreceptors of the lamprey, Lampetra japonica, were investigated intracellularly. Sinusoidally modulated light was obtained through a spinning and a fixed polarizer. The response were also sinusoidal except in the lower frequency region, where higher harmonics appeared. The plotted curve of the amplitude against the sinusoidal stimulus showed a peak in contrast to the sigmoidal curve obtained by the rectangular stimulation. The amplitude and the phase were measured for each frequency to plot the Bode diagram. The decrement of the amplitude was about 30dB while the frequency increased from 0.5 to 3Hz. The gain and phase characteristics were able to simulate by the linear model with 4th order transfer functions. The CFF of the pineal did not increase markedly with stronger illumination in contrast to the ERG. These findings support the view that the pineal photoreception are comparable to those of rods contrary to the morphological similarities between pineal receptors and cones.

246

AREA AND LATENCY OF DISCRETE POTENTIAL IN LOCUST PHOTORECEPTORS.
TSUKAHARA,Y. Res. Ctr. for Appl. Inf. Sci., Tohoku Univ., Katahira-cho, Sendai

One photon can induce a discrete membrane potential change (bump) in locust photoreceptor. The area and the latency of the bump change at random and mean values of these decrease with light adaptation. In this work the relation between the latency and the area was studied in fully dark adapted photoreceptors and significant correlation was not found between them. It is suggested that the fluctuations in the latency and the area result from probabilistic process in transduction rather than from differences in local adaptation level or location of the bump initiation.

247

LEARNING OF VISUAL TASKS WITH PATTERNS OF LARGE AND SMALL SIZES ON BACKGROUND PLAQUES OF THE SAME SIZE IN MACAQUE MONKEYS.
YAGINUMA, S., WATANABE, J., SATO,T., KIKUCHI, R. AND IWAI, E. Dept. of Behavioral Physiology, Tokyo Metropolitan Institute for Neurosciences, Fuchu, Tokyo 183.

Comparison was made between learning processes on two pattern discrimination tasks in 92 macaque monkeys. Both tasks consisted of the same white paper patterns of a plus-sign and an outline square pasted in the center of the black background square, 14° in visual angle. Only the difference between them was the size of the patterns, which were 10° in visual angle in Task I and 6° in Task II. Sixty-eight monkeys required 144 trials and 67 errors in average to learn Task I, whereas 24 monkeys did 414 trials and 196 errors to learn Task II. It was found that slower learning on Task II than on Task I depended on marked prolongation of the chance level performance rather than on any retardation of the improving process from the chance level to the criterional level. On the other hand, all monkeys showed perfect transfer from Task I into II and from Task II into I. At the initial stage of learning, monkeys used to give strong attention to their response-site. It was concluded therefore that the size factor of the pattern per se is not critical on the ease or difficulty of visual pattern discrimination, but the separation of the site of discriminative cue from the response-site, which is much larger in Task II than in Task I, makes more difficult it to learn Task II than to do Task I.

248

DEPENDENCE OF PLASTICITY OF THE KITTEN VISUAL CORTEX ON EYE MOVEMENTS

TSUMOTO, T. AND FREEMAN, R.D. Sch. of Optometry, Univ. of California, Berkeley, USA

In an attempt to induce a rapid change in binocular responsiveness of a visual cortex neuron, conditioning visual stimulation for 15-20 minutes was given to one eye of 28-day-old kittens anesthetized with N_2O while the cell was monitored physiologically. When the visual conditioning was associated with eye movements induced by electrical stimulation of the thalamic internal medullary lamina (IML), significant changes in ocular dominance occurred in 26 of the 42 cells tested. This change lasted longer than 9 hours after stopping the conditioning. The visual conditioning alone did not exert any significant effects. Also, the change did not occur when the associative electrical stimulation was applied to another site nearby the IML and did not induce eye movements. The same combination of IML and visual stimulation as in the 28-day-old kittens was applied to 3-month-old kittens but resulted in no significant changes in 22 cells tested. In another 28-day-old kitten paralysed with Flaxedil in addition to N_2O anesthesia, the same procedures did not cause any significant changes in 12 cells examined. These results suggest that eye movements as well as monocular visual stimulation may be necessary for a plastic change in binocularity of visual cortex neurons during kitten development.

249

SACCADIC SUPPRESSION IN CONGENITAL NYSTAGMUS.

TAMAI, Y., TSUJIMOTO, T., FUJII, T*., FUNAHASHI, T*. AND KOMAI, N*. Dept. of Physiology and Dept. of Neurosurgery*, Wakayama Medical College, Wakayama.

A saccadic suppression was studied in congenital nystagmus. Perception of a test flash by the subject was indicated by his depressing a push button. Delay of the test flash associated with the nystagmus was varid by computer in order to present the test flash at different times with respect to the eye movement.

The saccadic suppression was observed around the first component in jerk nystagmus: maximum at the early period and minimum at the end of the first component. The suppression curve oscillated between 100% detection and no chance of perception with the same frequency of the nystagmus. In pendular nystagmus, the suppression of vision was noted in both directions of the eye movement. The suppression curve oscillated with small amplitude and in twice the frequency of the nystagmus.

Based on these results a complete recovery of the saccadic suppression seems to exist rhythmically in jerk nystagmus but may not consist in pendular nystagmus.

250

ANALYSIS OF SOMA SIZE AND AXONAL CONDUCTION VELOCITY IN GANGLION CELLS OF THE EASTERN CHIPMUNK'S RETINA.

WAKAKUWA, K., WASHIDA, A., FUKUDA, Y. AND IWAMA, K. Dept. of Neurophysiol., Inst. Higher Nerv. Activ., Med. Sch. Osaka Univ.

Retinas of the eastern chipmunk (Tamias sibiricus) were spread flat and stained with 0.1% cresylviolet. The density of ganglion cell ranged from 2,000/mm^2 to 8,000/mm^2. The soma size of ganglion cell differed according to the retinal eccentricity; in the central retina small to medium-sized cells predominate while in the periphery small cells are most abundant with a good proliferation of large cells. The axonal conduction velocity was determined for each ganglion cell by measuring response latencies to stimulation of the optic chiasm and the superior colliculus. Evidence was obtained for the presence of the three conduction velocity groups; slow, intermediate and fast groups. The axons from the peripheral retina were differentiated into the three groups, whereas those from the central retina belonged exclusively to the intermediate group. The ratio of the extra- to intra-retinal conduction velocity was larger in the axons from the central retina than in the axons from the peripheral retina.

251

TEMPORAL PROPERTIES OF LGB CELL ACTIVITIES TO MONOCHROMATIC LIGHT STIMULI (I. RED / GREEN TYPE)

TAKEBAYASHI, M. AND KURIOKA, Y. Electrotechnical Laboratory, Nakoji, Amagasaki, 661

+G/-R and +R/-G types of opponent color cells were recorded in the lateral geniculate body of monkey brain. Interspike intervals of those cells were measured at several intensity steps of color stimuli($1-10^4$ troland), and stochastic properties of the intervals were analyzed. Without light stimulation, interval histogram of spontaneous discharge of the cells fitted to the exponential distribution. Light intensity was increased at excitable wavelengths of 520 nm for +G / -R cell and 660 nm for +R / -G cells. For both types of cells, interval histograms fitted approximately to the exponential distribution at low light level and to the Poisson distribution at high light level, respectively.

The above results might be explained by using the receptive field properties of opponent color cells, which have center-surround structures.

252

RETINOTOPIC ORGANIZATION AND SOME RECEPTIVE-FIELD CHARACTERISTICS OF NEURONS IN RAT VENTRAL LATERAL GENICULATE NUCLEUS.

T. NAGATA, Y. HAYASHI AND F. MORITA. Dept. Physiol., Hyogo College of Medicine, Mukogawacho, Nishinomiya, Hyogo.

The representation of the visual field within the ventral lateral geniculate nucleus (LGV) and receptive-field (RF) properties of neurons in LGV were studied in rats anesthetized with urethane.

A clear retinotopic representation was seen within LGV. Nasotemporal expansion of the visual field was represented dorsoventrally in LGV. The lower field was represented toward the postero-medial regions while the upper field had the larger representation toward the antero-lateral regions. The central area 30° wide and 130° long with the long axis extending from the upper nasal field to the lower temporal field was widely represented within LGV. No significant correlation was found between the RF size and the eccentricity.

Most of ON-tonic LGV neurons had inhibitory areas (I-areas). Their RF organization was not concentric. I-areas were found on one or both sides of the excitatory RF and mainly parallel to the horizontal meridian. Most of them were located at 5° to 30° from the center of the excitatory RF.

253

SENSORY INPUTS TO THE RAT THALAMIC RETICULAR NUCLEUS.

SHOSAKU, A., SUMITOMO, I. AND IWAMA, K. Dept. of Neurophysiol., Inst. of Higher Nervous Activity, Osaka Univ. Medical School, Kita-ku, Osaka.

In urethane-anesthetized rat, the sensory input to the thalamic reticular nucleus (TR) was investigated at the single cell level. Neurons receiving the auditory input (a-TR neuron) were found in addition to those receiving the visual input (v-TR neuron) and those receiving the somatosensory input (s-TR neuron). (1) A series of grouped discharges, each being composed of several spikes, were elicited in the a-TR neurons to single electrical stimulation of the inferior colliculus or the auditory cortex. This discharge pattern was similar to those seen in v-TR and s-TR neurons responding to stimulation of the respective sensory pathway or sensory receiving area of the cortex. (2) The a-TR neurons responded to click stimuli with a series of grouped discharges. A tone pip of 2 sec duration caused ON-OFF phasic responses in most of the a-TR neurons. (3) The s-TR, v-TR and a-TR neurons occupied the rostral, dorsocaudal and ventrocaudal portions of the TR, respectively. (4) In some TR units there was convergence of sensory inputs of different modalities.

254

INTERACTIONS OF DIFFERENTLY ORIENTED STATIONARY SLITS IN VISUAL CORTICAL NEURONS OF THE CAT KAJI, S. & YAMANE, S. Bionics, Electrotechnical Laboratory, Umezono, Sakura-mura, Ibaraki.

The neural interactions between stationary flashing slits with different orientations were examined. Orientation sensitive single neurons were recorded from the visual coetex near the border between areas 17 and 18 of anesthetized and immobilized cat. Cell's responses to a following slit with optimal orientation reflected interactions of these slits. Thus interaction curves were obtained.
The preceding slit remarkably reduced the cell's response to a following slit, and when the preceding slit was situated at around the optimal orientation, the recovery of the responsiveness were prolonged. Therefore the interaction curves generally looked like mirror image of the tuning curves. Some neurones were asymmetric in interaction curves as compared with their tuning curves. This effect was also observed after disappearance of the first slit without any excitatory OFF response. The preceding optimal slit induced a decrease of a gain of the orientation tuning property, but not so large change in a half value width and centrality. These characteristics were commonly seen in both S and C type neurons.

255

POSTNATAL DEVELOPMENT OF STRIATE CORTICAL NEURONS PROJECTING TO THE SUPERIOR COLLICULUS IN KITTENS. SUDA, K. AND TSUMOTO, T. Dept. of Physiol., Kanazawa Univ. Fac. of Med., Takaramachi, Kanazawa

Properties of striate cortical neurons projecting to the superior colliculus (C-C cells) were studied in Nembutal anesthetized kittens aged from the 10th day to 7th week. At the 10th day of age, about half of the C-C cells were visually responsive. But these responses were so weak and easily fatigued to repeated stimuli that the cells could not be classified as complex or simple. In the 3rd week of age, more than 50% of the C-C cells already had unequivocal responses of complex type. The axonal conduction velocity of the C-C cells was slower than 1m/sec in the 2nd week and became close to an adult value in the 5th week. As to laminar location of C-C cells, there was a tendency that the cells were widely distributed from layers II+ III to VI up to the 3rd week but thereafter became restricted to layer V. Comparing these with the previous results about development of cortical cells of the other types, it is suggested that visual response properties of C-C cells may mature earlier than the other types of cells.

256

CHANGES IN SINGLE UNIT RESPONSES OF THE CAT VISUAL CORTEX UNDER ELECTROPHORETIC ADMINISTRATION OF PUTATIVE NEUROTRANSMITTERS AND THEIR BLOCKERS; NIKARA, T. AND SATO, M. Dept., of Physiol., Sch. of Med., Iwate Med. Univ., Morioka

None of ACh, carbamylcholine, hexamethonium, d-tubocurarine, ergotamine, taurine, and substance-P produced a significant effect on single unit responses to a moving slit(RMS). Glutamate induced an instantaneous increase in firing rate in both background discharge (BGD) and RMS(15 cells out of 19 cells examined). The frequency increase was followed by a gradual decrease in spike amplitude, and finally by complete cessation of firing. GABA induced a marked decrease in frequency of both BGD and RMS(15 cells out of 22 cells examined). Bicuculline caused an increase in frequency of both BGD and RMS(14 out of 27 cells examined). Picrotoxin produced a gradual decrease in both frequency and amplitude of RMS but only in 2 out of 7 cells. Atropine induced a gradual decrease in both frequency and amplitude of RMS. Similar results were obtained by applications of dopamine, B-alamine and noradrenaline. Aspartate induced an increase in frequency of RMS in one out of three cells examined. All the effects mentioned above were analysed on the excitatory responses of binocularly(EE- and EI-type) and monocularly(E-type) driven cell. The inhibitory response of the EI-type was not blocked by either bicuculline or ergotamine. This fact seems to exclude the possibilities that this inhibitory input to the EI-type cell is GABA-ergic or dopaminergic.

257

TONOTOPIC ORGANIZATION IN FROG AMPHIBIAN PAPILLAE STUDIED BY HORSERADISH PEROXIDASE INJECTED WITHIN THE EIGHTH NERVE GANGLION. YANO,J., OOYAMA,H. SUGAI,T. and CHUJO,T. Dept. of Physiol., Kanazawa Med. Univ., Ishikawa.

In frog amphibian papillae (AP), there are some evidences which suggest tonotopic organization that neurons with lower and higher characteristic frequencies (CF's) may innervate anterior and posterior macula, respectively. In order to elucidate this point, horseradish peroxidase (HRP) solution was iontophoretically injected into recording sites after identification of CF of the 8th nerve units. When HRP was injected into the 8th nerve ganglion pericellularly, a few fibers protruding from somata could be observed. In two preparations, transported HRP was observed within the AP. In one preparation, HRP was injected near a neuron with CF of 400 Hz, and labeled fibers were found in the middle portion of the AP. In another preparation, HRP was injected twice near neurons with CF of 150 and 160 Hz respectively, and a labeled fiber was observed in the nerve branchlet innervating the anterior macula. These observations are consistent with the prior suggestion. HRP injections, however, were extracellular in both preparations, and this interpretation of above results remains somewhat uncertain.

258

AN ANALYSIS OF THE FIBERS CONNECTION FROM THE MEDIAL GENICULATE BODY (MGB) AND THE INFERIOR COLLICULUS (IC) TO THE PRIMARY AUDITORY FIELD (AI) BY MEANS OF INTRACELLULAR POTENTIAL RECORDINGS. MITANI,A., ITO,K. AND SHIMOKOHCHI,M. Dept. of Behav. Physiol., Fac. of Human Sciences, Osaka Univ., Suita, Osaka.

Intracellular potentials were recorded in AI of the cat by stimulation of MGB or IC. EPSPs, IPSPs or antidromic spike potentials were observed. EPSPs with the latency of 1.0 msec by MGB stimulation were most frequently observed, being considered monosynaptic EPSPs from their latencies. Besides monosynaptic EPSPs, polysynaptic late EPSPs were also observed. By a double shock applied to the MGB, the EPSPs produced by the second shock were strongly depressed in some AI neurons. On the other hand, EPSPs with the latency of 2.0 msec were most frequently observed by IC stimulation. From their latencies and the facilitatory effect by a double shock, they were considered disynaptic EPSPs. In addition, in a few cases, short latency EPSPs (0.9-1.2 msec) were observed by IC stimulation, suggesting the existence of the monosynaptic pathway from IC to AI. IPSPs with the latencies of 2.0 msec and 3.0 msec by MGB stimulation, 3.0 msec and 4.0 msec by IC stimulation were frequently observed. They were probably produced by inhibitory interneurons. The latencies of antidromic spike potentials had a fairly wide distribution, but most of the conduction velocity ranged about from 20 to 40 m/sec.

259

AUDITORY EVOKED POTENTIALS OF FIELD L OF NEOSTRIATUM IN THE PIGEON. NOMOTO, M. Dept. of Physiol., Med. Sch., Dokkyo Univ., Mibu, Tochigi, 321-02

Auditory evoked potentials in the Field L of neostriatum in the pigeon to clicks and pure tone bursts were recorded by means of tungsten microelectrodes. A negative evoked potential to clicks appeared with the shortest latency to peak of about 15 msec. Evoked potentials to pure tone bursts with 5 msec rise time ranged approximately between several tens Hz and 5 kHz. The shortest latency to peak of the negative evoked to pure tones was observed over the range of 1.5 kHz irrespective of the recording sites, while the longer latency was observed at higher frequencies of 5 kHz and at lower frequencies of several tens Hz. The amplitude of the evoked potentials to clicks became larger, smaller, or remained unchanged under the condition of a continuous pure tone application at several frequencies as a background stimulus. There were four types of the amplitude change of the evoked potentials to clicks by application of a continuous pure tone. First, 14% of the evoked potentials recorded showed no change. secondly, 21% of the evoked potentials showed only one facilitatory band at frequencies of a continuous pure tone. Thirdly, 26% exhibited only one inhibitory band. The fourth type of 39% had both facilitatory and inhibitory bands to the evoked potentials to clicks.

260

FIRING PATTERNS OF SINGLE AUDITORY FIBERS IN THE GOLDFISH'S SACCULAR NERVE
MATSUURA, S. , KUNO, MIYUKI, KAWASE, I. & MINOWA, Y. Dept. of Physiol. Osaka City Univ. Med. Sch., Abeno-ku, Osaka

Spontaneous activities of small auditory fibers could be classified from non-sequential inter-spike interval histograms into three groups; irregular or random response type, burst or multimodal response type and regular or periodic response type. Fibers of the former two types responded more easily than the fibers of regular response type to tone stimulus (100 - 300 Hz). Fibers without spontaneous activity (large fibers) showed adaptive rundown in the sequential firing rate histograms or sequential inter-spike interval histograms for tone stimulus (250 - 800 Hz). The adaptation was explained from the response behavior of the excitatory postsynaptic potentials (e.p.s.p.s). Fibers of the regular response type frequently showed no response to tone stimulus (100 - 800 Hz, 50 - 100 dB SPL), but they sometimes showed apparent e.p.s.p.s which were phase-locked to the sound wave. When tetrodotoxin was locally applied, e.p.s.p.s which remained after block of spike initiation showed the same adaptive rundown as that of firing rate histogram in the large fiber. However, effects of lidocaine on the e.p.s.p.s were quite different from the action of tetrodotoxin; e.p.s.p.s were smaller in size than those before application of lidocaine and the decrease was more intense at the beginning of the sound, showing no apparent rundown of the e.p.s.p.s.

261

A STUDY ON NEURAL MECHANISM OF VOICE DISCRIMINATION.
MARUYAMA, N., SAITOH, K. and KUDOH, M. Dept. of Neurophysiol., Brain Research Inst., Niigata Univ., Niigata.

As reported previously, about 7% of auditory cortical neurons in unanesthetized cats are formant detectors which respond exclusively to synthesized formants. About 50% are BN units which exhibited sustained responses to bands of noise. BN units are divided into 3 types (N, M and W types) based upon the best bandwidth of the stimulus noise. In the present experiments, we used the synthesized formant generated by a terminal analog method as well as complex sounds generated by modulation methods, and obtained the following results. 1) A formant detector which responded exclusively to the synthesized formant by a terminal analog method was found. In this unit, two local maximums were found in terms of the formant frequency, and the response to a combined stimulus of two formants, respective formant frequencies of which were the local maximums, was 1.5 times larger than the sum of the responses to the individual formants. 2) The responses of BN units of W type to the synthesized formant by a modulation method were studied. In some of these units, the effective range of the formant frequency of the synthesized formant was much more restricted than that of the center frequency of the band of noise. This suggests the possibility that some of BN units of W type may be close to the formant detectors in the character.

262

EFFECTS OF METHYLMERCURIC CHLORIDE ON AUDITORY EVOKED POTENTIAL IN RATS
*ABE, K. AND **TANAKA, I. Dept. of Physiol., Kumamoto Univ., *Coll. Med. Sci., **Med. School, Kumamoto

Rats received twice a week 5 mg/kg of methylmercuric chloride (MMC). After the muscle was relaxed with suxamethonium chloride at 0, 20, 40, 60, 80, and 100 mg/kg, the averaged vertex response evoked by auditory stimuli was recorded. Pure tones of 1, 2, 4, and 8 kHz were presented to rats. The intensity of the tone was set at 90 dB SPL and attenuated in 10 dB steps until its intensity failed to elicit detectable response. As a tone frequency was increased in the range of 1 to 8 kHz at each given intensity, the amplitude of the evoked response diminished. This tendency was opposite to that in man. As the intensity decreased at each given frequency, the amplitude of the response diminished. As the total doses of MMC increased, the response evoked by the 8 kHz, 90 dB-tone diminished, and the response was not detectable at the low frequency and intensity. Averaged brain stem response (BSR) to click stimuli was recorded from the auricle in the rat anesthetized with sodium pentobarbital. No effect of MMC on BSR was observed. These results suggest that the auditory cortex was damaged by MMC, but that the auditory pathways were not affected.

263

TWO TONE SUPPRESSION STUDIED BY PERIOD HISTOGRAMS ON CAT COCHLEAR NERVE FIBERS. ITO,S., HORIKAWA, J. AND MURATA, K., Dept. Neurophysiol., Tokyo Med. & Dent. Univ., Tokyo

In order to analyze the mutual suppressive interactions between two tones in various frequency combinations, responses to each of two tones (F1 or F2) which was not harmonically related to each other, and to the combined tone(F12) were recorded from cochlear nerve fibers. A period histogram of F1 response was fitted to a sinusoidal curve by the least squares method, and the amplitude of the curve was adopted as the effective amplitude of F1 (AS). From the period histogram of F12 response, which was synchronized to F1, the contribution of F1 component to the firing probability was calculated from the peak value and the total number of impulses of the F12 histogram and was used as an effective amplitude of F1 (AC) in F12. The ratio of AC to AS was introduced to express the suppressive effect of F2 on the response to F1. The intensity of F1 being kept at 15 dB above the F1 threshold, the ratio began to decrease at the F2 intensity about 10 dB above the F2 threshold and reached to nearly zero with further 15 dB elevation of F2 irrespective of the F2 frequency. When the intensity of F1 was increased by 10 dB, an increment of less than 10 dB for the F2 intensity was enough to give the same suppressive effect. The slope of decrease in the ratio in areas where the discharge rate was suppressed was not so steep as that in the other area.

264

ULTRASONIC RECEPTION OF MONGOLIAN GERBIL
KAMADA, T. AND KAMEDA, K. Dept. of Oral Physiol.,Sch. Dent., Univ. Hokkaido, Sapporo

Rodents use ultrasonic as well as audible sounds for communication.
Cochlear microphonics (CM) and single auditory units discharge were recorded to study the ultrasonic reception in the mongolian gerbil (Meriones unguiculatus).
Threshold curve of CM showed peak sensitivity around 2 kHz, but second and third peak was around 20 and 40-50 kHz respectively. This is reasonable because they emit 20 kHz in adult and 40-50 kHz in pups. Unit discharges were recorded through micro-electrodes. When thresholds of single auditory units were plotted against their best frequency (BF), the curve connecting minimal value is similar to CM threshold curve. Out of 93 auditory units, we could not find any one with BF above 20 kHz. The failure to record ultrasonic specific units may be because they are small in number or because their location auditory nerve is too limited to reach (in our electrode arrangements). Since evoked potential in inferior colliculus is reported to be more sensitive to ultrasonics, some mechanisms beyond our present knowledge may exist. Q(10 dB) value seemed to be larger if BF was higher.

265

ENCODING OF SOUND INTENSITY IN THE AMPHIBIAN PAPILLA NERVE OF THE TOAD. OOYAMA, H., SUGAI, T., YANO, J., and CHUJO, T. Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa

The relation between single unit firing rate and intensity of tone burst stimuli of various frequencies was studied in the amphibian papilla nerve of the Japanese toad. In the most of the units, with the increase of stimulus strength at the characteristic frequency (CF), the firing rate increases monotonically, and attains a maximum firing rate (MFR) of 20-120imp/sec. About half of the low CF (100-200Hz) units, however, can respond by one to each one cycle of the stimulus tone of their own CF. One to one response is also seen when a unit of before mentioned type is stimulated by some tones lower than its CF, and the absolute MFR of any unit may be obtained on such a condition.

Under simple assumptions, the estimated number of just noticeable differences of the stimulus strength in a single unit is the larger, the higher the MFR is. Results seem to suggest the possibility that the amphibian papilla nerve encodes more precisely the intensity of low frequency sound than that of high frequency sound, in spite of the relatively small population of the low CF units in the nerve.

266

GENERATING PROCESS OF NON-MONOTONE AMPLITUDE CHANGE OF CM DURING FATIGUE RECOVERY.
UCHIYAMA, H., Dept. of Neurophysiol., Medical Research Institute, Tokyo Med. & Dent. Univ., Kanda Surugadai, Chiyoda-ku, Tokyo.

In the simultaneous CM recording from the basal and 3rd turn of the guinea pig cochlea using the tones, for instance, of 550 Hz for test and 400 Hz for fatiguing, 3rd-turn electrode shows no bounce, while the basal-turn gives non-monotone changes beyond the control amplitude including the case of three extrema. The following is a rheological hypothesis for better understanding the generating process of this phenomenon in place of our old explanation which was tentatively made from the view-point of phasor superposition effect. The modulus decrease of a supposed entropy spring of the Corti-Tectoria complex by a large deformation simply results in CM decrease independent of electrode placement. At the same time this modulus decrease may give, to the basal-side electrode, CM increase by a local increase in BM displacement due to the basalward shift of BM vibratory pattern. The time relation in fatigue recovery between the above two CM changes as contributed to the basal-side electrode is well understood from the retardation time distribution due to the distribution of fatiguing load along the cochlear partition, which situation is similar to that for polymer behavior known as elastic memory.

267

THE EARLY AUDITORY RESPONSE IN FRONTAL FOREBRAIN OF THE PIGEON.
MAEKAWA, M. Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi, Japan

Unusual auditory responses have been described within frontal area of avian cerebrum. These data were, however, controversial: Question is whether the response is auditory or otherwise because of very short latency of responses and their vicinity of cerebral response area (basal ganglion) which represents mechanical vibration. To clarify the question, peripheral auditory projections were identified by retrograde HRP labelling. Frontal auditory responses of adult pigeon followed click stimuli and the latencies of evoked and unit response were within 5-12 msec which measures a half of usual latency of cerebral auditory area (field L). Response area was limitted within frontal neostriatum (NF) and tractus fronto-archistriatalis (FA). HRP injected in minimal size of response area through recording electrode by oil pressure. HRP positive neurons appeared uniquely to be interspersed in the root of the cochlear nerve which extends apart from the medulla. The NF is innervated monosynaptically by the afferent neurons which may represent auditory peripheral response. An unique connection directly between the NF and medullary cochlear nerve suggests that the early responses of the NF is auditory and their latencies is short.

268

NEURONAL REPRESENTATION OF SPEECH PARAMETERS.
HASHIMOTO, T, Div. of Biocybernetics, Inst. Med. & Dent. Engineering, Tokyo Med. & Dent. Univ., Surugadai, Kanda, Chiyoda-ku, Tokyo 101.

Neural mechanism of the feature extraction of speech sounds were investigated by single unit recordings of responses of an unanesthetized guinea pig's medial geniculate body to synthetized, speech-like sounds. Synthesized speech-like sounds were produced by a bank of octave filters, following the "terminal analog" model of speech production. A random noise source was used to synthesize fricative or noise-like speech sounds. A periodic pitch source was also provided to model voiced sounds. A preferable formant pattern and the source were closely related to the responsiveness of the geniculate neuron. A specific combination of several formant frequencies and the relative intensity corresponding to each of them was more effective than any other formant combinations of speech sounds to activate the neuron. The feature parameter originating on the voice generating system may be important for the central auditory system to decode and recognize speech sounds.

269

MOTOR ACTIVITIES FOR OVIPOSITION IN CRICKETS. AI,N.,HIRAMURA,K. AND OKADO,H. Dept. of Biol.,Tokyo Gakugei Univ., Tokyo,184

In adult female cricket, there are a certain sequence of the motor patterns for oviposition by electrophysiological observation from concerned nerves and muscles. Eggs sent out from ovary to lateral oviduct get into genital chamber(G.C.) and then pushed out towards the ovipositor by the whole contraction of the G.C. This contraction patterns of the G.C. are changed when an egg pushed open the ostium of it normally or sometimes artificially, and when it is extended, afferent impulses are bilaterally recorded in N5-2(a branch of the 5th lateral root of the 5th abdominal ganglion). Immediately after the alteration of contraction patterns in G.C., the basement opener muscles of ovipositor(M5) are contracted and then the valuvules are opened widely enough to pass the egg to the ovipositor. To send fertilized eggs to the ground, retractor muscles of the ovipositor(M1,M2) are contracted rhythmically and move the valuvules individually to the posterior direction. These muscular activities seem to appear just like to follow a set order controlled by the neural activities in A.G.V.

270

EFFECTS OF MORPHINE AND ELECTROACUPUNCTURE ON TOOTH PULP-EVOKED CENTRAL RESPONSES IN RAT. A. IRIKI, K. TODA, M. ICHIOKA, & H. TANAKA* Dept. of Physiol., Fac. of Dent. & *Dept. of Anesth., Fac. of Med. Tokyo Med. & Dent. Univ., Tokyo, Japan.

Effects of morphine and electroacupuncture stimulation on evoked responses after tooth pulp stimulation recorded from six sites in various CNS levels were tested in rat. Three of six recording sites were of lemniscal system and others were of extralemniscal one in the trigeminal sensory pathway. On the lemniscal system, electroacupuncture was more effective than morphine and the suppression induced by both treatment was stronger in higher CNS. By contrast, along the extralemniscal system, action site of electroacupuncture was almost in the secondary neuron level, while that of morphine was not specified. This electrophysiological study suggests that there are some differences between the action of extragenous morphine and morphine like action of the electroacupuncture stimulation.

271

A HYPOTHESIS OF ACUPUNCTURE ANALGESIA IN THE RAT CAUDAL SPINAL TRIGEMINAL NUCLEUS.K. Toda, A. Iriki, M. Ichioka, H. Tanaka*. Dept. of Physiol. Fac. of Dent., Dept. of Anesthesia, Fac. of Med*., Tokyo Med. & Dent. Univ., Tokyo, Japan

The inhibitory actions induced by electroacupuncture stimulation were investigated in caudal part of rat spinal trigeminal nucleus. To apply noxious stimuli, tooth pulp was stimulated electrically. Yin-Hsiang (intrasegmental point) or Ho-Ku (extrasegmental one) was used as a cathodal electroacupuncture point and an anodal point was decided about 2.5 mm peripheral from each point. we found at least three types of inhibitions in the nucleus: TYPE I inhibition is the most forcefull one caused by postsynaptical and opiate-related action, and lasted for 40-60 min after the cessation of electroacupuncture stimulation. TYPE II is evoked by nostsynaptical mechanism for about 40 ms after the stimulation is terminated. TYPE I and II inhibitions were evoked by both intra- and extrasegmental acupuncture point stimulation. TYPE III inhibition is elicited by presynaptic mechanism and only produced by stimulation of intrasegmental acupuncture points for about 200 ms.

272

RESPONSES OF RAT CHORDA TYMPANI NERVE TO ELECTRICAL AND CHEMICAL STIMULATIONS OF THE TONGUE. NINOMIYA, Y., MIZUKOSHI, T. AND FUNAKOSHI, M. Dept. of Oral Physiol., Gifu College of Dentistry, Hozumi, Motosu, Gifu

In order to clarify the receptor mechanism for taste nerve response to electric current applied to the tongue, the characteristics of the integrated rat chorda tympani responses and single fiber responses to chemical and electrical stimulations of the tongue were examined. The integrated chorda tympani responses to anodal currents were suppressed after cessation of the blood flow to the tongue or application of $FeCl_3$ to the tongue surface. Magnitude of the integrated response to anodal current decreased with a decrease in concentration or an increase in flow rate of the bathing solution flowing over the tongue during the electrical stimulation. The across-fiber correlations between the responses to chemical stimuli and anodal currents indicate that the responsiveness to anodal current was not always well correlated with the kind of cation in the bathing solution over the tongue. From these results, we assume that the response to electric current was due to the binding of electrophoretically carried ions to not only specific but also non-specific receptor sites for the ions.

273

A ROLE OF CYCLIC AMP AND α-ADRENERGIC AGENT ON TASTE RECEPTION. SHIMOTAHIRA, K. AND KASHAHARA, Y. Dept. of Oral Physiol., Kagoshima Univ. Dent. Sch., Kagoshima

Our previous reports have indicated intravenously administered cyclic AMP (cAMP) enhanced summated response of the chorda tympani to four basic taste stimuli in rats. Among some cAMP derivatives, this taste enhancing effect of cAMP are observed only when we injected dibutyled cAMP. The dibutyl cAMP is assumed moving into cells but the cAMP is not. These fact mean that the cAMP's effect on taste response is efficacious in the cell (i.e. taste cell). The cAMP's taste enhancing action were diminished without catecholamine. The norepinephrine or α-adrenergic agent (ephedrine) have taste enhancing effect which is analogus to that of cAMP. If we used α-blocking agents (naphazoline, phenylephrine, yohimbine), the cAMP's taste enhancing effect was ceased. On the contrary, the epinephrine, a β-adrenergic agent (isoproterenol) or a β-blocking agent (dichloroisoproterenol) had not effect on summated response of the chorda tympani. Results obtained from this experiment may indicate a system involving the cAMP, the α-adrenergic agent and the α-adrenergic receptor has some role in the taste reception.

274

DISTRIBUTION OF THE SENSORY NERVE ENDINGS IN THE LABIAL MUCOSA OF THE RAT. YAMAMOTO, T., TAZAKI, M. AND SAKADA, S. Dept. of Physiol., Tokyo Dent. Coll., Chiyoda-ku, Tokyo.

The distribution of the encapsulated corpuscles and the bush-like nerve endings in the labial mucosa of the rat were investigated by vital methylene blue staining method. The encapsulated corpuscles with an inner core and a capsule around the axon were located in the lamina propria at a distance from the epithelium and distributed uniformly throughout the labial mucosa. The density of the encapsulated corpuscles was 3.5-5.3 per sq. mm. The bush-like nerve endings, the axon of which showed a complex aspect of arborization, were situated in the lamina propria close to the epithelium and localized within the long and narrow area of the mucosa along the median line where the epithelium was well developed and the formation of papillae remarkable. The density of the bush-like nerve endings in the area where these endings concentrated showed high values 38.9-60.6 per sq. mm. No Pacinian corpuscles and Merkel-cell neurite complexes were observed in this area.

275

IMPULSE DISCHARGE PATTERNS OF SLOWLY ADAPTING AFFERENT UNITS INNRTVATING THE FROG SKIN. OGAWA, H. AND YAMASHITA, Y. Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto

Though two types of slowly adapting cutaneous mechanoreceptive afferent (SA) units--SA type I and II--have been recognized in many animals, the SA units of frogs could not be classified into two subgroups in the previous study because they did not show any prefered sensitivity to a stretching of the skin. In the present study, 34 SA units were isolated from the sciatic nerve of american bullfrogs, Rana catesbiana, to analyse a pattern of impulse discharges in response to prolonged displacements. Interspike intervals (ISI) were measured at around, but always including the 500 and 1000 msec points after the onset of stimulation and pooled in 50 trials for statistical analysis. Correlations between the two successive ISI at 500 and 1000 msec points were small ($P>0.05$, t-test), and the ISI histograms at both points were skewed and fit the gamma functions ($P>0.05$, x^2-test) in all the units studied. These findings suggest that the SA units of frogs might resemble the SA type I units.

276

PHASE RELATIONS OF SPIKE DISCHARGES IN RESPONSE TO SINUSOIDAL STIMULATIONS OF MECHANORECEPTOR AFFERENT UNITS INNERVATING FROG SKIN. TANIGUCHI, K., YAMASHITA, Y.,OGAWA, H. Dept. of Health and Physical Edu., Fac. of Gen. Edu. and *Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto

Phase relations of the first spikes discharged in each cycle of sinusoidal stimulations were examined in various cutaneous mechanoreceptive afferent units of frogs, Rana catesbiana, by means of polar diagrams. Conduction times from the receptor to the recording sites were taken into consideration. Different types of cutaneous units showed different phase relations. SA units discharged their first spikes at 45°, which did not change greatly with varying frequencies or amplitudes of stimulation. On the other hand,RA units discharged at two phases, each of which decreased with an increase of amplitudes. RA type I units discharged at around 0° and 180°, at the phase of greatest velocity. RA type II units produced spikes at around -90° or +90° at the phase of greatest acceleration. The present findings reveal that the SA units are displacement detectors, RA type I velocity detectors and RA type II acceleration detectors.

277

THE CHANGE OF TONGUE SURFACE POTENTIAL TO SALT AND WATER APPLICATION SOEDA, H., NODA, K., SAMEJIMA, C. AND WATANABE, K. Dept. of Physiol., Fukuoka Dental College, Nishi-ku, Fukuoka

Our previous report revealed that slow potential change could be recognized on the surface of the isolated frog tongue (surface potential) by the application of chemicals or water. Further analysis of the potential has been made. NaCl-induced potential was negative to the reverse side while water-induced one was positive. Both were not only dependent upon the stimulus intensity but proportional to the afferent nervous activity. They were not influenced by DNP or ouabain but abolished by anesthetics. The surface potential was depressed or reversed when polarized negatively and augmented when polarized positively. Electric resistance between free surface and reverse one of the tongue was decreased in NaCl-induced potential and was increased in water-induced potential to that of resting state. Ratio of resistance change was proportional to the amplitude of surface potential. Significance and mechanism of the surface potencial similar to the taste potential are not yet known. This potential may contribute to produce or modify taste sensations.

278

RESPONSES TO WATER, Ca AND HIGH Na IN A SINGLE WATER FIBER OF THE FROG TONGUE.
KITADA, Y. Dept. Physiol., Sch. Dent., Univ. Okayama, Okayama, 700

A single water fiber in the glossopharyngeal nerve of the frog responds to distilled water, low Ca and hypertonic Na solution. The aim of the present investigation was to study differences between the stimulation mechanism of the Na response and that of the Ca response. Tongues isolated from bullfrogs were used. A suction electrode was employed to record spike activities from a single water fiber. Hypertonic solutions of NH_4Cl and KCl as well as NaCl stimulated the water fiber. The order of effectiveness of monovalent cations was $NH_4 > K > Na$. Choline-Cl had no excitatory effect. Thus, the excitatory effect of hypertonic solution varied with kinds of monovalent cations. On the other hand, such monovalent cations in low concentration inhibited the Ca response and the degree of inhibitory effect was the same. H^+ inhibited the water response and the Ca response, but enhanced the Na response. A treatment of the tongue surface with 0.1 % pronase E did not affect the Na response, but decreased markedly the water response and the Ca response. These results show that Na and Ca interact with diffent receptor sites, respectively.

279

INNERVATION OF FROG GUSTATORY ORGAN.
SATO, T. and OKADA, Y. Dept. of Physiol., Nagasaki Univ. Sch. of Dent., Nagasaki, 852

Innervation of gustatory disks within the fungiform papillae was studied by staining the bullfrog tongue with methylene blue or by recording action potentials of the myelinated afferent fibers. The number of myelinated afferent fibers entering single fungiform papillae was a mean of 8.2. A single afferent fiber branched several times at the base of the papillae, resulting in the innervation of several fungiform papillae located in a local narrow area of the tongue. The distance along the afferent fibers between the basement membrane of gustatory disk and the ramification point at the base of the papillae was 0.96 ± 0.32 mm (mean ± SD, n=89). The diameter of myelinated afferent fibers within the fungiform papillae was a mean of 5.5 μm and increased at a rate of 0.8 μm/cm length fiber as they run toward the proximal end of the tongue, consequently resulting in a gradual increase in the conduction velocity. Following emergence from the tongue, the diameter of the myelinated afferent fibers scarcely changed.

280

RESPONSE CHARACTERISTICS OF THE SOLITARY TRACT NEURONS TO NATURAL STIMULATION OF THE FROG TONGUE.
HANAMORI, T. AND ISHIKO, N. Dept. of Physiol., Miyazaki Med. Coll., Miyazaki

Single solitary tract neurons in the frog immobilized by succinylcholine chloride were classified into 6 types according to their sensitivity to gustatory(0.5M NaCl, 0.5mM quinine, 0.01M acetic acid, 0.5M sucorse and water), thermal(0.01M NaCl at 30°C) and mechanical stimuli. Of 224 units studied, 101 responded only to tactile stimuli(Type VI), whereas 4 and 119 of the remainder were inhibited(Type V) and facilitated(Type I-IV) by gustatory as well as by other stimulus modalities, respectively. Among the last group of neurons, 31, 31, 36 and 2 % were sensitive to one (Type I), two(Type II), three(Type III) and four(Type IV) qualities of taste stimuli, respectively, the most effective stimulant being found to be NaCl. The relationship between responses of gustatory neurons and log molar concentration of NaCl was approximately linear, similar to that obtained from the glossopharyngeal nerve. These solitary tract neurons were found to locate within the area between 0.5 and 3.5 mm rostral to the obex, and between 0.4 and 1.2 mm lateral from the midline, the depth being 0.3-1.3 mm from the dorsal surface of the medulla oblongata.

281

ROLE OF Ca^{2+}, cGMP AND cAMP IN TASTE TRANSDUCTION MECHANISM
KURIHARA, K. Faculty of Pharmaceutical Sciences, Hokkaido Univ., Sapporo

1) The lingual artery of the bullfrog was perfused with artificial solution and the effect of Ca, Ca-channel blockers ($MnCl_2$ and verapamil), cGMP and cAMP added to the perfusing solution on the gustatory nerve responses was examined. The responses to chemical stimuli of group 1 ($CaCl_2$, NaCl, distilled water, D-galactose and L-threonine) were highly dependent on Ca concentration in the perfusing solution, suppressed by the Ca-channel blockers, enhanced by cGMP and suppressed by cAMP. The responses to chemical stimuli of group 2 (quinine, HCl and ethanol) were practically not affected by a decrease in Ca concentration, the Ca-channel blockers, cGMP and cAMP. The responses to the stimuli of group 1 seem to be induced by Ca-influx into a taste cell which is triggered by depolarization and modulated by the cylcic nucleotides in a taste cell. The responses to group 2 seem to be induced without accompanying Ca-influx. 2) Addition of the respiratory inhibitors such as KCN or antimycin A to the perfusing solution suppressed the responses to chemical stimuli of group 2, while the addition did not suppress the responses to group 1. 3) The frog taste cells exhibited regenerative potentials when the cells hyperpolarized were subjected to anode break stimulation. The potentials were composed of voltage-dependent Na-component and Ca-component.

282

SACCHARIN-BINDING PROTEIN IN FRACTIONS FROM TONGUE EPITHELIA.
SHIMAZAKI, K. AND SATO, M. Tokyo Metropol. Inst. Neurosci., Fuchu, Tokyo.

Binding of ^{35}S-saccharin to ammonium sulfate fractions (AF) extracted from rat tongue epithelia containing taste buds was studied with the equilibrium dialysis method. Labeled saccharin bound most to 40-60% AF fractionated from 105,000xg supernatant of the tongue epithelia homogenized in 0.1M Na phosphate buffer. Binding of ^{35}S-saccharin to this fraction was inhibited to half by the presence of 4.7×10^{-4}M saccharin Na, and nearly completely by 30mM. It was also inhibited by the presence of 0.1M glucose, sucrose and lactose by about 20%, while binding of labeled saccharin to 40-60% AFs from tongue epithelia without taste buds and from tongue muscles was much small compared with that to the same fraction from epithelia with taste buds and was not inhibited by sugars. From the results obtained we hypothesize that the protein that binds to saccharin and sugars could be a candidate for the sweet receptor protein.
Further fractionation with DEAE-Sephadex A50 column of 40-60% AF from epithelia with taste buds indicates that a major protion of proteins that binds to saccharin are contained in 0.1M NaCl fraction.

283

RECPTIVE FIELD CHARACTERISTICS OF TASTE NEURONSE IN THE PARABRACHIAL NUCLEUS OF THE RAT.
HAYAMA, T. AND OGAWA, H. Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto

We recorded 34 gustatory (G) and 8 mechanoreceptive (M) units in the parabrachial nucleus (PB) of SD-strain rats anesthetized with sodium amobarbitone while applying natural stimulations to the oral cavity. Receptive fields (RF) could be located in 21 G and 8 M units. Nine G and 1 M units had a single RF on the tongue with a large RF in some units and, 1 G and 1 M units on the palate. But 9 G and 5 M units had 2 separate RF's with one on the tongue and another on the palate. Eleven mechanosensitive G units had RF's common for both modalities, but 6 units had different RF's for different modality. In the solitary tract nucleus (NTS), we found only a few G and M units with 2 RF's in the oral cavity and a few G units with a single RF on the palate. The present findings, therefore, suggest that taste and mechanical information from the tounge through the NTS converges further on the PB neurons but that some PB neurons might receive taste information from the palate through non-NTS structures. The averaged magnitude of responses to each of 4 basic tastes in PB units was two times as large as that in NTS units.

284

THALAMIC RESPONSES TO LOT AND TCN SHOCKS IMAMURA, K., ONODA, N. OBATA, E., IINO, M. AND TAKAGI, S. F. Dept. of Physiol., Sch. of Med., Gunma Univ.

We investigated the thalamic responses to the lateral olfactory tract (LOT) and/or the tympanic chordal nerve (TCN) shocks in the curarized rabbit in oder to figure out the interaction of olfaction and taste. Out of 30, 6 cells (20%) responded to LOT shocks alone and 6 cells (20%) did to TCN or tongue shocks. Eighteen cells (60%) responded to both LOT and TCN shocks. Each recording site was histologically identified. They were not only a medial part of the ventroposteromedial nucleus (VPM) but also far lateral to or far ventral to it. Olfactory and gustatory inputs are conisdered to converge in these areas. Response patterns and their latencies were independent of units location. Detailed analyses of thalamic responses to odor and taste stimuli remain to be dealt with in a later study.

285

GLOSSOPHARYNGEAL-HYPOGLOSSAL REFLEX IN THE FROG. KUMAI, T. & NOMURA, H. Dept. of Oral Physiol., Matsumoto Dent. Coll., Shiojiri

Discharges induced reflexly by chemical stimulation of the frog tongue were recorded from the main trank of the hypoglossal nerve and its branch to the hyoglossal muscle. 1 M NaCl, 0.5 mM QHCl and HCl at pH 2.5 produced pronounced reflex discharges in both nerves. On the other hand an application of 1 mM $CaCl_2$ induced no reflex discharge, indicating that frog calcium response has no relation with tongue movements.

Reflex discharges produced by applying the chemical solutions to different portions of the tongue were recorded from three branches of the hypoglossal nerve. Reflex discharges in the hyoglossal branch were elicited mainly when the caudal part of the tongue was stimulated, whereas those in the genioglossal branch mainly when the rostral part was stimulated. The intrinsic branch responded reflexly whatever portion of the tongue was stimulated. Electrical stimulation of the glossopharyngeal nerve revealed that the reflex activity of the hyoglossal branch was induced by sensory inputs from low threshold fibers in the medial branch of the glossopharyngeal nerve, whereas that of the genioglossal branch mainly by the lateral branch. Measurement of reflex times between electrical stimulation of the afferent branches and the action potential of the efferent branches demonstrated that the medial-hyoglossal reflex has the shortest pathway but is composed of polysynapses.

286

REFLEX DISCHARGES EVOKED BY WATER STIMULATION ON THE FROG TONGUE
NOMURA, H. AND KUMAI, T. Dept. of Oral Physiol., Matsumoto Dental Coll., Shiojiri

The frog tongue contains a chemoreceptor sensitive to tap water, the role of which has not been clarified. Zotterman (1949) has suggested that the water on the frog tongue reflexly keeps the mouth closed to reduce an obvious increase of the intake of water. If this is valid, reflex discharges must be evoked in the nerve innervating the elevator muscles such as the masseter and temporal muscles by tap water stimulation.

Experiments were carried out by using male frogs in automn. The afferent and efferent discharges evoked by tap water stimulation were lead simulatanously in the glossopharyngeal nerve and the trigeminal or facial nerve or their branches, respectively.

So far as we have studied, no pronounced reflex discharge was evoked in the nerve innervating the masseter and temporal mucles when the tongue was stimulated by tap water. On the contrary, pronounced discharges were evoked in the nerve innervating the submental and submaxillary muscles by tap water stimulation. Since the submental muscle appeared to act as the nostril closing muscle by protruding the apex of the mandible, these facts suggest that the chemoreceptor sensitive to tap water in the frog plays a role in the nostril closing reflex.

Electrical stimulation on the glossopharyngeal nerve also evoked reflex impulses in the nerves innervating the submental and submaxillary muscles.

287

THE AFFERENT IMPULSES OF SENSORY UNITS IN THE SUBLINGUAL AND THE SUBMANDIBULAR DUCT OF THE CAT.
SAKADA, S., IIZUKA, M. AND YAMAZAKI, S.
Dept. of Physiol., Tokyo Dent. Coll. Chiyoda-ku Tokyo

The sublingual duct and the submandibular duct in the cat are innervated by afferent nerve fibers in the lingual nerve. It was histologically shown that there were free nerve endings, unencapsulated endings and encapsulated endings in these ducts in the part close to the oral mucosa. The number of the encapsulated endings in the sublingual duct was 17-125(Mean ± SD : 62 ± 24 endings, n = 12 ducts) and that of those in the submandibular duct 8-58 (Mean±SD : 26±14 endings, n = 12 ducts). The existence of encapsulated endings, however, was exceedingly rare in these ducts in the part near the hilus far from the mucosa and naught in the parotid ducts.

Asimilar to free nerve endings, the encapsulated or unencapsulated endings were readily responsive to the distension of the duct and the pressure from the oral mucosa and possessed the same physiological characteristics of acceleration detector and vibration detector as those of the morphologically similar endings in the oral mucosa.

288

STUDIES ON THE ELECTRICAL CHANGE IN THE COURSE OF SALIVATION FROM PAROTID-GLAND.
INOMATA, K., TAMAGAWA, K., ITO, K. and NAKAMURA, H.*
Dep. of Physiol., Sch. of Dent., Higashi-Nippon-Gakuen Univ., Dep. of Oral-physiol., Sch. of Dent., Higashi-Nippon-Gakuen Univ.*, Ishikari-Tobetsu, Hokkaido, 061-02

When the human lingua was stimulated with tartaric acid, the electrical change between papilla parotidea and lobulus auriculae in the course of salivation from parotid gland showed about 2-6mV. In our experiment, the reference electrode which was set in suction capsule (Krasnogorski's type) was placed on papilla parotidea and the indifferent electrode was placed on lobulus auriculae, but if the reference electrode was placed on near the papilla parotidea, the electrical change showed lower potential, that was about 0.2-0.5mV. According to our result, the reduction of electrical change (2-6mV-0.2-0.5mV) was dependent on the decrease of saliva in suction capsule which was used reference electrode, on the other hand, increasing a saliva in suction capsule, the electrical change showed higher potential(2-6mV). So that, it was considered that the large part of electrical change due to the saliva.

289

ASSOCIATION FIBER PROJECTIONS TO THE ORBITAL GYRUS FROM THE OLFACTORY CORTEX.
MOTOKIZAWA, F., INO,Y. AND KAKUTANI, H. Dept. of Physiol., Nara Medical College, Kashihara, Nara

In the cat the orbital gyrus receives an olfactory input not through a thalamic relay, but presumably through subcortical association fibers originating from the prepyriform cortex(Motokizawa and Ino, Neuroscience, 6, 39-46, 1981). In the present experiment, this association fiber connection was investigated histologically and electrophysiologically. In 10 cats HRP was injected into the cortical layers of the orbital gyrus under direct vision. After injection of the enzyme in the dorsal bank of the rhinal sulcus, labeled neurons were detected in the ventral bank of the rhinal sulcus, lateral aspect of the prepyriform cortex, olfactory tubercle and cortical amygdaloid nucleus. In the prepyriform cortex, labeled cell bodies were densely distributed in the deep layers. In 9 cats anesthetized with chloralose the prepyriform cortex or cortical layers of the orbital gyrus were stimulated. Cortical neurons in the dorsal bank of the rhinal sulcus within the orbital gyrus were activated orthodromically following stimulation of the prepyriform cortex. In addition, antidromic responses were also obtained from the prepyriform cortex by stimulation of the orbital gyrus. These findings indicate that there are association fiber projections from the olfactory cortex to the orbital gyrus.

290

PROPERTIES OF SELF-MUTILATION IN DORSAL RHIZOTOMIZED RAT. Y. YAMAGUCHI. Laboratory of Clinical Physiology, College of Biomedical Technology, Osaka University, 1-1, Machikaneyama, Toyonaka, Osaka

After dorsal rhizotomy from C5 to T1, rats showed self-mutilation, such as chewing and/or abnormal scratching of the deafferented limb and the adjacent regions. The self-mutilation was supposed to be evoked not only by anesthesia but by abnormal sensation, including chronic pain. The author studied properties of such behaviors in this experiment. 1) Chewing was easily inhibited by extrastimulus. On the other hand, scratching often continued in spite of extrastimulus. 2) Fluothane anesthesia provoked abnormal chewing in some rats, which showed moderate hippocampal arousal pattern in the EEG's. 3) Repetitive electrical stimulation given to the limbs contralateral to the deafferentation delayed onset of the self-mutilation. 4) Additional wounds chronically settled at the top of the cranium delayed significantly appearence of the self-mutilation in some rats, while wounds at the dorsum of the nose tended to facilitate the self-mutilation.

291

MORPHINE EFFECT ON THE NEURONAL ACTIVITIES IN THE RAT RAPHE MAGNUS. H. TANAKA, S-H. YOON, K. TODA*, A. IRIKI* AND M. ICHIOKA*. Dept. of Anesth. Fac. of Med. and *Dept. of Physiol. Fac. of Dent. Tokyo Med. & Dent. Univ. Bunkyo-ku, Tokyo 113, Japan

Single unit activities were recorded using tungsten electrode (1-5 M Ω at 1 kHz) from nucleus raphe magnus, AP 8.5-11.0 according to Fifkova & Malsala's brain atlas, of lightly anesthetized Wistar albino rats. Morphine-HCl was administered once intraperitonially in various doses of 5, 10 and 20 mg/kg. In the present study,three types of neurons were observed, that is 1) Neurons whose activities were enhanced by morphine injection, (43%, Type A), 2) Neurons whose activities were suppressed by its injection, (39% Type B,). 3) Neurons which are not affected by morphine injection (18%, Type C). In the neurons of Types A and B, changed acitivities were antagonized by naloxone injection (0.5-2.0 mg/kg). Moreover, time courses of the modified activities had correlations with that of suppressive effects of morphine of tooth pulp-evoked noxious responses in secondary somatosensory cortex. These may suggest that these types of neurons have something to do with the morphine induced analgesia, although action of Type C neuron is not clearly understood.

292

VIBRATORY SENSITIVITY OF MECHANORECEPTIVE UNITS IN HUMAN GLABROUS SKIN
MANO, T. AND MIYAOKA, T.* Dept. of Physiol. and Dept. of Psychol.*, Hamamatsu Univ. Sch. of Med., Hamamatsu

Mechanoreceptive units in human glabrous skin of the palm were classified into three types based on their microneurographic responses to mechanical stimuli : 1. slowly adapting type I (SA-I) units with dynamic and static responses, 2. slowly adapting type II (SA-II) units with mainly static responses, 3. rapidly adapting (RA) units with dynamic "on-off" responses. Among these, RA units showed high sensitivity to vibration. The maximum vibratory frequency followed by 1 : 1 responses of RA units was found around 550 Hz. Meanwhile, RA units were classified into two different types (RA-I and RA-II) according to the relationship between the threshold of 1 : 1 responses and the vibratory frequency. RA-I showed the minimal threshold at the vibratory frequency around 50 Hz, while RA-II represented the minimal threshold at the frequency around 150 Hz. The receptive field of RA-I was small, while that of RA-II was very large. Referring these findings to those reported in animal, it is concluded that RA-I in the present study corresponds to Meissner corpuscle and RA-II corresponds to Pacinian corpuscle.

293

RESPONSE OF THE MUSCLE SPINDLE OF THE CAT DURING LOCAL TETANUS TO FM-VIBRATION. MIZOTE,M.(Dept. of Physiol.,Sch. of Med.,Chiba Univ.) AND TAKANO,K.(Physiol. Inst.,Univ. of Göttingen, West Germany).

The discharge patterns of the primary ending of the muscle spindle in response to FM-vibration are classified into two types, one type of endings responds up to 150 Hz (type B) and the other only at low frequencies (type K). The former comes from endings on nuclear bag fibers and the latter from those on nuclear chain fibers (Mizote,1976). This FM-vibration technique was used in the tetanus intoxicated cat after (1-7 days) injection of tetanus toxin (5-500 mouse MLD/kg) into the gastrocnemius muscle. For example two days after injection of tetanus toxin at the dose of 100 mouse MLD/kg, the primary ending was more sensitive and responded completely to FM-vibration up to 200 Hz or more. Takano and Kano (1969) have demonstrated the higher gamma-activity in the early period of local tetanus. Four days after intoxication, the muscle had shortened powerfully and was extended only by strong stretching. All primary endings showed a little tonic discharge (like type K) during strong FM-vibration. This result suggests that viscous property of nuclear bag fibers is changed into elastic property in the later period of tetanus intoxication.

294

EFFECTS OF CALCIUM AND NEOMYCIN ON THE MECHANO-SENSITIVITY OF THE LATERAL-LINE ORGAN. SHIOZAWA, K., ASANUMA, A. AND YANAGISAWA, K. Dept. Physiol., Tsurumi Univ. Sch. Dent.

The lateral-line organ of Necturus maculosus was stimulated with sine wave vibrations and afferent nerve discharges were recorded by suction electrode. The mechano-sensitivity was expressed as an increment of the synchrony between the stimulus and the discharge. The synchronization was remarkably improved by Ca^{2+} and was strongly suppressed by neomycin (NM). Suppressive effects of NM were decreased with increasing concentration of Ca^{2+}. Previously proposed action sites of Ca^{2+} and NM were membrane lipids especially polyphosphoinositides. Uranyl ions are known to have a high affinity for phospholipids of the cell membrane. The synchronization was completely suppressed by 0.1 mM UO_2^{2+} and this effect was also reversed by Ca^{2+}. Another group-specific reagent parachloromercuribenzoate, known as blocker of SH group of protein, had no effect on the synchronization. All these results suggest the action sites of Ca^{2+} for enhancement of mechano-sensitivity may be related to membrane phospholipids. As Maeno et al. reported on the neuromuscular junctions, competitive action of Ca^{2+}, NM and 4-aminopyridine at the same receptive sites were observed in the lateral-line organ.

295

VARIATION OF MECHANORECEPTIVE SENSITIVITIES IN CRAYFISH SETAL NEURONS. CHICHIBU, S. Dept. of Physiol., Kinki Univ. Sch. Med., Sayama, Osaka, 589

A number of different external morphological types is observed among mechanosensory hairs on the crayfish (Procambarus clarkii) exoskeleton. They were innervated by one or more neurons located at the base of the hair socket. Sensory neurons responded to mechanical stimuli having the rectangular step waveform with impulse trains. The dynamic range was obtained by the magnitude of hair shaft deviation to produce a linear increase in impulse frequencies. The dynamic range of A- and V-units of the first antenna was between ±1° and ±3.5°,respectively. The value for D-unit was about ±2° to ±4.5°. The similar comparison was made propodite hair neurons in the walking legs. The number of innervating neuron was apparently one in the majority. The dynamic range was between ±7° and ±18° . The value for neurons of the second antenna hair was much larger, and ranged between ±12° and ±30°. These differences in the dynamic range values seems to reflect the differnce between the contact and the stream detector natures.

296

BIMODAL (INFRARED + MECHANICAL) UNITS IN THE PITS OF Python reticulatus.

SHIN-ICHI TERASHIMA & RICHARD C. GORIS, Dept. of Physiol., Sch. of Med., Tokyo Med. & Dent. Univ., Bunkyo-ku, Yushima, Tokyo 113

29 bimodal single units (infrared + mechanical) were recorded from a branch of the trigeminal nerve. Each unit had only 1 receptive area 150 -250 μm in diameter inside one of the pits. This sensitive area was identical for both infrared and mechanical stimuli. The mechanical thresholds ranged from 15 mg to 1 g when tested with von Frey hairs. Response to both types of stimulus was always transient, the unit remaining silent during prolonged stimulation. Background discharge was generally absent, but 7 units had irregular background discharge. 2 of the 7 units were tested under steady-state temperature conditions, and had discharge peaks at 25 and 27° C, respectively. The maximum background discharge rate was 12 imp/sec. These findings contrasted strongly with the characteristics of infrared units in crotaline snakes, which usually have a higher peak rate (average 20 imp/sec) of constant background discharge and very small receptive areas (ca. 40 μm).

297

EXCITATION-CONTRACTION UNCOUPLING IN FATIGUED MUSCLE FIBER.
KANAYA, H., AND *TAKAUJI, M. Div. of Physical Education, Hokkaido Educat. Coll., Iwamizawa and *Dept. of Physiol., Sapporo Med. Coll., Sapporo.

We previously reported that the cause of muscle fatigue is the excitation-contraction uncoupling. In the present report, we examined in detail the properties of caffeine contracture and potassium contracture in fatigued single muscle fiber. Following results were obtained. 1) The activation curve of caffeine contracture in fatigued muscle fiber shifted toward the right; the peak tension of caffeine contracture was completely inhibited at lower concentration of caffeine (below 5 mM). However, in the presence of 25 mM K or 0.01% Triton X-100 caffeine contracture occurred sufficiently even at lower caffeine concentration and in fatigued muscle fiber. 2) In fatigued muscle fiber, the initial component of potassium contracture (60 and 80 mM K) was slightly inhibited, whereas the secondary component was inhibited markedly. These results indicate that the caffeine influx and the Ca influx induced by K-depolarization, through transverse tubular membrane (T-membrane)are inhibited in fatigued muscle fiber. Therefore, it was suggested that the cause of fatigue in single twitch muscle fiber is the uncoupling of excitation-Ca link induced by functioal disturbance of T-membrane.

298

SOME APPROACHES TO THE INTERNAL SYSTEM OF THE APMHIBIAN SKELETAL MUSCLE FIBER AND ITS EXCITATION-CONTRACTION COUPLING.
YAMAGUCHI, T. Dept. Biol. ICU, CLA, Mitaka, Tokyo, FUJINO, M., SATO, Y., ARIMA, T., AND TAKAI, H. 1. Dept. Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama.

To obtain detailed informations of the mechanically skinned muscle fiber of Xenopus laevis, an electron microscopic and an X-ray micro-analytical studies were done. Although the myofibrillar structure was preserved well, the interfibrillar spaces were widely open, and the whole SR was vesiculated in pieces; especially the part of the lateral sac (LS) was swollen and the content of it was accumulated beneath its membrane. In the skinned fiber, which was loaded by Ca^{2+}in K-CH_3SO_3solution buffered by 10 mM EGTA to pCa 6.3 after SR Ca had been released by 10 mM caffeine, the content of K in both cytoplasm and LS, was larger by about 70 to 80% than that of the intact fiber,indicating the different condition. After a transient contracture was induced in the above fiber by immersing a solution of pCa 6.7 of which anion was composed of Cl^- instead of $CH_3SO_3^-$,Ca content of LS was decreased, whereas K and Mg contents were increased. In the skinned fiber previously treated with optimum concentrations of acrolein, the ordinary contracture was induced by replacement of anion with chloride, showing the preservation of inner functions. A cation channel blocker, 4.7 mM hexamethonium had no effect on the contracture induced by replacement of anion with chloride.

299

INTRACELLULAR LOCALIZATION AND DISTRIBUTION OF SUBSRANCES IN AMPHIBIAN MUSCLES: APPROACH BY RUTHENIUM RED (RR)-STAINING AND ELECTRON PROBE ANALYSIS OF CRYOSECTION.
FUJINO, M., ARIMA, T., SATO, Y., TAKAI, H., * YAMAGUCHI, T. 1. Dept. Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama, *Dept Biol. CLA, ICU, Mitaka, Tokyo.

1. Substances filling lateral sac (LS) (LS-substances) of Rana japonica (Rj) are of granular appearance and stained with RR, the stained substances forming a spherical body which locates on T-tubular side of LS. 2.Granular appearance of LS remains unchanged by treatment of glycerol-extracted Rj muscle fiber with negatively charged chemicals (heparin and tannic acid); whereas the granular substances are stained with positively charged chemicals (RR and toluidine blue). LS-substances seem, therfore, of negative charge. 3.RR-stainability of LS is not inhibited by acrolein condition to inhibit E-C coupling, but is done by that to inactivate contractile ability. 4. Under the condition of cryosection single muscle fiber of Xenopus laevis can give an excellent pattern to carry out electron-probe analysis. The analysis of the contents of elements in cytoplasm and LS are as follows: Mg, P and S are contained almost the same amounts in both places, respectively; Na and Cl are somewhat more abundant in LS, and Ca is prominently abundant in LS.

300

INHIBITION OF EXCITATION-CONTRACTION (E-C) COUPLING BY ACROLEIN IN SINGLE MUSCLE FIBERS OF XENOPUS LAEVIS. FUJINO, M., SATO,Y., ARIMA, T., TAKAI, H. AND *YAMAGUCHI,T. 1. Dept. of Physiol.,Natl. Def. Med. Coll., Tokorozawa; *Dept. of Biol. CLA. ICU, Mitaka, Tokyo.

1. Acrolein (1-5 mM) is capable of inhibition of E-C Coupling: Tetanus and potassium contracture were inhibited; whereas, action potential and caffeine contracture remained almost normal. 2. Rm of fibers returned to normal Ringer after exposure to acrolein for 5 min decreased to about half the normal; while Ri and Cm remained unchanged. 3. 9 vinyl and allyl compounds of similar structure to acrolein and 19 aldehydes gave no results to conclude the inhibitory effect on E-C coupling. 4. SH-compounds (L-cysteine, 2-mercaptoethanol, dimercaprol, dithiothreitol, and dithioerythritol) had the protective effect against the acrolein action. 5. Conclusion: Both aldehyde-radical and double-bond of acrolein are indispensable for combining with E-C coupling site localized in T- membrane or triadic junction.

301

INACTIVATION OF EXCITATION-CONTRACTION COUPLING IN SINGLE TWITCH MUSCLE FIBERS OF THE FROG. TAKAUJI, M. AND TSUTSU-URA, M. Dept. of Physiol., Sapporo Med. College., Sapporo

The caffeine (3.5-5 mM) contracture under depolarization with 20-25 mM K is inhibited during the biphasic time course of the inactivation and at the completely inactivated state which have been induced by conditioning depolarization with low (20-25 mM) $[K]_o$ and constant (about 120 mM) $[Cl]_o$. In the present study, we examined the cause of this inhibition. Under the condition of constant $[Cl]_o$, fiber diameter was increased by conditioning with 25 mM K, and the peak tension of the caffeine contracture under K-depolarization was also inhibited even in the single muscle fiber whose transverse tubular membranes had been disrupted, although the extent of the inhibition was about half of that in the intact muscle fiber under the same condition. These phenomena were not observed in the presence of impermeable anion (chloride was replaced with sulfate). It was suggested that the inhibition, induced by conditioning depolarization, of the caffeine contracture under K-depolarization is due to the inactivation of potassium contracture and the direct action of chloride on caffeine contracture. The inhibition of rate of rize and the small inhibition of the peak tension of the caffeine contracture under K-depolarization were also caused by conditioning depolarization in the presence of impermeable anions (sulfate, methanesulfonate or propionate).

302

MEASUREMENT OF RAPID SARCOMERE LENGTH CAHNGES IN SKELETAL MUSCLE WITH LASER LIGHT DIFFRACTION. KOBAYASHI, T., KAMIYAMA, A. AND SUGI, H. Dept. of Clinic. Physiol. and Physiol., Sch. of Med., Teikyo University, Itabashi-ku, Tokyo.

The interpretation of muscle mechanics data generally rests on the assumption that the mechanical response in each sarcomere is uniform along the entire length of muscle fibers. To ascertain the validity of this basic assumption, we constructed an experimental device with which rapid sarcomere length changes can be measured on diffraction patterns with He-Ne laser light. This device has a high sensitivity to detect sarcomere length changes of less than 10Å, and a time resolution of about 10μsec. When a quick release was applied to single frog semitendinosus or tibialis anterior muscle fibers, the shortening of sarcomeres at the released end of the fiber followed the length change of the fiber very closely, while the shortening of sarcomeres at the fixed end showed a distinct delay in its onset and the subsequent shortening was much slower than the change in fiber length. These results indicate that, even by the use of the tibialis anterior fibers which is much shorter than the semitendinosus fibers, the sarcomere shortening during a quick release does not take place uniformly along the entire fiber length.

303

STIFFNESS CHANGES DURING CONTRACTION IN SKELETAL MUSCLE AS STUDIED BY ULTRASOUND VELOCITY MEASUREMENTS. SUGI, H. AND TSUCHIYA, T. Dept. of Physiol., Sch. of Med., Teikyo University, Itabashi-ku, Tokyo.

Methods were developed to examine the time course of change in muscle stiffness during contraction by measuring the transmission velocities of ultrasound (MHz region) in longitudinal and transverse directions with a high time resolution (tens of usec). When a frog sartorius muscle was made to contract isometrically, the longitudinal stiffness started to increase before the onset of tension development, and reached a maximum during the rising phase of an isometric twitch tension; on relaxation, the stiffness returned to the initial value in parallel with the decay of tension. The transverse stiffness, on the other hand, was found to decrease during an isometric twitch, though its time course relative to twitch tension was similar to that for the longitudinal stiffness. A linear relation was seen between the amount of stiffness changes and the twitch tension, suggesting that the stiffness changes reflect the force-generating mechanism.

These experiments were performed in collaboration with Drs. I. Hatta, Y. Tamura and T. Matsuda in the Department of Applied Physics, Faculty of Engineering, Nagoya University.

304

MEMBRANE POTENTIAL CHANGE AND CALCIUM ION FLUXES IN THE FRACTIONATED SARCOPLASMIC RETICULUM FRAGMENTS. KOSHITA, M. AND HOTTA, K. Dept. of Physiol., Nagoya City Univ. Med. Sch., Mizuho-ku, Nagoya

Fragmented sarcoplasmic reticulum (FSR) isolated from frog skeletal muscle was fractionated into light SR (LSR, derived from longitudinal reticulum) and heavy SR (HSR, derived from terminal cisternae). Ca^{2+} uptake created inside positive potential change in these fractions. The addition of valinomycin (K^+ ionophore) and the replacement of Cl^- with gluconate$^-$ (less permeable anion) enhanced Ca^{2+} uptake and affected potential formation. 4,4'-Diisothiocyano-2,2'-stilbene-disulfonic acid (DIDS, potent inhibitor of anion exchange) inhibited both Ca^{2+} uptake and Ca-ATPase activity of FSR. These results suggest that Ca^{2+} uptake is enhanced by K^+ efflux and inhibited by Cl^- influx, though anion influx is required for Ca^{2+} uptake. Anion-induced Ca^{2+} release was inhibited by the addition of sucrose and not inhibited by dantrolene not only in LSR but HSR. Cation exchange did not cause Ca^{2+} release even in the presence of DIDS. These results support that the cause of Ca^{2+} release is the osmotic effect in this experimental system.

305

MODIFACATION OF LIGHT DIFFRACTION INTENSITY BY DANTROLENE IN SKINNED STRIATED MUSCLE FIBER OF FROG. OBA,T. AND HOTTA,K. Dept. of Physiol., Nagoya City Univ. Med. Sch.

The diffraction intensity profiles of the first order line were studied in mechanically skinned fibers. Activation of skinned fibers by calcium decreased the intensity at all sarcomere lengths at which the filaments overlapped. The magnitude of intensity decrease depended on calcium concentration in the medium. Dantrolene sodium (DAN) added in a relaxing solution produced the intensity decrease in skinned fibers, being comparable to that obtained at pCa = 6.86 to 6.75 at the corresponding sarcomere length. DAN in the Ringer solution did not affect the diffraction intensity of intact single fibers. In activating solution at pCa = 5.49, DAN inhibited the calcium-induced intensity decrease in skinned fibers. These results indicate that action sites of DAN may be located on the intracellular membrane of T-tubule and the surface of the sarcoplasmic reticulum (SR) membrane. DAN action upon these structures suggests the presence of a trigger calcium on T-tubular membrane and also DAN stimulates calcium uptake of SR.

306

MUSCLE CONTRACTION UNDER HIGH HYDROSTATIC PRESSURE (II).

MURAKAMI T.H. Dept. of Biol., Kagawa Med. Sch.

When skeletal muscle of frog is immersed in liquid petrolatum and is applied to high hydrostatic pressure, there is a marked increase in the muscle tension during the period of compression. With in a compression force of about from 100 to 300 Kg/cm^2, the tension is practically unchanged; whereas, at from 500 to 600 Kg/cm^2, the tension increased to unreversible contructure.

By electron microscopy, the specimen fixed after compression (600 Kg/cm^2) showed that destruction of Z-line, and the orientation of the thin and thick-filament was disorganized.

307

LONGITUDINAL AND LATERAL ELASTICITY OF RESTING FROG SKINNED SKELETAL MUSCLE FIBERS.

Y.UMAZUME AND N.KASUGA Dept. of Physiol., Jikei Univ. Sch. of Med., Minato-ku, Tokyo

Contributions of myofilaments and cytoskeleton to longitudinal and lateral elasticity of sarcoplasma were studied in resting skinned muscle fibers at 20°C. On the course of increasing ionic strength($\Gamma/2$), intensity of first order diffraction lines and resting tension started to decrease simultaneously at $\Gamma/2 \simeq 0.25M$, suggesting that structure of thick filaments contributed to longitudinal elasticity. Polarizing microscopy and SDS gel electrophoresis confirmed that thick filaments disolved at $\Gamma/2 \simeq 0.25M$. Length-tension relation showed also smaller resting stiffness of partially myosin extracted fibers. Width of rigor, KCl and KI ghost fibers were 95, 90 and 70% of resting skinned fiber respectively. In lateral compression study by PVP(K-30), rigor/ghost fibers showed increase/decrease of lateral stiffness. We changed pH considering the contribution of lateral repulsive force between myofilaments and/or myofibrils to lateral elasticity. At pH≃5 to 4, width of fiber decreased to about 60%. This change was irreversible. This phenomenon was also observed in KCl and KI ghost fibers.

308

CHANGES IN THE LATERAL FILAMENTARY SPACING CAUSED BY ACTIVATION OF CHEMICALLY SKINNED MUSCLE FIBRES.

MATSUBARA, I. AND YAGI, N. Dept. of Pharmacol., Sch. of Med., Univ. of Tohoku, Sendai

A toe muscle was isolated from a hind limb of the mouse and treated with saponin to make the sarcolemma more permeable to the solutes of the bathing medium. The sarcomere length was adjusted to 2.6 μm using the light diffraction method, and the equatorial X-ray diffraction pattern was recorded to determine the 1,0 spacing of the hexagonal myofilament lattice. In a relaxing solution (pCa>8, 17-20°C) the spacing was 43.3±1.1 nm(mean ±S.D., n=8). When the muscle was activated isometrically in a calcium -containing solution (pCa=5.49) to produce the maximum tension, the spacing decreased to 40.4±1.1 nm (n=6). This decrease was similar in magnitude to that caused by immersing the muscle in a relaxing solution containing 4 g/dl polyvinylpyrrolidone (K-30, M_n=40,000 D). From this result the lateral force produced on the maximum activation was calculated to be 4×10^{-10} N/ μm of a thick filament in the overlap region. This was comparable to the axial force produced during the maximum contraction, i.e. 6×10^{-10} N/ μm of a thick filament.

309

MOVEMENTS OF MUSCLE CROSSBRIDGES DURING AND AFTER AN APPLIED LENTH CHANGE.

YAGI, N. AND MATSUBARA, I. Dept. of Pharmacol., Sch. of Med., Univ. of Tohoku, Sendai

Behaviour of crossbridges in frog skeletal muscle was studied with a time-resolved X-ray diffraction technique. When a muscle during tetanus was stretched or released at a constant speed (7% muscle length in 300 or 800 msec), the intensity of the meridional myosin reflection at 14.3 nm decreased indicating a change in the axial distribution of cross-bridges or their angle of attachment to actin. When the speed of length change was small, the intensity decrease was greater during stretch than during release. After a stretch the tension remained greater than the control value even after stress-relaxation. This residual tension was accompanied by a sustained decrease in the intensity of the reflection. On the other hand, both the tension and the intensity returned to the control values after a release. These results, in addition to our previous observation that the intensities of the equatorial reflections are unaffected by stretch, suggest that the residual tension after stretch is associated with axial displacement of crossbridges.

310

THE RELATION BETWEEN SHORTENING HEAT AND SARCOMERE LENGTH IN FROG SKELETAL MUSCLE.

YAMADA, K., KOMETANI, K. AND KOBAYASHI, T.* Dept. of Physiol., Med. Coll. of Oita, Oita, *Dept. of Physiol., Teikyo Univ. Med. Sch., Tokyo

The heat of shortening was measured during tetanic contractions of semitendinosus muscles of Rana japonica at 0°C and at various sarcomere lengths from 2.2 to 3.5μm, as measured by laser diffraction. The shortening heat was estimated as the excess heat produced during 0.34 sec after the muscles were released by 1 mm at nearly maximal velocity. It was also found that the resting muscles showed an absorption of heat when released at sarcomere lengths beyond 2.5μm (rubber-like elasticity). Because apparent shortening heat became negative at very long sarcomere lengths the similar absorption of heat should also occur in actively shortening muscles as in the resting muscle. After the apparent shortening heat was corrected for this absorption of heat, taking that the same elasticity holds in active muscles as in resting ones at sarcomere lengths longer than 2.5μm, the shortening heat is rather constant at sarcomere lengths between 2.2 to 3.1μm, and declines abruptly beyond 3.3μm.

311

CONFORMATION CHANGES OF TROPONIN, TROPONIN-(C+I) COMPLEX AND TROPONIN C ASSOCIATED WITH CALCIUM BINDING.

KOMETANI, K. AND YAMADA, K., Dept. of Physiol., Medical College of Oita, Oita

The conformational changes on Ca binding of troponin (TN), troponin-(C+I) complex (TN-(C+I)) and troponin C (TN-C) from rabbit skeletal muscle were studied by microcalorimetric titrations at pH 7 and at different temperatures of 5°, 15° and 25°C. Changes in Gibbs free energy, enthalpy, entropy (ΔS) and heat capacity (ΔC_p) associated with Ca binding to each of the four Ca-binding sites were determined. From the values of ΔS and ΔC_p, individual contributions to ΔS arising from the hydrophobic effect (ΔS_{hyd}) and the internal vibrational mode (ΔS_{vib}) were estimated (Sturtevant, 1977). The binding of both the 1st and the 2nd 1 mole of Ca^{2+} to TN in Mg-free solution gives a large positive ΔS_{hyd} and a large negative ΔS_{vib}, indicating that the interactions of the hydrophobic residues with sorrounding water molecules largely decrease and TN becomes more rigid. These changes become smaller for the further binding of Ca^{2+}. Both the positive ΔS_{hyd} and the negative ΔS_{vib} remain substantial in the presence of 1 mM Mg. TN-(C+I) showed similar but less marked changes (about half of those of TN). Changes of TN-C in Mg-free solution differ from those of TN and TN-(C+I) in that the binding of the 2nd 1 mole of Ca^{2+} shows a large negative ΔS_{hyd} and a large positive ΔS_{vib}.

312

RELATIONSHIP BETWEEN RCC ACTIVATION AND FIXED CHARGES OF THE T-TUBULES.
SAKAI, T., KURIHARA, S., USUI, S. AND KONISHI, M. Dept. Physiol., The Jikei Univ., School of Med. Minatoku, Tokyo. 106.

Since RCCs of frog skeletal muscles were elicited in any specimen; i.e. completely depolarized, T-tubules disrupted and skinned muscle fibers, it has concluded that calcium ions released from the sarcoplasmic reticulum play a triggering role for activation. Recently, authors descussed on activation of RCC which Ca^{2+} releasing from sarcoplasmic reticulum might be influenced by some functional changes of T-system through the T-tubular membrance. Also, we reported that the RCC was'nt so influenced by change of pH_o at 1.0 mM caffeine, while at the lower concentration activation of RCC was dependent upon the pH_o from 5.0 to 9.0.

We studied, furthermore, some experiments in details by use of toe muscle dissected from Rana nigromaculata. Adjustment of medium pH followed in Dorrscheidt-Kafer's manner (1976). In these experiments we found the fact that dose-response relation on RCC at pH=9.0 was more shifted to left site than that at pH=7.2. Particularly, in alkaline medium a rate of rise of tension was remarkably accelerated at low concentration of caffeine.

313

A MICRO-DETERMINATION OF MYOGLOBIN CONTENT IN CANINE SKELETAL MUSCLES
KAWASE, M. School of Physic. Educ., Tenri Univ., Tenri NAKATANI, A., ENOKI, Y. AND TOMITA, S. Dept.of Physiol., Nara Med. Univ., Kashihara

Myoglobin(Mb) was prepared from canine skeletal muscles and its absorption characteristics were determined in visible, Soret and ultraviolet regions. Using these characteristics and concomitantly determined Mb concentration, the molar absorption coefficients were calculated. These coefficients were used to derive the following equations for estimating the Mb content of canine muscles,

$$[Mb] = \{ 6.219 (A_{538} - A_{568}) (V + 0.75W) \}/ W \quad (1)$$

$$[Mb] = \{ 0.311 (A_{422} - A_{416}) (V + 0.75W) \}/ W \quad (2)$$

where [Mb]: Mb content (mg/g muscle), A_x: absorbances at $x$nm, V: buffer volume (ml) and W: wet muscle weight (g). The Eqn.(1) and (2) were used with ~1g~ and ~0.1g~ muscle, respectively. The results by the macro procedures agreed fairly with those by the micro ones, mean±SD of the difference being 0.087 ± 0.330mg/g (n=20). A positive correlation between the Mb content and cytochrome C content was revealed by the present procedure. (r=0.669).

314

EFFECTS OF PROTEASE INHIBITORS ON THE ACTIVITY CHANGES OF SEVERAL ENZYMES IN MURINE MUSCULAR DYSTROPHY.
TSUJI, S. and MATSUSHITA, H. Dept. of Physiol. Wakayama Medical College, Wakayama.

There have been several studies suggesting that the increased activities of intramuscular proteases are causally related to muscle atrophy in murine muscular dystrophy. In order to examine the usefulness of applying protease inhibitors to prevent progression of muscular dystrophy, we investigated the effects of protease inhibitors which are known to be closely correlate to the disease, on the activity changes of several enzymes in muscle and serum of dystrophic mice. The results obtained was summarized as follows:

1. Continuous administration of leupeptin or bestatin to dystrophic mice at early stage of the disease resulted in a striking recovery of several enzyme activities in muscle and a considerable decrease of released enzyme activities in serum.
2. There are two ways of effects of the protease inhibitors on the enzyme activities in dystrophic mice; one is direct effect to suppress to catabolic enzyme activities and the other is functional recovery of cell membrane and membraneous structure of intracellular organella to cause restoration of normal enzyme activities.
3. A complete recovery from clinical symptoms of hindleg paralysis and a normal gain of body weight are appeared in about a half numbers of mice treated with bestatin.

315

THE JUNCTIONAL GAP BETWEEN SR AND T-TUBULE OF THE FROG SKELETAL MUSCLE

YOSHIOKA,T.,NAGAMI,K.,NARUSAWA,M.,NAKANO,S. Dep. of Physiol., Tokai Univ. Sch. of Med., Isehara 259-11, Kanagawa.

Functional and morphological research of the junctional gap of the skeletal muscle had been reported elsewhere.We used in this study Triton X-100 and Brij-58 which are both non-ionic detergent substances, and attempted to decide what concentration was suitable and how much incubation time was necessary in order to influence the SR and T-tubule without causing any damage to the sarcolemma of the toe muscle. The twitch continued for 20-30 minutes after having been placed in 0.05 mM Triton solution, and after RCC (Sakai,1965) can be easily elicited. Many thick filaments tended to shift to the Z-line of the sarcomere at the peak height of RCC. Slight swelling SR and T-tubule were observed, but the junctional gap was almost intact. However, in 1 mM Brij, the twitch can be induced for 30-40 minutes, but there is no RCC. Much damage was observed in the membrane system in this case. It may be said that the functional connection of the junctional gap is decreased in Triton X-100 and occured irreversible change in Brij-58 solution.

316

CONTRACTILITY AND CALCIUM MOVEMENTS IN THE DISPERSED SMOOTH MUSCLE CELLS. KOSAKA, I., OBARA, K., OOTA, I. AND YABU, H. Dept. of Physiol., Sapporo Med. College, Sapporo 060.

Single smooth muscle cells were dispersed from the guinea-pig taenia coli by the treatment with 0.3% collagenase for 30 min at 35°C. Contraction was induced by 4 mM caffeine. The contractility was examined for cells suspension by the fixation method: the solution containing about 10^4 cells/ml was added to a glass test tube in which caffeine had been placed, and after the adequate reaction time, acrolein was added. The cells fixed were mounted on a slide glass and the cell length was measured under the microscope. Percent decrease in cell length by caffeine was 15 - 35% and the maximum decrease was caused within 30 sec. In the presence of 10 μM chlorotetracycline (CTC), the contraction induced by caffeine was not inhibited, but rather enhanced. Ca movements at or in the membranes in the cell were monitored by CTC fluorescent probe. The fluorescence changes were measured by the fluorospectrophotometer (Shimadzu, RF-510). Ca-CTC fluorescence was increased with the concentration of Ca in the medium, and the fluorescence of the Ca-CTC-Cell system was decreased by about 60%, when 4 mM caffeine was applied. The decrease reached maximum about 25 sec after the application of caffeine. The time to peak of fluorescence change is nearly the same as that of contraction. The decrease of the intensity of the fluorescence by caffeine may be considered to monitor the release of Ca from the membranes into sarcoplasm.

317

ACTION POTENTIALS IN THE OVIDUCTAL SMOOTH MUSCLE OF THE GUINEA-PIG AND EFFECTS OF CATECHOLAMINES
OHKAWA,H. AND WATANABE,M. Dept. of Physiol., Yamaguchi Univ. Sch. of Med., Ube

The spontaneous action potential of the oviductal smooth muscles of the non-pregnant guinea-pig was recorded intracellularly. The resting membrane potential was about 50 mV. The spontaneous action potential which consisted with a plateau phase and several spikes superimposed on it was observed frequently in the regions of isthmus and ampulla. Adrenaline, noradrenaline and phenylephrine exhibited the excitatory action on the membrane activity while adrenaline showed the inhibitory effect after the treatment with phentolamine. The inhibitory effect of isoprenaline was observed while this effect was blocked by propranolol. Prostaglandin $F_{2\alpha}$ also showed the excitatory action. These results indicate that the sympathetic innervation on the oviductal smooth muscle is alpha-excitatory and beta-inhibitory. The effects of catecholamines on the mechanical activity of the strip were also similar.

318

CONDUCTION VELOCITY AND PERIOD OF PERISTALTIC WAVES IN THE URETER : APPLICATION OF A NEW DIAMETER GAUGE. SAKAGUCHI, M*, OHHAHSI, T., MIYAZAWA, T. AND AZUMA, T., *Dept. of Elec. Eng., Nagano Tech. College, Dept. of Physiol., Shinshu Univ. Sch. of Med., Matsumoto 390

We had constructed a diameter gauge utilizing the high resolving power and stability of image sensor. The device made it possible to carry out contact-free diameter measurements of a cylindrical organ. Using the diameter aguges, we constructed a new device to measure conduction velocity and period of peristaltic waves of the isolated canine ureter and investigated effects of noradrenaline and electrical field stimulation. A pair of the diameter gauges were positioned at proximal and distal portions of the preparation. The conduction velocity and period of contraction waves were electrically calculated and displayed on a direct-writing oscillograph. Overall frequency response of the device was flat up to 3 Hz. The conduction velocity ranged from 24 to 32 mm/sec at 37°C. A negative correlation was found between the velocity and the rhythm of peristaltic activity when no drug administration or electrical stimulation was made.

319

ELECTROMYOGRAPHIC STUDY OF THE GASTRIC MOTILITY AFTER ATYPICAL PROXIMAL VAGOTOMY

FUKUDA,T. KUWASHIMA,T. ARAKAWA,T. KURAMOTO,M. AND KOMI,N. Dept. Surg., Sch. Med., Univ. Tokushima

Atyp- SPV was proposed as either the anterior or posterior nerve of Latarjet was sacrified at selective proximal vagotomy (SPV). In order to study the gastric motility after atyp- SPV, eight mongrel dogs on which SPV had been performed underwent atyp- SPV , with subsequent truncal vagotomy (TV). These surgeries were performed about 4 to 5 weeks' interval, and gastric myoelectrical activities were recorded serially through chronically implanted four bipolar electrods in the stomach.

In other four dogs with atyp- SPV, contractile activities of the gastric wall were recorded by means of waterproof straingauges sutured on the gastric wall.

Following atyp- SPV, the mean propagation velocity and discharge interval of the stomach were almost similar to those in SPV. Subsequent TV decreased the propagation velocity significantly although did not alter the discharge intervals except for an early postprandial period in transection of the anterior nerve of Latarjet.

Atyp- SPV maintained the gastric contraction with a waxing and wanning pattern of varying amplitudes in the antrum and monotonic activities in the corpus.

320

ELECTROMYOGRAPHICAL STUDY ON THE RESIDUAL STOMACH AND THE INTERPOSED JEJUNAL MOTOR FUNCTION FOLLOWING MERENDINO'S PROCEDURE

ARAKAWA,T. KUWASHIMA,T. FUKUDA,T. KURAMOTO,M. KOMI,N. Dept. of Surg. Tokushima

In order to study the motor function of the interposed jejunum and residual stomach following Merendino's operation, eight bipolar electrodes were implanted in them using adult mongrel dogs. Three types of surgery, truncal vagotomy (TV), selective proximal vagotomy (SPV) and TV with pyloroplasty (PP) were done. In the interposed jejunum, the propagation of the BER was not constantly directed from oral to anal side with phase lead level migration. In the residual stomach, following TV, the significant reduction of the BER frequency and propagation velocity were noted, and dysrhythmia was noted, and dysrhythmia was observed frequently. After feeding, however the BER frequency increased and dysrhythmia was alterd to the regular rhythmic pattern. In the group of TV with PP, the frequency of dysthythmia was not decreased. BER frequency and propagation velocity were not changed after feeding. In the group of SPV, the frequency of dysrhythmia was low and the propagation velocity was preserved in the normal rate.

On pathohistological findings, reflux esophagitis was not observed in all eheir esophagus.

321

REGULATION OF AUTOMATICITY OF RAT PORTAL VEIN BY Ca^{2+} AND Sr^{2+}.

YAMAMOTO, Y. and HOTTA, K. Dept. of Med. and Physiol., Nagoya City Univ. Med. Sch.

The automaticity of the smooth muscle of rat portal vein was investigated with microelectrodes. Slow depolarization is a direct trigger for burst discharge of spikes which superimposed on it. Addition of 2.5mM Sr^{2+} into the medium with 2.5mM Ca^{2+} enhanced duration of the slow depolarization, but not its amplitude. By total substitution of Ca^{2+} with Sr^{2+}, both amplitude and duration increased forming a plateau phase. This plateau was abolished in Na^{+}-free medium, whereas it was persisted in Cl^{-}-deficient medium. Blocking of K^{+} channel by 20mM TEA resulted in persistent depolarization of the membrane. Membrane resistance decreased monotonously during Sr^{2+}-mediated plateau phase in Ca^{2+}-free solution with GEDTA, whereas without GEDTA it increased gradually reaching twice of the value during resting phase. The results indicate that the plateau may be produced by the combination of increased Na^{+} conductance and decreased K^{+} conductance. There may be separate sites on the membrane, which have affinity for these bivalent cations and regulate amplitude and duration of the slow depolarization, respectively.

322

THE CONTRACTURE PRODUCED BY Na-REMOVAL IN THE RAT MYOMETRIUM.
MASAHASHI, T., SUZUKI, M., TAKAI, A.* AND TOMITA, T.* Dept. Gynaecol. and Dept. Physiol.,* Sch. Med., Nagoya Univ., 466 Nagoya

When the external Na concentration was reduced to less than about 20 mM, both the longitudinal and circular muscles of non-pregnant rat myometrium produced a sustained increase in tension. This contraction was composed of two components: phasic contraction due to spike activity and tonic contraction due to depolarization of the membrane. The contracture was larger in the longitudinal than the circular muscle. Rhythmic contractions were usually superimposed on the tonic contracture. In the longitudinal muscle, the rhythmic activity often disappeared by repeated application of Na-free solution. The contracture in Na-free solution was transiently suppressed by reapplication of more than 3 mM Na, and this suppression became stronger with higher concentration of Na and with longer exposure to Na-free solution. The contracture was increased with increasing Ca concentration up to more than 25 mM. D-600 (10^{-6} M) quickly blocked the rhythmic activity and reduced the contracture, but some tonic contracture remained. Ouabain had weak suppressing effects.

323

EFFECTS OF MAGNESIUM AND MANGANESE IONS ON OXYTOCIN-INDUCED ELECTRICAL AND MECHANICAL ACTIVITY OF RAT UTERINE MUSCLE.
OGASAWARA,T., KATO,S. AND OSA,T. Dept. of Physiol., Yamaguchi Univ. Sch. Med., Kogushi, Ube 755

Longitudinal muscle of estrogen-treated rat uterus was used for experiments. Oxytocin (0.1-1 mU/ml) caused a depolarization in a Locke solution, a prolongation of burst discharge carried on the plateau potential and an increase in the frequency of spontaneous activity. These actions were potentiated by addition of 1-3mM Mg and 0.5-2mM Mn, but depressed by 5mM Mn. Marked depolarization and contracture were produced by oxytocin when the application of Mn was discontinued (rebound potentiation). The rebound phenomenon was also found in the action of acetylcholine. It is suggested that the action of oxytocin is modified by Mg and Mn at the membrane surface of myometrial cells, and an influx of Mn may cause the rebound potentiation of depolarization and contraction.

324

Mg ATP-DEPENDENCE OF TENSION DEVELOPMENT IN GLYCERINATED STRIATED AND SMOOTH MUSCLES OF THE SCALLOP.
TANAKA, H. Central Laboratory, Sch. of Med., Teikyo University, Itabashi-ku, Tokyo.

The dependence of tension development on the Mg ATP concentration was studied on glycerinated adductor muscles of the scallop consisting of both striated and smooth muscle fibers, with special reference to the mode of tension development in the absence of Ca^{2+}. The dependence of tension development on the Mg ATP concentration in the striated adductor muscle fibers, having the myosin-linked regulatory system, was very similar to that in vertebrate striated muscle fibers, having the actin-linked regulatory system; namely, the lack of Ca^{2+} sensitivity was observed at low Mg ATP concentrations. The mode of tension development in the smooth adductor muscle fibers was, on the other hand, similar to that in other smooth muscles; no appreciable tension development was seen in the absence of Ca^{2+}, and in the presence of Ca^{2+} the Mg ATP concentration higher than 10^{-4}M was required for tension development.

325

ACTION OF NORADRENALINE ON THE CALCIUM CURRENT IN THE VAS DEFERENS SMOOTH MUSCLE IN TEA ION MEDIUM.

INOMATA,H. AND MIMATA,T.* Dept. of Applied Physiol.,Sch.Med.,Univ.Tohoku and Dept. of Int.Med.,Sch.Med.,Univ.Tohoku*.

The calcium ionic mechanism in α -excitatory action of noradrenaline (NA) on the vas deferens tissue of guinea-pig was examined under constant-current and voltage-clamp conditions using the double sucrose gap technique. The behavior of calcium current (I_{Ca}) was observed in Krebs solution replacing 68 mM-Na ion with tetraethylammonium ion (TEA) in an attempt to suppress the potassium outward current (I_K). By adding NA at the concentrations of 1×10^{-6} to 5×10^{-6}g/ml, the membrane potential was slightly depolarized, the amplitude of the spike reduced, and the maximum dV/dt retarded,but the duration not significantly affected. Under voltage-clamped condition, addition of NA decreased the maximum I_{Ca} and shifted its reversal potential (E_{Ca}) towards negative voltages by about 10 mV, with reducing the conductance, g_{Ca}. The voltage dependent time constant of the inactivation of I_{Ca} was reduced and the peak time to the maximum I_{Ca} prolonged; the degrees of their changes were dependent on the membrane potential level. The above findings in TEA medium were in contrast with those in normal Krebs solution already published elsewhere by us.

326

LOCALIZATION AND TRANSLOCATION OF ACTIVATOR CA IN SEA CUCUMBER SMOOTH MUSCLE.

SUZUKI, S., GOMI, S., TSUCHIYA, T. AND SUGI, H. Dept. of Physiol., Sch. of Med., Teikyo University, Itabashi-ku, Tokyo.

Physiological and cytochemical studies were carried out to obtain information about the origin of activator Ca for contraction in longitudinal retractor muscle (LRM) of a sea cucumber, Stichopus japonicus. K- and acetylcholine (ACh)-induced contractures were dependent on the Ca concentration of the external medium, and reduced by Mn (10mM) or La (20mM) ions, indicating that the contraction is mainly caused by Ca-influx from the external medium. However, procaine (5mM) also reduced the tension of K- and ACh-induced contractures. In the absence of external Ca, however, a fraction of the maximum contracture tension could still be produced by the removal of external Mg ions or by the hypertonicity, suggesting that the LRM also has some amount of intracellular Ca available for the activation of contraction. Electron microscope observation revealed the existence of numerous subsarcolemmal vesicles which were assumed as a store site of intracellular Ca. These results indicate that, in the LRM fibers, the contraction is initiated not only by Ca-influx but also by Ca-release from the intracellular store sites. This view is further supported by cytochemical study on the intracellular Ca localization and its translocation during mechanical activity, using K-pyroantimonate, and by electron probe X-ray microanalysis.

327

INFLUENCE OF Na ION ON K CONTRACTURE IN THE GUINEA-PIG TAENIA COLI.

ASHOORI, F., TAKAI, A. AND TOMITA, T. Dept. of Physiol., School of Medicine, Nagoya University, Showa-ku 466 Nagoya

Tension development of the guinea-pig taenia coli which had been treated with Ca-free excess K solution was studied in response to reapplication of Ca, usually at a concentration of 2.5 mM. The tension increased dose-dependently with increasing the Ca concentration up to more than 50 mM. The tension gradually declined during a prolonged application of Ca in Na-free solution, while this tendency was less in Na-containing solution. Similarly, in the absence of Na, the tension development became small when Ca reapplication was repeated, and this decrease was prevented when more than 10 mM of Na was added. Thus, Na has a potentiating effect on the K contracture. However, when the solution containing Na and solution containing no Na were alternatively applied repeatedly, it was found that Na gradually depressed the K contracture. These effects of Na were not essentially modified by ouabain (10^{-4} M). It seems that Ca transport across the membrane is influenced by Na in a complicated way, and that a Na-Ca exchange process plays only a minor role in this process.

328

INTERACTION BETWEEN Na PUMP AND Na-Ca EXCHANGE SYSTEM IN RABBIT A-V NODE CELLS: KURACHI, Y. AND IRISAWA, H. NATIONAL INSTITUTE FOR PHYSIOLOGICAL SCIENCES

In the rabbit A-V node cells, long K free perfusion (more than 6 min) caused marked spontaneous hyperpolarization of the membrane. This spontaneous hyperpolarization(SP) ocurred in K free solution containing 10^{-5}M strophanthidin, and disappeared in Ca free solution. SP in K free solution was accompanied by prominent increase of the membrane conductance and the tonic tention. From these results, Ca activated G_K is the most possible candidate for SP. That is, elevated $[Na^+]_i$ caused increase of $[Ca^{++}]_i$ through Na-Ca exchange system. To estimate the change of the effectiveness on $[Ca^{++}]_i$ control by Na-Ca exchange in K free perfusion various concentration of caffeine was applied. In normal Tyrode and early phase of K free perfusion, even 20 mM caffeine could not cause SP. In relatively long K free perfusion, 2 mM caffeine induced SP and tention development. Furthermore, when $[Na^+]_i$ was reduced to 10%, low dose of caffeine could induce hyperpolarization of the membrane with increase of the tonic tension. From these results, it was estimated that the effectiveness of Na-Ca exchange is maintained by the Na gradient across the cell membrane which is controlled by the activity of the Na pump.

329

THE EFFECT OF Ca ION AND SEVERAL AGENTS ON THE ACTION POTENTIAL IN THE CULTURED CHICK EMBRYONIC HEART CELL.

YAMASHITA, E. Dept. of Visual Physiol., Sch. Educ., Univ. Tohoku, Sendai, 980.

The action potential of cultured chick embryonic heart cell was recorded with the microelectrode method. The increase in external Ca ion concentration produced the enhancement of overshoot and max. rate of rise and shortning of duration of action potential. The effect of Sr was different from Ca in bringing longlasting afterpotential. Extra- or intracellular application of TEA or 4-AP prolonged the duration of action potential. The prolongation was not so manifest in 4-AP as in TEA. Prompt application of more increased Ca ion initially abolished the action potential except pace maker component, but it began to recover again progressively. This result suggests that the action potential is composed from three components with different connection to Ca and K : initial spike, plato-component and pace maker potential.

330

AUGMENTED DEPRESSION OF THE CALCIUM CONDUCTANCE BY ACETYLCHOLINE IN ADRENALINE TREATED VENTRICULAR MUSCLE.

OCHI, R. Dept. Physiol., Sch. Med., Juntendo Univ., Tokyo

The efficiency and the mode of depression of slow inward current(i_s) by ACh was examined in guinea pig papillary muscle in the presence of adrenaline(Adr). The membrane potential was controlled by the single sucrose gap voltage clamp method and pure i_s was obtained by subtracting Co^{2+} resistant current. Maximal amplitude of i_s was reached at the depolarization to 0mV. With further increase of depolarization i_s was decreased and reversed its polarity at the reversal potential(E_s). E_s was 45mV in 1.8mM Ca^{2+} and changed as expected from the Nernst equation for Ca electrode. Adr(2μM) increased i_s 3-5 times but sufficient clamp was possible by depressing i_s conductance by gentamicine(50-200μM). In the presence of 2μM Adr the maximal amplitude of i_s was diminished to 27% by 2μM ACh, while it was diminished only to 60% in the absence of Adr. No change in E_s was observed on the application of Adr or ACh, suggesting that the selective filter of individual i_s channel was not affected by ACh. Moreover, neither the time course of inactivation of i_s nor the time to peak of i_s (at 13-15°C) was affected by ACh. These results support the hypothesis that ACh decreases calcium conductance indirectly by diminishing the density of i_s channels.

331

Development and differentiation of electrical activty in very early embryonic heart monitored by a voltage-sensitive dye. K. KAMINO, A. HIROTA, S. FUJII, T. SAKAI, Dept. of Physiol. Tokyo Med. & Dent. Univ. Sch. of Med., Bunkyo-ku Tokyo

Spontaneous action potentials in very early embryonic chick heart were measured optically using a voltage-sensitive merocyanine-rhodanine dye. The spontaneous action potential activity was generated at the 7 somite stage of development, and as early as the 7 somite stage, the beginnings of rhythmic spiking were apparent. However, in the 7 to early 8 somite embryonic hearts, a non-specific pattern of optical signal was usually detected. Optical signals resembling the pacemaker type action potential with a diastolic depolarization phase were seen first in the hearts at the later period of 8 somite stage, and the diastolic depolarization phase developed as development of the embryo proceeded to the 9 somite stage. Furthermore, using the simultaneous recording from 5∿8 different portions of an embryonic heart, we demonstrated that as the primitive tubular heart was formed, the pacemaking area which possesses the highest intrinsic rhythmicity is localized mainly in the left atrial primordia and subsequently shifts to the future sinus region, by the 11 somite stage. With future development of the heart, the pacemaking cells of the sinus primordium probably organized themselves into nodes and bundles while maintaining their original relationaship with the surrounding musculature.

332

Effects of temperature on action potential activity in early embryonic heart monitored optically using a voltage-sensitive dye. A. HIROTA, S. FUJII, T. SAKAI, K. KAMINO, Dept. of Physiol. Tokyo Med. & Dent. Univ. Sch. of Med. Bunkyo-ku, Tokyo

Effects of temperature on the spontaneous action potential activity in the 7-9 somite embryonic chick heart, corresponding to 25∿32 hours after incubation, were investigated by means of an optical method capable of measuring membrane potential. The embryonic hearts were stained with a voltage-sensitive merocyanine-rhodanine dye (NK 2761). Cooling caused a marked decrease in the frequency of rhythmic recurrence of the spontaneous optical spikes. The Q_{10} of the frequency was around 5.0 in the 8-9 somite embryonic hearts. This slowing was associated with a decreased rate of diastolic depolarization of the pacemaker type action signals. The threshold firing level remained relatively constant until about 30°C. In both the pacemaker and the non-pacemaker type action signals, with cooling of the bathing solution, the duration of the action signals increased. On the other hand, the amplitude of the action signals was not altered. We also recorded action signals simultaneously from 5-8 different portions in an embryonic heart at various low temperatures; the conduction velocity of the action potential decreased to 0.36mm/sec at 20.0°C from 1.5mm/sec at 36.7°C in a 9 somite embryonic heart. Synchronization of the action signals among the different portions was rarely distorted.

333

EFFECT OF PARASYMPATHETIC CARDIAC NERVE-BRANCH STIMULATION ON VENTRICULAR REFRACTORINESS IN DOGS

ENDOU, K., YAMAGAMI, J., TAKEUCHI, A., MIYAHARA, H., SATO, T., NARA, Y. Dept. of Medicine, School of Medicine, Kitasato University, Kanagawa

The influence of individual parasympathetic efferent cardiac nervous activity on ventricular refractory period duration (RP) was studied in 15 alpha-chloralose anesthetized mongrel dogs. Parasympathetic effects were studied in vagotomized dogs by inducing cholinergic blockade with atropine 0.1 mg/kg, and by sectioning the ansa bilaterally. On the right, caudovagal nerve and craniovagal nerve produced prolongation of RP (4-7 msec) significantly, especially on the right ventricle (12.5 msec). Prolongation of RP disappeared either when atropine was injected, or when ansa were ligated bilaterally. On the left, no significant prolongation of RP by stimulation of l. vagus, VMCN, and VLCN was observed. Strength-interval curve was also shifted later by stimulating craniovagal nerve and r. vagus in 3 vagotomized dogs.

Caudovagal and craniovagal nerve seem to produce prolongation of RP especially on the right ventricle by antagonizing sympathetic tone.

334

LEFT VENTRICULAR SYSTOLIC PRESSURE VOLUME AREA AND OXYGEN CONSUMPTION

SUGA, H., HAYASHI, T., SUEHIRO, S., HISANO, R. and SHIRAHATA, M.
Dept. of Cardiac Physiology, National Cardiovascular Center Research Institute, Suita, Osaka 565

Left ventricular systolic pressure volume area has been shown to highly correlate with its oxygen consumption. In this study, we divided the area into two parts: external mechanical work and what is considered the end-systolic elastic potential energy. We determined the optimal coefficient of the potential energy for the best correlation between the sum of external work and a variably weighted potential energy and oxygen consumption. Results in 7 canine hearts showed that the best correlation was obtained when the potential energy was multiplied by 1.03 ± 0.03(SE). We therefore concluded that the pressure volume area can serve as a predictor of cardiac oxygen consumption, and that the part for the potential energy should have a physiological significance in the coupling between cardiac mechanics and energetics.

335

LENGTH-TENSION AND FORCE-VELOCITY RELATIONS IN FROG CARDIAC MUSCLE OBTAINED FROM THE UNDAMAGED REGION.

MATSUMURA, M., OCHI, K., KIMURA, H., ENOMOTO, H. AND TOYOTA, H.
Dept. of Physiol., Kawasaki Med. Sch., Kurashiki

A muscle fiber bundle was prepared from the atrium of the bullfrog and it was repetitively stimulated at a rate of 12/min and at 23-25C. Two black tapes (0.5 mm wide) were stuck on muscle 3-4 mm apart. The distance between two marks was not only detected with the position sensitive photodiodes but also controlled by the servomotor supplied from the feedback amplifier. Even if the whole muscle was held isometrically, the central region shortened by about 7%. When the length of the central region was controlled, although not succeeded in the precise control, the whole muscle was stretched during a twitch and both the peak tension (10%) and the rate of tension rise (20-30%) were augumented. The length-tension curve was shifted towards the left by about 10% along the length axis. In an isotonic twitch, the shortening velocity of the central undamaged region was not so different from that of the whole length of muscle if the loads were small (<0.2 P_o), but the former was larger by 20-50% than the latter under the considerable amounts of the loads (>0.7 P_o). It is concluded that the damaged ends distort the contraction speed much more than the contraction height since they act as an extra compliance. Supported by a Research Grant for Cardiovascular Disease (54C-1) from the Ministry of Health and Welfare.

336

EFFECTS OF TEMPERATURE ON THE ISOTONIC SHORTENING IN CARDIAC MUSCLE

SAEKI,Y. AND SHIBATA,T.* Dept. of Physiol., Tsurumi Univ. Sch. of Dent. Med., Yokohama; Dept. of Pediat., Heart Institute of Japan, Tokyo Women's Med. College, Tokyo*

To identify the mechanical properties of activated heart muscle, tension of the kitten papillary muscle in Ba^{2+}-contracture was quickly decreased stepwise (within 3 msec) or changed sinusoidally (frequency, 0.05 - 80 Hz) and the length response was analyzed. The length response to step tension reduction showed four different phases, the time course of which were nearly constant over the range of initial muscle length between 80% of Lmax and Lmax when the tension reductions were less than about 20% of the initial tension. With increasing amplitude of tension reduction, period of time of the second phase slightly became longer when the initial muscle length was near Lmax, whereas at the initial length below about 0.9 Lmax it became shorter. While, the third phase became shorter with increasing amplitude of tension reduction regardless of the initial muscle length. Amount of shortening in the first and second phase increased with both increasing amplitude of tension reduction and decreasing the initial muscle length. Increasing temperature markedly decreased the amplitude of the length response and shorten the second and third phase independently of initial muscle length (temperature coefficient Q_{10}, 3 - 4). These results were consistent with those properties characterized with sinusoidal tension perturbations.

337

OSCILLATIONS OF MEMBRANE POTENTIAL AND TENSION IN DOG VENTRICULAR MUSCLE FIBERS

HIRAOKA, M., KAWANO, S. and OKAMOTO, Y. Dept. of Cardiovasc . Dis., MRI., Tokyo Med. and Dent. Univ., Tokyo

We have reported that muscle fibers developed oscillatory afterpotentials (OAPs) at potentials more negative than -70 mV. The Ca^{++} movement is suggested to be involved in the genesis of OAPs. To examine the mechanism of OAPs, we studied changes in membrane potentials and isometric tensions using dog ventricular muscle fibers. The OAPs were induced with preparations superfusing the K^+-free, high-Ca^{++} (3.6-7.2 mM) solutions. OAPs were always recorded with oscillation of tension. The timings and the amplitudes of these after contractions (ACs) changed similarly as those of the OAPs. Amplitudes of OAPs and ACs as well as twitch increased with rapid stimulation, in the higher $(Ca^{++})_o$ and by application of isoproterenol. The application of 2 mg/L verapamil suppressed the twitch rapidly but it did OAPs and ACs slowly. The $(K^+)_o$ over 2 mM easily eliminated OAPs and ACs with a marked suppression of twitch. The high $(Na^+)_o$ = 203 mM augumented and the low $(Na^+)_o$ = 108 mM depressed OAPs and ACs. The application of caffeine (1 or 10 mM) suppressed OAPs and ACs but it caused a transient augumentation of both during the wash-out period. The results suggest that the cyclic release of Ca^{++} from internal stores may induce ACs and OAPs.

338

DEPRESSION OF CONTRACTION BY ACTIVE SHORTENING IN FROG VENTRICULAR MUSCLE.

OKADA, T., OKUYAMA, H. AND MASHIMA, H. Dept. of Physiol., Sch. of Med., Juntendo Univ. Tokyo

The tension-length curves determined by isometric and afterloaded contractions were compared in twitch or tetanus of frog ventricular muscle. The contracted length of afterloaded contraction at a certain tension was always longer than the length at the same tension on the isometric tension-length curve, suggesting the depressive effect inherent in the active shortening. The degree of depression was in proportion to the amount of shortening. Therefore, a linear relation was observed between the initial length and the amount of shortening at a fixed load and the slope of the line decreased with increasing degree of depression. This depression increased with increasing load but decreased with increasing adrenaline or Ca^{2+} concentration in the external solution. In a series of twitches, when the contraction mode was changed to isometric after several afterloaded twitches, the first isometric twitch was potentiated compared with the control, suggesting that the necessary substance for the contraction was not used and accumulated during the shortening. The mechanism of the depression may be deactivation of cross-bridges due to decreased Ca^{2+} utilization during active shortening. Similar depressive effect of contraction was also observed during the ejection of canine left ventricle.

339

REST TWITCH POTENTIATION IN VENTRICULAR MYOCARDIUM OF THE DOG.

M. ENDOH and T. IIJIMA Dept. of Pharmacol. Tohoku Univ. Sch. Med., Sendai 980

In the canine isolated right ventricular trabeculae carneae (stimulated at 0.5 Hz at 37°C) short rest of regular stimulation induced a transient increase of subsequent twitch tension (RTP). This RTP attained the maximal level when the rest period was 120 sec and decayed progressively at longer rest periods. The RTP was accompanied by the acceleration of rate of tension development and rate of twitch relaxation, and abbreviation of duration of contraction. The duration of action potential was prolonged progressively when the rest period was prolonged until 120 sec and maintained to this level at longer rest periods. Theophylline (2 mM) increased the strength of steady state contraction, but abolished the RTP. Changes in action potential configuration during RTP were not affected appreciably by theophylline. Manganese (1-3 mM) reduced the strength of steady state contraction by about 50%, but did not affect the RTP. These results suggest that the intracellular calcium transport mechanism rather than calcium influx during the action potential may play an important role for maintenance of RTP in the canine ventricular muscle.

340

HYPERPOLARIZATION PHENOMENA OF THE PACEMAKER POTENTIAL

GOTO, K., TAKAHASHI, T., MIYAMAE, S. AND KANEDA, T. Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa.

Pacemaker cells of the isolated sinus node of the rabbit were exposed to K-free or ouabain Krebs solution. Potentials recorded by means of a conventional microelectrode technique showed two types of hyperpolarization, fluctuation potentials, and a transient facilitation. One of the hyperpolarization was an increase of amplitude just after application of K-free Krebs solution. This was not inhibited by ouabain. The other was evidenced by a sagging phenomenon which was activated by K^+, $Cs^+$and Rb^+Krebs solution after a few minutes application of the K-free solution. The latter was inhibited by ouabain.

Fluctuation potentials of alternating hyperpolarization and depolarization were Ca-dependent and voltage dependent, too. They were disappeared by verapamil which could be correlated with the slow inward Ca-current. The transient facilitation was increased by the K-activated hyperpolarization. The facility was directly proportional to the difference of K concentration. An intracellular K-cleft probably plays an important role in the facilitation.

341

KINETICS AND MAGNITUDE OF THE SLOW INWARD CURRENT IN THE RABBIT SINOATRIAL NODE CELL.

Noma, A., Kokubun, S., and Taniguchi, J. National Inst. for Physiological Sciences

The slow inward current (i_s) in the rabbit sinoatrial node cell was studied by the conventional two microelectrode voltage clamp technique. When i_s was measured as the difference between two records obtained before and after blocking i_s with D 600, the fully-activated current-voltage relation was non-linear; the conductance decreased in the negative potential range as to result in an almost constant amplitude of i_s negative to -10 mV. The degree of steady-state activation was about 1 at -5 mV and 0 at -65 mV. The time constant of exponential recovery time course of i_s was about 120 msec at -40 mV and decreased to about 40 msec at -70 mV. The steady-state conductance of i_s, calculated from the activation and inactivation curves, produced a large hump in the steady state I-V curve between -60 mV and -30 mV, which was not observed in the experiment. The activation and inactivation curves which can simulate the experimental I-V curve were proposed.

342

SPONTANEOUS ACTION POTENTIALS OF CANINE ATRIOVENTRICULAR NODE CELL.

T. IIJIMA and N. TAIRA, Dept. of Pharmacol., Tohoku Univ. Sch. of Med. Sendai 980.

Small atrioventricular (A-V) node preparations (0.3 x 0.3 x 0.2 mm) were dissected from the canine heart. The A-V node was identified by its anatomical localization and the action potential configuration. The A-V node preparation displayed spontaneous activities. The maximum diastolic potential, the resting membrane potential, the overshoot potential and the maximum rate of rise of the spontaneous action potential were -70 mV, -45 mV, +15 mV and 12 V/sec, respectively. Tetrodotoxin (3 μmol/l) failed to modify the action potential. The spontaneous discharge rate and the overshoot of the action potential were significantly increased by increasing calcium ion concentrations of the superfusing fluid from 1.8 to 3.6 mM. Cobalt ions (2 mmol/l) decreased the spontaneous discharge rate and the overshoot, and then abolished the action potential. The effects of cobalt ions were partially reversed by increasing the extracellular concentration of calcium ions.

These results indicate that in the A-V node cell calcium ions contribute to the generation of the spontaneous action potential.

343

EFFECTS OF Ca-FREE OR Na-LACK RINGER ON THE MEMBRANE POTENTIALS AND CURRENTS OF THE BULLFROG ATRIUM. GOTO, M., FUJINO, T. AND URATA, M. Dept. of Physiol., Faculty of Medicine, Kyushu University.

Changes in the membrane currents and action potentials which occur during Ca-free or Na-lack condition were investigated in the bullfrog atrial muscle with double-sucrose gap method. In Ca-free medium, background current (I_{k_1} and others) decreased markedly. Slow inward current, I_S, diminished because of elimination of calcium inward current, I_{Ca}. Remaining sodium inward current, I_{Nas}, was less than one fifths in amplitude of the control I_S, and showed a faster activation and a slower inactivation. In Na-lack medium, where LiCl or sucrose were substituted for NaCl, I_{k_1} increased while other background currents decreased. The I_S increased in amplitude despite the elimination of I_{Nas}, and the enhanced I_{Ca} showed a slow activation and a faster inactivation. The amplitude of fully activated I_X diminished, but the activation of I_X was much faster than the control. Thus, it became clear that in Ca-free condition the overshoot of action potential (AP) decreased because of the elimination of I_{Ca}, and the plateau prolonged due to the pronounced delay of activation of I_X and the depression of I_{k_1}. The I_{Nas} was too small to contribute to the prolongation or repolarization of AP. In Na-lack conditions AP amplitude increased because of the enhancement of I_{Ca}, and AP duration was shortened due to the fast activation of I_X and the increase of I_{k_1}.

344

ACTION POTENTIAL AND SODIUM CURRENT IN THE MAMMALIAN SINGLE HEART CELL. KURAOKA, S.*, OYAMA, Y., AKAIKE, N. AND NISHI, K. Dept. of Pharm., Kumamoto Univ. Med. Sch., and Dept. of Physiol., Ginkyo College, Kumamoto 860, Japan.

Rapid inward sodium current (I_{Na}) was recorded from isolated cells from rat and rabbit ventricular myocardium by a suction pipette voltage clamp technique. When I_{Na} elicited by single depolarizing voltage steps from a holding potential, V_H, of -80 mV, the I_{Na} was inhibited in the dose-dependent manner by antiarrhythmic drugs. The inhibitory actions were stronger in the order of quinidine > lidocaine $\gg$ procaineamid. However, at V_H greater than -110 mV, these drugs had no effects on I_{Na}. The results indicate that the effects of antiarrhythmic drugs on I_{Na} is also voltage-dependent. In addition, β-adrenoreceptor blocking agents such as propranolol, bunitrolol and indenolol also showed dose- and voltage-dependent inhibition on I_{Na}.

345

SEPARATION OF I_{Na} IN SINGLE RAT HEART CELL BY USING SUCTION PIPETTE METHOD AND IONIC SELECTIVITIES OF Na CHANNEL FOR VARIOUS MONOVALENT CATIONS. NISHI, K., AKAIKE, N., OYAMA, Y. AND KURAOKA, S.* Dept. of Pharm., Kumamoto Univ. Med. Sch., and *Dept. of Physiol., Ginkyo College, Kumamoto 860, Japan.

The ionic selectivities of sodium channel for various monovalent cations were studied in collagenase dispersed individual rat ventricular myocites. The sodium channel was separated from other potassium and calcium channels by a suction pipette method which allows internal perfusion and voltage clamp. The permeability sequence, which was estimated by both the reversal potential and the constant-field equation, was in the order of Na > Li > hydrazine > guanidine > formamidine > hydroxylamine > methylguanidine > monomethylamine. The permeability was markedly diminished by methylation of the chemical compound.

It was concluded that the membrane permeabilities of various organic cations to the sodium channel are essentially similar to those of squid giant axon and frog node, though the permeability ratios in the former seems to be slightly greater than those in other two tissues.

346

THE EFFECT OF DILTIAZEM ON ACTION POTENTIALS OF PURKINJE FIBERS IN 24-HOUR-OLD MYOCARDIAL INFARCTS IN DOGS. KOYAMA, T., IKEDA, T., KUBOTA, K., FUJIKI, A., SUGIMOTO, N. AND HATTORI, N. First Dept. of Internal. Med., School of Medicine, Kanazawa University.

We studied the effect of diltiazem (1.0, 5.0 μg/ml) on action potentials of Purkinje fibers in 24-hour-old myocardial infarcts in dogs. With diltiazem 1.0 μg/ml, action potential duration (APD) was not changed in the normal zone (NZ), but significantly decreased in infarcted zone (IZ). After superfusion of diltiazem 5.0 μg/ml, APD was significantly shortened in both NZ and IZ. Diltiazem, regardless of low or high concentration, did not significantly change effective and functional refractory period in NZ and IZ. The level of action potential plateau (L) remained unchanged in both NZ and IZ at diltiazem 1.0 μg/ml, but at a concentration of 5.0 μg/ml, the shortening of L was significantly greater in IZ than in NZ. These results suggest that the effect of diltiazem on transmembrane potentials of Purkinje fibers in the infarct are different from those effect on fibers in normal hearts.

347

OPTICAL RECORDING OF CONDUCTED ACTION POTENTIAL IN HEART MUSCLE USING A VOLTAGE SENSITIVE DYE. SAWANOBORI, T., ADANIYA, H., HIROTA, A.*, FUJII, S.* and KAMINO, K.* Inst. for Cardiovasc. Dis. and * Dept. of Physiol., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo

Voltage dependent absorption signals from the bullfrog atrium were detected using a merocyanine-rhodanine dye. The action spectrum of the dye exhibited a triphasic pattern with a decrease in absorption between 530 and 600 nm, and increase between 640 and 720 nm and decrease at 750 nm. Changes of pH and temperature did not shift the pattern of action spectrum. Using a multiple optical recording method, we have been able to simultaneously monitor the action potential from eight different regions of the preparation. The onset of the optical signals coincided with that of the action potential. The conduction was able to measure even in Ca^{2+}-free solution: the velocity measured optically was equal to that obtained with a microelectrode measurement. The conduction velocity measured from right and left atrium of the bullfrog was 0.15 ± 0.04 m/sec (n = 14) and 0.17 ± 0.06 m/sec (14), respectively. There was no significant difference between them. Thus, the optical method can validly be used to solve some problems on arrhythmia-related mechanism.

348

ARRHYTHMIAS OF CULTURED HEART CELLS
GOSHIMA,K. AND WAKABAYASHI,S Inst. Mol. Biol., Fac. Science, Nagoya Univ. Chikusaku, Nagoya, 464 Japan

Cultured mouse and quail myocardial cells showed arrhythmic beating, such as fibrillatory beating, in the presence of ouabain. The role of cell to cell electrical coupling and of Na-Ca exchange system on the genesis of the ouabain-induced arrhythmias will be discussed in this meeting.

349

BEATING OF FUSED CELLS BETWEEN MYOCARDIAL AND NON-MYOCARDIAL CELLS IN CULTURE

WAKABAYASHI,S., GOSHIMA,K. AND MATSUI*, Y. Fac. Sci., Nagoya Univ., Chikusaku, Nagoya, 464 and *Showa Univ., School Dent., Shinagawaku, Tokyo, 142.

Cultured mouse myocardial cells could fused together with non-myocardial cells, such as KB cells (derived from human epidermoid carcinoma), on treatment with HVJ virus. The fused cells composed of one myocardial cell and one KB cell could not show spontaneous beating activity. The mechanism of the stopping of the beating of myocardial cells by fused with KB cells was studied in the present work.

350

REEVALUATION OF TIME DEPENDENT REACTIVATION PROCESS IN K^+-DEPOLARIZED VENTRICULAR MUSCLE.

KIYOSUE, T., ARITA, M., AOMINE, M. and IMANISHI, S. Department of Physiology, Medical College of Oita, Oita 879-56.

Time course of recovery of maximum rate of rise ($\dot{V}$ max) in the upstroke of premature action potentials was studied in K^+-depolarized guinea pig ventricular muscle. It could be fitted by two exponentials, fast and slow. The finding differs from earlier report by Gettes and Reuter (1974) who concluded that the time course could be fitted by single exponential at any membrane potentials. The discrepancy was not due to the difference in methods used: they investigated in "membrane" action potentials, while we studied in "propagated" action potentials. The time constant of fast process was voltage dependent, and increased from 20 to 50 ms as the membrane potential was depolarized from -70 to -57 mV; the time constant of slow process increased from 100 ms at -70 mV to more than 500 ms between -55 and -60 mV. Relative contribution of slow process to total $\dot{V}$ max was less than 10 % at potentials more negative than -70 mV, and increased up to 16 - 20 % between -55 and -60 mV. Ouabain (0.5 - 1 x 10^{-6} M) or l-verapamil (1 μg/ml) did not alter the time constants as well as the relative contribution of slow process. $BaCl_2$ (0.2 mM) did not change the time constants but significantly decreased the relative contribution of slow process. The results suggest that the slow process is introduced by deactivation of time and voltage-dependent K^+ current.

351

THE INOTROPIC EFFECT OF HYPERTONIC SOLUTION ON THE FROG ATRIAL MUSCLE

KAWATA, H., OHBA, M., HATAE, J. AND KISHI, M.* Dept. Physiol. and Lab. Human Biol.*, Sch. Med., Fukuoka Univ., Fukuoka

Hypertonic solution is known to exhibit a dual (positive and negative) inotropic effect on the heart beat, while it exerts only a suppressive effect on the contraction of the skeletal muscle. The optimum tonicity for the contraction of isolated atrial trabeculae from the bullfrog was about 1.5T. The possibility that an increase of calcium influx during each action potential can be excluded since both the overshoot and the plateau of action potential were strongly suppressed. The effect on the time course of twitch potentiation as well as muscle shrinkage was similar regardless of the sort of the solute (sucrose, NaCl or LiCl) used for elevating the tonicity, except that the excess sodium showed a rapid initial inhibitory phase of contraction and that this solute seemed to enter into the cell to some extent. Potassium contracture occurred even in the prolonged calcium-free perfusion when the muscle was previously perfused with hypertonic solution. These results suggest that an elevation in both the $[Ca]_i$ and the amount of calcium bound intracellularly may play an essential role in the positive inotropic action.

352

EFFECTS OF HYPERTONIC SOLUTIONS ON THE ELECTRICAL ACTIVITY OF MAMMALIAN CARDIAC MUSCLE

EHARA, T. Dept. of Physiol., Faculty of Medicine, Kyushu univ., Fukuoka 812, Japan

Hypertonic medium causes changes in the intracellular ionic composition associated with cell dehydration. The aim of this study was to investigate whether there is any causal relation between alterations in the membrane electrical property of cardiac muscle induced by hypertonic perfusion and possible changes in the internal ionic environment. Preparations dissected from the right ventricle of guinea-pig hearts were exposed to hypertonic solution (HT) made by adding various excess solutes (150-300 mOsm/l) to the Tyrode solution. The main results obtained were: (1) HT with excess sucrose, glucose, NaCl, or Na_2SO_4 all initially (<5 min) prolonged the action potential duration (APD). The prolongation was followed by gradual shortening. The resting potential was slightly increased in these solutions, while changes in the upstroke velocity of the action potential depended on the species of osmotic solute used. (2) APD shortened more rapidly with time in HT at higher stimulation rates. (3) In HT with lowered $[K]_o$ (2 mM-K), the shortening of APD occurred very rapidly and there was practically no initial prolongation. Thus HT has a dual action on APD of cardiac muscle cell, i.e. initial prolonging effect and late shortening one. The mechanism underlying the prolonging effect is unknown at present. However, the results (2) and (3) suggest that the shortening effect of HT is related to an intracellular accumulation of certain cations, probably Na and/or Ca ions, which may vary the conductance mechanism in the plasma membrane.

353

EFFECTS OF CUTANEOUS STIMULATION ON THE ADRENAL MEDULLARY HORMONE SECRETION.

ARAKI, T.*, KUROSAWA, M.*, NAKAMURA, H. and SATO, A. *Dept. of Biology Ochanomizu Univ., Bunkyo-ku, Tokyo; 2nd Dept. of Physiology, Tokyo Metro. Inst. Gerontol., Itabashi-ku, Tokyo.

The effects on adrenal medullary hormone secretion of noxious mechanical stimulation applied to the different segmental skin areas were investigated in anesthetized rats. In the rats with the central nervous system intact, adrenal norepinephrine and epinephrine secretions were reflexly increased during and after stimulation of the lower chest and hindpaw skin areas. The hormonal responses were correspondent with the reflex increases in adrenal sympathetic efferent nerve activity in response to cutaneous stimulation. In spinalized rats, the lower chest remained as effective skin areas, but hindpaws became ineffective. This evidence indicates that there is a marked segmental organization in the cutaneo-adrenal medullary reflex responses in the spinal level, which will be generalized under the control of the brain.

354

THE DISTRIBUTION OF VAGAL AFFERENT NERVE FIBERS AND TERMINALS IN RABBIT GASTRIC WALL BY LIGHT MICROSCOPIC AUTORADIOGRAPHY.

SATO,M., YOSHIZAKI,K. AND KOYANO,H. Dept. of Physiol., Akita Univ. Sch. of Med., Akita 010

It has already been established that radioactive amino acid applied to neuron soma was transported by axonal flow and reached to the nerve terminals. [^{3}H]leucine was injected directly into the nodose ganglion after supranodosal vagotomy. Following the survival period of 10 days, the distribution of vagal afferent nerve fibers and terminals in gastric wall was determined with light microscopic autoradiography.

Many clusters of silver grains were observed within small nerve branches in gastric serosa (20-50μm in diameter) as well as vagal nerve trunk of oesophagos region. Silver grains were overwhelmingly found over the myenteric and submucosal plexuses and some of the grains were especially localized around neuron soma. The scattering grains were detected all over the longitudinal and circular muscle layers. In mucosal layer, silver grains lined in a lamina propria of villus like a thin thread from lamina muscularis to epithelium. In next step of this study, electromicroscopic autoradiography should be adopted to explore a precise feature of afferent terminals.

355

POTENTIATING EFFECT OF β-ADRENOCEPTOR STIMULATION ON K^+ RELEASE INDUCED BY α-ADRENOCEPTOR AGONIST OR ACh IN THE LACRIMAL GLAND.

KATOH, K., NONOYAMA, T., KANEKO, K. AND NISHIYAMA, A. Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata City, Yamagata

Measurements of net K^+ flux and membrane potential were carried out in the superfused segments of rat lacrimal gland in order to investigate the effect of β-adrenoceptor stimulation on the K^+ transport of the acinar cell. Isoproterenol (ISO, 25 μM) did not cause any change in net K^+ flux. However it significantly enhanced K^+ release induced by phenylephrine (PH, 5 - 50 μM) or by ACh (0.22 - 5.5 μM). K^+ release induced by noradrenaline (30 μM) was reduced by 40 % in the presence of β-adrenoceptor antagonist propranolol (5 μM). The potentiating effect of β-adrenoceptor stimulation was mimicked by dibutyryl cyclic AMP (1 mM). ISO did not cause any potential change of the acinar cell. However it slightly reduced the membrane hyperpolarization induced by PH and shifted its equilibrium potential from -65 to -55 mV. From the results it was clear that β-adrenoceptor stimulation potentiated the K^+ release induced by α-adrenoceptor agonist or ACh through cAMP system. However, a precise mechanism remains to be solved. Several possibilities were discussed.

356

THERMOSENSITIVITY OF AFFERENT DISCHARGES RECORDED FROM THE CAROTID SINUS NERVE.
KOYANO,H., YOSHIZAKI,K. AND SATO,M. Dept. of Physiol., Akita Univ. Sch. of Med., Akita 010

There are two kinds of functionally different fibers, baroreceptor and chemoreceptor fibers, in the carotid sinus afferent nerve.

In vitro experiments with superfused carotid body of the rabbit, we found that if the temperature of an isolated carotid sinus and body fell a few degrees below body temperature an afferent discharge suddenly appeared.

Recording obtained from single afferent fiber demonstrated that the discharge produced by cooling was enhanced with lightly touching a restricted area surrounding carotid body, but not affected with low O_2 tension of superfusate. The temperature setting the afferent fiber in discharge was quite constant. These results seem to indicate that some group of baroreceptor fibers are sensitive to low temperature.

It is relevant to know whether the afferent discharges sensitive to low temperature has any reflex effects on the thermogenesis, since the temperature of blood circulating a sinus area is almost same as core temperature. The cooling effects of sinus area on the adrenal efferent discharges and shivering were tested. No apparent effects were observed at present experiments.

357

INHIBITION OF AORTIC DEPRESSOR REFLEX BY INTRACISTERNAL INJECTION OF 6-HYDROXYDOPAMINE IN RABBITS.
Terui, N., NUMAO, Y., SAITO, M. AND KUMADA, M. Inst. Basic Med. Sciences, Univ. Tsukuba, Ibaraki-ken 305

Role of the central noradrenergic system in the arteial baroreceptor reflex was investigated by comparing the aortic depressor reflex in rabbits with and without previous treatment with 6-hydroxydopamine (6-OHDA). One to two weeks after intracisternal 6-OHDA(600 μg/kg), electrical stimulation of aortic A fibers resulted in a depressor response comparable to that in control aminals. However, when the aortic C fiber-arterial pressure(AP) reflex was optimally activated, the decrease in AP was significantly ($P<0.001$) smaller in animals pretreated with 6-OHDA. Inhibition, by 6-OHDA, of the depressor response attributed to aortic C fibers was further confirmed by activating C fibers alone by anodal blockade. The diminished depressor response was associated with a shorter duration of the silent period of the renal nerve activity (RNA) and,at times, an enhanced excitation of the RNA preceeding the silent period. In view of evidences indicating that 6-OHDA selectively destroys the central noradrenergic system and that the aortic nerve of adult rabbits does not contain chemosensory fibers, the central noradrenergic system most likely participates in the arterial baroreceptor reflex mediated by barosensory C fibers.

358

THE EFFECTS OF MORPHINE AND NALOXONE ON THE SOMATO-SYMPATHETIC REFLEXES
ITO, K., NAKAMURA, H., SATO, A. and SATO, Y. 2nd Dept. of Physiology, Tokyo Metro. Inst. Gerontol., Itabashi-ku, Tokyo

The effects of morphine and naloxone on the somato-sympathetic reflexes were analyzed in the anesthetized cat. The sympathetic efferent activity was recorded from an inferior cardiac branch. Afferent electrical stimulation of an ulnar nerve produced separately the A-reflex discharges of about 60 ms of latency (evoked by myelinated fiber excitation), and the C-reflex discharges of about 270 ms of latency (evoked by unmyelinated fiber excitation). An intravenous injection of morphine (2 mg/kg) depressed markedly the C-reflexes without affecting the A-reflexes. Naloxone (0.2 mg/kg, i.v.), known as the morphine antagonist, abolished the depressive effects of morphine on the C-reflexes. The present result suggests that the somato-sympathetic C-reflexes can be used as an appropriate indicator for the morphine analgesic effects.

359

ROLE OF THE SUPRASPINAL CENTER ON THE RECTO-RECTAL INHIBITORY REFLEX CENTER AND ITS LOCALIZATION.
TAKAKI,M., NEYA,T. AND NAKAYAMA,S. Dept. of Physiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama

The marked contraction produced by afferent pelvic nerve(PN) stimulation largely diminished after Th 13 transection when unilateral PN was left intact. This reduced contraction unchanged after L 4 transection but recovered following the division of lumbar colonic nerves(LCN). Afferent PN stimulation elicited the contraction even after division of bilateral PNs. This contraction was completely abolished after Th 13 transection but did not reverse into relaxation. The reflex contraction by rectal distension was abolished after Th 13 transection. The reflex response remained disappeared following L 4 transection but recovered following LCN division. These results show that the potentiated activity of the supraspinal center caused by afferent PN stimulation inhibits the activity of the lumbar inhibitory reflex center and the pelvic afferent activity does not influence on the activity of the lumbar center.

The reflex contraction of the rectum by rectal distension did not alter after suprapontine transection but disappeared after subpontine or C 1 transection. And it reappeared following LCN division. Thus, the supraspinal inhibitory center appears to be located in the pons.

360

EFFECTS OF STIMULATION OF SATIETY CENTER(VMH) AND FEEDING CENTER(LH) ON GASTRIC,CECAL AND DISTAL COLONIC MOTILITY IN RATS.
LEE,Z.L. AND NAKAYAMA,S. Dept. of Physiol.,Okayama Univ. Med.Sch.,Shikata-cho,Okayama

Rats anesthetized with urethan were used.(1)Stimulation of VMH or LH produced excitation or inhibition of the gastrointestinal motility. But no significant difference between both effects of stimulation of VMH and LH was observed.(2)The responses of gastric and colonic motility following VMH stimulation were usually contrary to each other, and also LH stimulation.(3)The excitatory response of gastric and cecal motility was completely abolished by vagotomy or atropinization.(4)The inhibitory response of gastrocecal motility remained after splanchnicotomy and guanethidine or atropine, but was abolished by vagotomy.(5)The excitatory response of colonic motility was reduced by atropinization but not completely abolished. In the most cases the inhibitory response of colon was decreased after guanethidine, but not completely abolished. Excitatory and inhibitory responses of the colon were abolished by transection of the L_1 segment. It is concluded that VMH and LH may participate in the coordination of gastrointestinal motility, and that the excitatory response of stomach and cecum is produced via the vagus nerve, while the inhibitory one mainly via non-adrenergic, non-cholinergic inhibitory neurons involved in the vagus nerve. The excitatory and inhibitory impulses to distal colon are conducted through the spinal cord to the L_1 segment.

361

CORRELATION BETWEEN HYPOTHALAMIC PRESSOR AREA AND THE CAROTID SINUS OF THE RABBIT.
NAGAI, M. and IRIKI, M. Dept. Physiol. Tokyo Metrop. Inst. Gerontol., Dept. Physiol. Med. Univ. Yamanashi.

Functional correlation between hypothalamic pressor area and the carotid sinus was analysed employing blind-sack preparation of the carotid sinus in anaesthetized, immobilized and artificially ventilated rabbits. Different strength of electrical stimulations of a pressor area of the medial part of the posterior hypothalamus were applied at various resting blood pressure levels set by changing blind-sack pressure. Blood pressure(BP), renal sympathetic nervous activity(RSNA) and renal blood flow(RBF) were monitored, and renal vascular resistance(RVR) was calculated. Results: 1) RSNA and RVR showed positive correlation with resting BP. RBF was not affected by resting BP. 2) During maximum stimulation of the hypothalamus, the maximum values of BP were almost the same; resting BP levels didn't influence the level of maximum BP. Positive correlations between BP and RSNA or RVR were dissapeared. 3) During sub-maximum stimulation of the hypothalamus, maximum BP was higher at higher resting BP levels; pressor inputs of the hypothalamic and carotid sinus origins were algebraically cumulated. Correlation between BP and RSNA or RVR were re-established. Present results indicate that hypothalamic pressor inputs can alter BP partially independent of the negative feedback loop driven by carotid sinus baroreceptor inputs.

362

ROLES OF LARYNGEAL WATER FIBERS IN THE REGULATION OF WATER BALANCE
SHINGAI,T. AND MIYAOKA,Y. Dept. of Oral Physiol., Niigata Univ. Sch. of Dent., Niigata.

In previous study, we reported that water stimulation of the larynx increases urinary flow in rats anaesthetized with pentobarbitone, and speculated that water fibers in the superior laryngeal nerve (SLN) may participate in this phenomenon. The present study was designed to evaluate the effects of electrical stimulation of the SLN on urinary flow. The urinary flow before and after the stimulation was expressed by the interval of urinary drops. Stimulus was given the cranial cut end of the nerve (1.0V, 40Hz, 1msec, 30sec duration). Results showed that the electrical stimulation of the SLN elicited an increase in urinary flow and that it lowered arterial blood pressure. The diuretic effect reached its peak within 45 min after the onset of stimulation and turned to the previous level within 90 min. These results indicate that excitation produced by water stimulation of the larynx is sent to the central nervous system via the SLN and that it may contribute the regulation of water balance.

363

MEMBRANE CHARACTERISTICS AND CHEMOSENSITIVITIES OF LATERAL HORN CELLS IN CAT SPINAL CORD. YOSHIMURA, M. AND NISHI, S. Dept. of Physiol., Kurume Univ. Sch. of Med., Kurume

Intracellular recordings were made from neurons contained in the lateral horn in tissue slices cut from the upper thoracic segment of the cord. Lateral horn cells showed resting membrane potentials of -40 to -60 mV and input resistances of 30 to 120 MΩ. L-glutamate (0.2 mM) or aspartate (0.2 mM) applied by superfusion caused in a majority of cells a marked depolarization which triggered repetitive firing of the cell membrane. The depolarization elicited by l-glutamate was usually associated with a decreased membrane resistance, but occasionally accompanied by an increased membrane resistance. The aspartate-depolarization was generally associated with an increased membrane resistance. Noradrenaline (30 μM) and 5-hydroxytryptamine (30 μM) induced prolonged depolarizations which were always accompanied by an increased membrane resistance. A relatively large cohort of cells produced in response to acetylcholine (1 mM) which was prevented by d-tubocurarine (50 μM). This depolarization was often followed by a long-lasting burst of excitatory postsynaptic potentials which was abolished by atropine (50 μM). Addition of tetrodotoxin (0.5 μM) to the superfusing solution did not appreciably alter the glutamate-depolarization with reduced membrane resistance nor the 5-hydroxytryptamine-induced depolarization. This study was supported by a Grant-in-Aid for Scientific Research.

364

RESPONSES IN AUTONOMIC FUNCTIONS INDUCED BY MUSCULAR POLYMODAL RECEPTORS; NEUROHUMORAL FACTORS INVOLVED. KUMAZAWA,T., TADAKI,E., MIZUMURA,K., AND KIM,K. Dept.of Physiol., Sch. Med., Nagoya Univ. Nagoya, 466.

The phrenic nerve discharges, blood pressure, and heart rate were recorded in anesthetized, vagotomized, paralyzed, and artificially ventilated dogs. Intra-arterial injection of 4.5% NaCl, 1 μg/ml bradykinin, and 60mM KCl into the gastrocnemius muscle increased the respiratory output during stimulating period; the relative magnitudes of these responses fairly well coincided with those of unitary-discharge responses of polymodal receptors to the same method of stimulation. Using NaCl solutions of 1.8, 2.7, 3.6, and 4.5%, a highly significant correlation was found between the increases in respiratory outputs during stimulating period and the doses of chemical stimuli. Respiratory outputs 5 min after the end of stimulation remained at a higher level with 1.8%, while with higher concentrations decreased to a lower level than the pre-stimulus value. A similar intensity-response relation was found using electrical stimulation of the muscular afferent nerve. The suppressed phase was reversed by naloxone, an opiate antagonist, as well as by clonidine, an alpha-adrenergic agonist. Blood pressure response during the period stimulating muscular afferents was deviated to the pressor side by naloxone, clonidine delayed recovery from pressor response after the stimulation.

365

INCREASED SENSITIVITY TO NORADRENALINE AND SEROTONIN IN THE RATS CHRONICALLY INTOXICATED WITH METHYLMERCURIC CHLORIDE.
WAKITA, Y. and TANAKA, I. Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto

A small amount of methylmercuric chloride (MMC, 1.5 mg/kg of body weight/3 days), or distilled water as control, was chronically administered to male Wistar rats per os up to the total doses of 45 mg/kg b.w. Their right atria, aortic arteries and vasa deferentia were isolated at the various stages of intoxication, and placed in an organ-bath of 30 ml at constant temperatures of 32°C for atria and vasa, and 37°C for aortic arteries. Contractions of each tissue were recorded isometrically and atria rate was also monitored. The sensitivity of the tissues to NA (10^{-10}-10^{-4} M) was measured. Dose-response curves for the mean responses for NA revealed that all of the tissues from the MMC-pretreated rats (30-45 mg/kg b.w.) were more sensitive (2-3 fold) than controls. At the same stages, a similar increase in the responses of the aortic arteries to 5-HT (10^{-7}-10^{-4} M) was also found to occur. The treated rats showed no signs for weight loss and neurological symptom. These results suggest that MMC may give the sympathetic nervous system some disorders in the initial stages of intoxication.

366

Neural regulation of [^{3}H]dopamine uptake in adrenal chromaffin cell.
Hirano, T. and A. Niijima (Dept. Physiol., Sch. Med.,Niigata Univ. Niigata)

The function of adrenal medullary chromaffin cell is controlled by bothsympathetic nervous and pituitary-adrenocortical system. The uptake of [^{3}H]dopamine in chromaffin cell is decreased by hypophysectomy and restored by ACTH treatment(Arch. histol. jap. 1978, Neurosci. Lett. 1978). The uptake is also decreased by restraint plus water immersion stress(Brain Research, 1980). The left adrenal gland was denervated and the right served as a control. Thirty min after the injection of [^{3}H]dopamine, the mouse was fixed. The adrenal glands were removed and processed for autoradiography. Adrenal denervation increased the uptake of dopamine in adrenaline-cell. Adrenal denervation prevented the decreased uptake of dopamine by the stress. Chromaffin cells in the subcortical zone incorporated higher radioactivity than those in the center. Such tendency was more characteristic in denervated adrenals. The uptake of dopamine in noradrenaline-cell was not affected by the denervation. The results indicate that (1) normal innervation suppresses the uptake of [^{3}H]dopamine in adrenal chromaffin cell. Adrenaline-cell is more intensely controlled by sympathetic nerves than noradrenaline cell. (2) Neural control is more intense in the subcortical zone than in the center. (3) Increased pituitary-adrenocortical system by the stress did not enhance the uptake, which is necessary for manifestation of normal function of chromaffin cell.

367

DEPENDENCY OF CALCIUM IONS FOR THE SPONTANEOUS AND INDUCED MEMBRANE HYPERPOLARIZATIONS IN THE AUERBACH'S PLEXUS CELL OF HUMAN SMALL INTESTINE IN CULTURE.
MARUYAMA, T. AND SUZUKI, T. Dept. of Applied Physiol ., Tohoku Univ. Sch. of Med., Sendai.

The cultured Auerbach's plexus cells (large cells) which were derived from small intestine were employed in this study. These cells have maintained good cell proliferation. The membrane potential and membrene resistanceof these cells were measured by intracellular microelectrode techniques. After the subculture, 38% of these cells showed the spontaneous membrane hyperpolarization. The membrane potential nd input resistance were around -38 mV and 117×10^{6} ohm, respectively. The reversal potential for the membrane potential was about -82 mV under 6.8 mM potasium concentration. This value being quite close that of the equibrium potential of potasium ions. The membrane potential are hyperpolarizied by adding A23187 and calcium ions. The spontaneous membrane hyperpolarization and the hyperpolarization of the membrane potential by A23187 and calcium ions were not effective in TTX but suppressed by Co^{2+}, La^{3+} and EGTA. These results suggest that the increase of intercellular calcium ions across the cell membrane from the external medium induced the increase in potasium conductance of the cell membrane.

368

THE INCREASE OF GASTRIC ACID OUTPUT AND GASTRIN RELEASE CAUSED BY VESTIBULO-SPLANCHNIC NERVE REFLEX IN DOG. FUJII,K.& TAKASUGI,S*. Dept.of Physiol.& Surg*.,Hiroshima Univ., Sch.of Med.,Hiroshima.

Mechanism of gastric acid secretory functions caused by vestibulo-splanchnic nerve reflex was investigated in dogs anesthetized with pentobarbital sodium,immobilized with gallamine triethiodide,and artificially ventilated. The nerve connection was maintained only via the major splanchnic nerve between the stomach and medulla oblongata-thoracic cord. Augmentation of gastric juice,acid secretions and serum gastrin level in gastro-splenic venous blood caused by vestibulo-splanchnic nerve reflex was observed. These responses were inhibited by administration of atropine. Increase of gastric juice and acid secretion were inhibited by administration of cimetidine (CIM) and cepharanthine (CR). Increases of HCl output from completely denervated corpus pouch and serum gastrin level in gastro-splenic venous blood caused by vestibulo-splanchnic nerve reflex were observed. This increase response of HCl output was inhibited by administration of CIM or CR and by intraluminal perfusion of antrum with 0.1 N HCl. However, increase of serum gastrin level was not inhibited by CIM and CR. These results suggest that gastrin released by vestibulo-splanchnic nerve reflex stimulates the parietal cells in the denervated pouch wall via the blood stream and releases histamine, and consequently, activity of the parietal cells was increased.

369

THE AFFERENT AND EFFERENT PATHWAYS OF THE RECTO-RECTAL REFLEX IN THE DOG. FUKUDA, H. AND FUKAI, K. Dept. of Physiol. (2nd), Kawasaki Med. School, Kurashiki

On the recto-rectal reflex, nerve types of the afferent and efferent pathways, and locations of the ganglion cells are still subject of controversy. This work was carried out on chloralose anesthetized dogs in order to elucidate these problems. Reflex discharges of the rectal branch (RB) of the pelvic nerve were elicited by the afferent stimulation of the contralateral RB. These discharges occurred after the threshold stimulation for Aδ (conduction velocity, 10 m/sec) as well as for C (1.0 m/sec) afferent fibers. In nearly all of RB, response to the stimulation of the S2 ventral root disappeared after C6 applied to the pelvic ganglion. Conduction velocity of the pre- and post-ganglionic fibers was 8.7 m/sec and 0.9 m/sec, respectively. After degenerations of the pelvic and the hypogastric nerves, a rectal contraction was resulted by efferent stimulation of RB. This contraction disappeared after C6 applied to the rectum. Many surviving C fibers were observed in RB by electron microscope after the degenerations. Many positive cells were observed in the pelvic ganglion after HRP injection to the wall of the distal colon.

370

THE OUTFLOW OF THE AUTONOMIC NERVES INNERVATING THE DISTAL COLON AND THE KIDNEY DURING VOMITING IN DOGS. OKADA, H. AND FURUKAWA, N. Dept. of Physiol. (2nd), Kawasaki Med. School, Kurashiki

Retching activity (R) was produced by apomorphine (0.2 mg/kg) injection or by intragastric infusions of $CuSO_4$ and 0.5-N HCl solutions in decerebrated or chloralose anesthetized dogs immobilized with Flaxedil. The phrenic nerve activity (PA) was used as an index of R.

An increased outflow of the parasympathetic nerve (P) to the distal colon occurred simultaneously with PA after cessation of artificial respiration. Such a fluctuation of P was abolished by the lower pontine transection caudal to the pontine defecation reflex center, despite of the maintenance of the rhythmic PA. Enhanced outflows of P and of the renal nerves (RN) elicited during a few minutes before R, and they were followed by an inhibition during R. While responses in sympathetic outflow of the colonic nerve were classified into three types; 1) a similar response to that in RN, 2) an increased outflow with a rhythm of large gastric contractions during R and 3) no change of the outflow. The neural interaction among the vomiting center, the respiratory center and such autonomic nerve outflows was discussed.

371

HETEROGENEITY OF RESPONSES TO VASOACTIVE AGENTS IN EXTRA- AND INTRACRANIAL ARTERIES. KAWAI, Y., OHHASHI, T. AND AZUMA, T. Dept. of Physiol. and Res. Lab. for Cardiovasc. Dis., Shinshu Univ. Sch. of Med., Matsumoto

Administration of some vasoactive agents induced redistributions of flow between external and internal carotid arteries. In order to examine the possibility that similar redistribution may be elicited in intracranial cerebral arteries, we studied cumulative dose-response curves of several vasoactive agents in extracranial and intraossal internal carotid arteries (ICA), middle cerebral artery (MCA), basilar artery (BA) and external carotid artery (ECA). The curves were analysed from the morphological and pharmacological point of view The results obtained were as follows: (1) Contractions of extracranial and intraossal ICA were induced by 5-hydroxytryptamine (5-HT), prostaglandin $F_{2\alpha}$, ATP, and ADP. Responsiveness of these arteries to norephinephrin (NE) was much less. (2) No significant responses were elicited in MCA and BA by all the agonists used. (3) A pharmacodynamic analysis of α-adrenergic receptor-NE reaction showed that the dissociation constant of receptor-NE complex in extracranial ICA was larger than that in ECA.

372

CARDIOVASCULAR DEFENDING RESPONSE AGAINST ALLOXAN INDUCED ACIDOSIS IN DOG. KAKIUCHI, Y., KOYAMA, T. AND KOBAYASHI, S.* Div. of Physiol., Res. Inst. Appl. Electr., Hokkaido Univ. and Tateishi Inst. Life Sciences.*

To investigate cardiovascular response in dog during the course of pulmonary edema-formation by intravenous injection of alloxan monohydrate, we measured successively, 1) arterial pressure, PaO_2, $PaCO_2$, and plasma colloid osmotic pressure (COP) as indices of the central blood circulation, 2) lung lymph flow and colloid osmotic pressure as a measure of transvascular fluid shift in the lung, and 3) PtO_2 and fluorescence (REDOX-state) of hind leg muscle as an index of the peripheral blood circulation. An apparent cardiovascular defence was appeared with pregress of acidosis (pH 7.2 or less), in which the peripheral circulation decreased to the lowest level (abrupt fall of PtO_2 to zero and turnover to reduction state in the leg muscle) though arterial pressure, PaO_2 and $PaCO_2$, i.e. the central circulation, maintained undiminished. The depression of the peripheral circulation was often restored by administration of alkali (bicarbonate). However, unless buffered with alkali, a mild pulmonary edema followed accompanying a great increase in lymph flow and decrease in lymph COP which resulted from dilution of lymph protein due to water accumulation in lung interstitial spaces.

373

ERYTHROCYTE FLOW VELOCITY MEASUREMENT IN MICROVESSELS BY A DUAL SLIT PHOTOMETRY. HASEGAWA, M. AND MINAMIYAMA, M. Dept. of Vascular Physiology, National Cardioyascular Center Research Institute, Suita, Osaka

Dual slit photometry was used to measure the erythrocyte flow velocities in different microvessels of the rat mesentery. The velocity profile in a 54 micron diameter arteriole was blunted in comparison to the parabolic profile in the Poiseuille flow. In a 109 micron diameter venule, the profile exhibited an insignificant deviation from the parabolic profile. The centerline flow velocities ranged from 21.6 mm/sec to 1.4 mm/sec in the arterioles with a diameter of up to 54 microns. In the arteriolar region, the flow velocity of the microvessel decreased increasing frequency of its bifurcation. The true capillary exhibited low flow velocity-less than 2.5 mm/sec. After passing into the venular side, the blood again accelerated as the vessel diameter progressively increased. The venule with a diameter of up to 132 microns showed a flow velocity ranging from 8.0 mm/sec to 0.9 mm/sec. In this region, capillaries converged and the total cross-sectional area decreased up to the venular end. Comparing the flow velocity of a typical venule to that of the corresponding arteriole, the former is much lower than the latter. This is mainly due to the fact that the total cross-sectional area in vessels of the same diameter is larger in the venules than in the arterioles.

374

SPONTANEOUS PERIODIC FLUCTUATION WITH RESPIRATORY RHYTHMS IN EFFERENT DISCHARGES OF THE RENAL SYMPATHETIC NERVES IN THE CAT. NISHIKAWA, Y., MIYAKAWA, M. AND HUKUHARA, T., Jr.
Dept. of Pharmacol. II, Jikei Univ. Sch. Med., Minatoku, Tokyo.

Thirteen paralyzed cats were maintained by artifitial ventilation under monitoring $F_{E_{O_2}}$ (15.4±0.6%) and $F_{E_{CO_2}}$ (4.35±0.64%). Vagi and sinus nerves were cut bilaterally. Autocorrelation coefficient (CC) for the respiratory burst activity spontaneous efferent discharges of the renal sympathetic nerve was computed by means of correlation analysis in combination with a fractionated band-pass filtering technique (band width, 50 or 200 Hz each). Correlation analysis of the components of the nerve activity within a range from 100 to 400 Hz yielded a significantly ($p<0.01$) larger CC (0.172±0.053, range 0.115-0.307) as compared with that obtained by the analysis of the nerve activity ranging from 500 to 700 Hz. Effects of change in artifitial ventilation on the renal sympathetic nerve activity were examined. Both hyper- and hypoventilation did not produce any significant changes in levels of arterial blood pressure as well as the total power of the nerve activity. While CC of the nerve activity was decreased ($p<0.001$) during hyperventilation accompanied with decrease in $F_{E_{CO_2}}$ ($p<0.001$), to the contrary during hypoventilation CC was increased ($p<0.01$) accompanying a concomitant increase in $F_{E_{O_2}}$ ($p<0.001$). Thus, CC value depended on CO_2 concentration in expired air in a range from 2.4% to 6.5% showing a positive linear regression ($r=0.40$, $p<0.01$).

375

CENTRAL NEUROREGULATORY MECHANISM OF CARDIAC SYMPATHETIC NERVE ACTIVITY IN CONSCIOUS ANIMAL. NINOMIYA,I.,NISHIURA,N.,OKADA,Y. AND HIRATA,S.
Dept. of Card. Physiol., Res. Inst., National Cardiovascular Center,Suita Osaka

Cardiac sympathetic nerve activity (CSNA),ECG,EMG and left ventricular pressure (LVP) are measured continuously for more than 2 weeks in conscious cats with the use of multichannel biotelemeter. Relationships among CSNA, instantaneous heart rate (IHR), systolic LVP and EMG are analyzed in both of the transition and steady states of various behaviors. At the onset of postural changes, exercise or feeding an overshoot increase in CSNA is always observed with or without an increase in EMG. The peak responses of IHR and systolic LVP lagged 6.0 (mean) sec after that of CSNA. The systolic LVP and IHR increased almost linearly with the peak and mean values of CSNA obtained in both of the transition and steady states, respectively. It is concluded that in conscious cats CSNA as a control signal of IHR and LVP is regulated initially and directly by a feedforward signal originated from the higher central nervous system coupled with various behaviors and then reflexly by feedback signals from the cardiovascular receptors.

376

TRANSPOSITION RESPONSE IN SPONTANEOUSLY HYPERTENSIVE RATS
IRIUCHIJIMA, J., TERANISHI, Y., and TADA, T. Dept. of Physiol., Sch. of Med., Univ. of Hiroshima and Internal Medicine, Saiseikai Shimonoseki Hospital

The transposition response(TR) is a cardiovascular response complex observed when a rat is transposed from a habitual box to a new box. In intact normal rats TR is an "isopressor" response, in which arterial pressure remains almost unchanged, heart rate and cardiac output increase and total peripheral resistance decreases (Iriuchijima et al.: Jpn. J. Physiol. 30: 887, 1980). TR was induced in spontaneously hypertensive rats(SHR), with an electromagnetic flow probe implanted around the ascending aorta and an arterial cannula inserted into the abdominal aorta. In SHR TR was a pressor response instead of an isopressor: arterial pressure was elevated. The elevation of arterial pressure was ascribable to a greater cardiac output increase in TR in SHR than in normal rats. The decrease in total peripheral resistance was similar in both rat groups. However, considering that total peripheral resistance tends to decrease when cardiac output increases, it may be said that the decrease in total peripheral resistance was less in SHR. In other experimental hypertensive rats, TR was pressor in DOCA salt and neurogenic hypertensive rats and isopressor in renovascular hypertensive rats.

377

CONTROL OF CARDIAC PERFORMANCE BY THE PERIPHERAL CIRCULATORY MECHANICS

SATO, T., ENDOU, K., TAKEUCHI, A., YAMAGAMI, J., SHIRATAKA, M.*, NARA, Y.*, AND IKEDA, N.** Depts. of Medicine, Physiology*, and Information Science**, School of Medicine, Kitasato University, Kanagawa

The effect of arterial compliance, pre and post capillary resistances and compliance of the peripheral circulation on the hemodynamics was studied with the nembutalized dogs. The heart was denervated and electrically paced. A reservoir was attached to the aorta to change the arterial compliance, and arerio-venous shunt of variable compliance was connected between brachiocephalic artery and jugular vein. The experimental results were compared with the computer simulation based on the model of cardiac performance curve to pre and after-load and parallel peripheral circulatory beds. Both model and experiments show the three distinctive properties of the peripheral vascular beds on the diagram of mean arterial pressure vs. stroke volume: A shunt without compliance causes clockwise increase in stroke volume and biphasic change in arterial pressure. A shunt with moderate compliance decreases mean arterial pressure with no change in stroke volume. A shunt with large compliance lowers both mean arterial pressure and stroke volume. The results can be utilized to evaluate the property of a vascular bed under various conditions.

378

ON THE CHANGE IN BLOOD DISTRIBUTION ACCOMPANIED WITH DEPRESSER RESPONSE TO THE STIMULATION OF AORTIC NERVE

HATAKEYAMA, I., TAKEI, Y. AND ŌKUBO, J. Dept. of Physiol., Kitasato Univ. Sch. of Med., 1 Kitasato, Sagamihara

It is considered that the vasodilation (vasoconstriction) which occurs at some region must be accompanied with the transitory or lasting vasoconstriction (vasodilation) of some of other regions. As the first step of the investigation on the blood redistribution during reflexogenic cardiovascular response, the change in volume of various parts of the body caused by the stimulation of aortic nerve of rabbit was studied. The volume of head, chest, abdomen (epi-, meso- and hypogastrium) and thigh was measured by an original volumetric method, electrocapacitography (Hatakeyama, 1959).

Volume of head included brain decreased with depresser response caused by the stimulation of aortic nerve except one case where a biphasic effect was observed. Volume of the chest, mesogastrium and hypogastrium increased at most cases and that of the epigastrium and thigh tended to decrease during depresser response. The position of the center of gravity, which was continuously measured, was caudally shifted during depresser response. Both of rise and drop of the central venous pressure was observed.

The vasodilation, which is a cause of the drop of arterial pressure caused by the stimulation of aortic nerve is considered to occur mainly at lower part of stomach.

379

THE DYNAMIC ANALYSIS ON TRANSIENT PROCESS BETWEEN CIRCULATORY EQUILIBRII

SHIMAZU, H., YAMAKOSHI, K. AND KAMIYA, A. Research Institute of Applied Electricity, Hokkaido University

Theoretical analysis on dynamic behavior of the closed circulatory system developed from the circulatory equilibrium theory by Guyton showed that the transient response of the system to the hemodynamic changes is the first ordered one with time constant T given by $T = Cv/(G_{CO} + G_{VR})$, where Cv is the systemic venous compliance and G_{CO} and G_{VR} are the gradient (conductances) of cardiac output curve and venous return curve, respectively.

The validity of this theory was examined by the in-vivo measurement of such responses in the acute and chronic experiments. The time course of the consequent venous pressure against the stepwise change in the cardiac output function was almost a monoexponential function of time as predicted, allowing accurate measurement of the time constant T.

The time constant of the venous pressure is a good measure to represent the rapid responsibility of the circulatory system.

380

BLOOD VOLUME AND HEMODYNAMIC FUNCTION IN HYPOTHERMIA.
NOSE, H., MIKI, K., YAMADA, S., ISOGAI, Y. AND MORIMOTO, T.
Dept. of Physiol., Kyoto Pref. Univ. Med., Kyoto

The effects of hypothermia on circulating blood volume and the regulatory mechanisms of blood volume were studied on 9 splenectomized dogs. The lowering of core body temperature to 30°C over 2 hrs caused decrease of plasma volume from 39.0 to 36.2 ml/kg. At the initial stage of body cooling, blood pressure and COP showed increases. At lower body temperature than 35.5°C, blood pressure declined while COP showed steady level. The results indicate that protein free water is filtered out from vascular space at the initial stage of body cooling and plasma is excluded from circulation at lower body temperature. To analyze the mechanism of the fluid shift, the compliances of vascular(C-vas) and interstitial fluid space(C-isf) and the transvascular filtration coefficient(Kf) on the whole body were determined both in normothermia and hypothermia by a simulation analysis. The results obtained were the the decreases of C-isf and Kf and the increases of C-vas. These changes are concomitant with the changes due to the redistribution of blood into splanchnic area and suggests that the vascular and the interstitial fluid space in splanchnic circulation have important roles for blood volume regulation under hypothermia.

381

MEASURMENT OF MUSCLE AND TENDON BLOOD FLOW BY HYDROGEN GAS CLEARANCE METHOD DURING REST AND EXERCISE. TAKEMIYA,T., HASHIZUME, K. and TANAKA, Y. Div. of Physiol., Inst. of Health & Sport Sci., The Univ. of Tsukuba, Ibaraki.

Local blood flow of the muscle and tendon were measured simultaneously in Tibialis anterior, Soleus and Gastrocnemius of the rabbit anesthetized with urethane. A wire type of Pt-Pt black electrode with 80 μm in diameter was applied as the hydrogen gas sensor. With spontaneous arterial pressure at 84.6 mmHg, the resting blood flow (ml/100g/min) (mean±S.E.,n) in muscle and tendon were 21.33±1.79(14) and 26.60±3.69(12) in Tibialis anterior, 12.53±1.79(19) and 29.83±6.33(8) in Soleus and 14.46±1.95(21) and 30.49±3.96(11) in Gastrocnemius, respectively. After exercise evoked by sciatic nerve stimulation at 1 to 5 Hz, muscle blood flows increased approximately two times above the control whereas tendons showed no change or a slight decrease in some data. Local tissue temperature in muscle measured with thermocouple increased immediately after the onset of exercise, but the same phenomenon was not observed in tendon tissue. These results indicate that blood flow in tendon is larger than that of muscle at rest, and biomechanical effect may regulate the circulation of tendon during exercise.

382

MORPHOLOGICALLY CHARACTERISTIC FEATURES OF GLOMUS CELLS IN THE CAROTID LABYRINTH OF XENOPUS LAEVIS. KUSAKABE, T., ISHII, K. AND ISHII, K. Dept. of Physiol., Fukushima Med. Coll., Fukushima, 960

In the previous report it has been confirmed that the carotid labyrinth of Xenopus laevis has chemoreceptor function and the cells containing many dense-cored vesicles exist there. In the cell membrane of these cells, however, exocytotic figures of dense-cored vesicles were often observed, suggesting a secretory function. In further study with electron microscope characteristic figures were obtained. A gap junction is often found between two adjacent cell membranes. Some of the cells are found in intimate relation with the smooth muscle. Cell body itself or its foot-like processes are contacted with the latter. In these contacted area(g-s connection) only a space of 100-150 A separates the glomus cell membrane from that of the smooth muscle without intervention of basement membranes. In many cases exocytotic figures are observed very close to the smooth muscle. When the glossopharyngeal nerve is efferently stimulated with the electric shock for 60 second dense-cored vesicles in cytoplasm significantly reduce in number compared with those in the control frogs and some of them are concentrated on the site of g-s connection. These results suggest us a possibility that a target of secretory function of glomus cells may be smooth muscles which affect the vascular tone of the carotid labyrinth.

383

EFFECT OF HYPOXIA ON THE ISOLATED INTRALOBAR PULMONARY ARTERY OF THE RABBIT

MIMATA, T., OHE, M., HANEDA, T., AND TAKISHIMA, T. The 1st Dept. of Intern. Med., Tohoku Univ. School of Med.

Although alveolar hypoxia induces the constriction of pulmonary artery (PA), it has been observed that hypoxia decreases the tension of PA in vitro. We have attempted to produce the hypoxic constriction of PA, in vitro, in glucose-free solution.

Vascular strips of intralobar PA were isolated from rabbits and mounted for isometric tension recording. Two hrs after start of exposure of the strip to normoxic solution (Po_2 =104 mmHg), the tension was measured during 30 min exposure to hypoxic solution (Po_2=11 mmHg) on every 30 min intervals.

Hypoxia increased the tension of all strips (n=7) from 135±6(SE)mg to 293±15 mg. In contrast, reoxygenation decreased the tension from 293±15 mg to 119±6 mg. Repeated hypoxic exposure reduced the time of contraction process and prolonged the duration of relaxation. Nifedipine (10^{-6}M), Ca^{2+}-free solution, and Procaine (10^{-3}M) did not inhibit this hypoxic vasoconstriction. Papaverine (10^{-5}M) and Nitroglycerine (10^{-4}M) did not inhibit this response either.

Results demonstrate that hypoxic PA constriction, in vitro, occurs in glucose-free medium, and this phenomenon could be due to the disturbances of an energy-requiring sequestration system for calcium ion.

384

STUDIES ON CARDIOVASCULAR AND MICROVASCULAR EFFECTS OF SMOKING IN MAN AND ANIMALS. (12) CARDIOPULMONARY RESPONSES TO NASAL AND TRACHEAL ADMINISTRATION OF TOBACCO SMOKE IN THE RABBIT.

M. ASANO, C. OHKUBO, K. SAWANOBORI, K. YONEKAWA. Dept. of Physiol. Hyg., the Inst. Publ. Health, Minato-ku, Tokyo

Cardiopulmonary responses to nasal and tracheal administration of tobacco smoke were studied in lightly anesthetized (urethane, 0.5g/kg, i.p.) conscious rabbits. Tobacco smoke was generated by a specially devised smoking machine and introduced with a silicone elastomer tubing into the nostril or trachea via tracheostomy tube. Under normal nasal respiration, the immediate responses to intra-nostril administration of an appropriate volume of tobacco smoke consisted of bradycardia with extrasystoles, a rise in blood pressure and bradypnea with apnea in expiration, in general. The combined responses to the same procedure were much more intense under tracheal respiration than under nasal respiration. On the contrary, the responses to intra-tracheal administration of smoke were almost negligible or much less intense than those to nasal administration of smoke. The more distal part of the nostril for the nasal tubing head was selected, the more intense responses to the intra-nostril administration of smoke were developed. However, the combined responses subsided after a sufficient application of lidocaine aerosol to nostrils.

385

BLOOD DISCHARGING ACTIVITY OF PERIPHERAL VASCULAR BEDS DURING BRAIN ISCHEMIC PRESSOR RESPONSE.

TAKEUCHI, T.* AND MIYAKAWA, K.** *Dept. of Physiol., Yamanashi Med. College, Tamaho, Yamanashi, **Dept. of Physiol., Shinshu Univ. Med. Sch., Matsumoto

Body fluid discharged from peripheral organs was measured in rabbits with plethysmograph during a systemic arterial pressure oscillation with its level elevated in steps. The oscillation was produced by stepwise elevation of side pressure on the common carotid artery which was surgically prepared as the sole route of blood supply to the brain. Muscular volumes of right foreleg and left hind leg indicated slight increase with a slight rise of systemic arterial pressure, which were followed by exponential decrease with the further rise. Volume of right paw indicated much stronger increase with elevation of systemic arterial pressure, which was followed by sharp decrease with the further elevation. Liver volume showed exponential decrease with elevation of systemic arterial pressure. At the extreme elevation of systemic arterial pressure, % decreases in weight of respective organs in the conditions of -0.6, -0.3, 0, +0.3, +0.6% blood volume changes of the body weight were as follows. P.c. decreases of right foreleg skeletal muscle were 0.56, 0.59, 0.64, 0.73, 0.70, left hind leg skeletal muscle, 0.70, 0.73, 0.83, 0.98, 0.98, right paw, 0.73, 0.64, 0.23, 0.47, 0.50 and liver, 9.6, 8.7, 8.4, 8.6, 6.9, respectively. The respective vascular beds indicated characteristic modes of blood discharge in the regulation of the circulatory blood volume.

386

OXYGEN CONSUMPTION DURING BLOOD PRESSURE OSCILLATION IN RABBITS. MIYAKAWA,K. KANAI, K. AND HAYASHI, M. The 2nd Dept. Physiol., Shinshu Univ. Med. Sch. Matsumoto

All the arteries to the brain except a common carotid are occluded in rabbits and the carotid is compressed by exertion of side pressure on it. Then there appears a blood pressure oscillation (B.P.O.). The animal can survive the situation more than several hours. Cardiac output is distributed to the brain and the heart at the peak of the B.P.O. and to the other organs including the heart at the bottom of the glen. Thus the organs in the body share blood supply in sequence. B.P.O. can be regarded as another mode of life. It is nothing but an appearance of a new order in time and space in blood distribution, i.e. a phenomenon of reduction of entropy. The efficiency of the new mode of life and the energy consumption which should accompany the reduction of entropy was examined by measuring the oxygen consumption (O.C.) of the animal. The O.C. before and during the B.P.O. were 13.98 ± 6.22 ml/min/kg and 17.01 ± 13.93 ml/min/kg, respectively. The difference was not significant in paired test. Thus it can be concluded that the B.P.O. is well qualified for maintenance of life. On the other hand, the B.P.O. is a fluctuation of blood pressure around a level higher than its control and of course it requires more energy. However, the increase of the energy expenditure of the cardiovascular system is compensated by its decrease in cosumer organs which receive reduced blood supply during the B.P.O.

387

DYNAMICS OF A RED BLOOD CELL IMPINGING ON THE WALL.
NIIMI, H., MINAMIYAMA, M. AND HANAI, S. Dept. of Vascular Physiology, National Cardiovascular Center Research Institute, Osaka

The red blood cell (RBC) is so deformable that its shape may be easily changed by external forces such as fluid-dynamic pressure and viscous shear stress. We studied in theory and experiment how a single RBC moving near a wall impinges on and then rebounds from the wall under their fluid-dynamic interaction.

Human (or dog) RBC was used together with plasma; latex (0.8 μm diameter) was added in plasma for visualization. RBC suspension in plasma (or saline solution) was flowed in the jet stream from a micropipette of diameter of several micron at an angle on a plane wall whose surface was coated with gold. The motion of RBCs and the plasma flow near the wall were observed in the system of microscopy, high speed shutter TV camera, TV monitor and motion analyser.

Experiments showed that the RBC moved differently from the plasma flow near the wall; RBCs impinged on and rebounded from the wall almost as an elastic body while the plasma flowed as a stagnation-point flow. The RBC shape was not changed except at the moment of impingement, but the direction of its axis was changed at the impingement. The change in the RBC orientation can be explained theoretically considering the fluid-dynamic moment on the RBC.

388

THE BLOOD PRESSURE OSCILLATION IN SHEEP EVOKED BY LOW PRESSURE OR LOW OXYGEN. SAKAI,A., UEDA,G., YOSHIMURA,K.*, FUKUSHIMA,M.*, KUBO,K.* AND KOBAYASHI,T.*. Inst. of Adapt. Med., Dept. of Internal Med.*, Shinshu Univ. School of Medicine, Matsumoto, Nagano.

Altogether 12 sheep, awake and standing, were used for experiments. Before and during the experiments of a 6,600 m-altitude exposure or a 10 %-oxygen inhalation at a 600 m-altitude, the systemic blood pressure P_S, pulmonary artery pressure P_A, left atrial pressure P_L, cardiac output, heart rate and the pattern of respiration were measured. Under low pressure exposure, blood pressure oscillations were noticed in 10 of 20 cases, while under low oxygen exposure the oscillations appeared in 5 of 11 cases. The wave height was 9.7 ± 3.7 mmHg and the period was 17.1 ± 3.9 sec in the former, while 14.4 ± 5.6 mmHg and 15.2 ± 4.1 sec were seen in the latter. Secondly, as for the oscillation it was noticed that the waves of P_{LA} and P_A appeared later than those of P_S when Biot's pattern appeared, whereas P_A preceded those of P_S when Biot negative. Thirdly, the Biot-type respiration appeared in 9 of 15 cases. The appearance in general coincided well with the rising phase of the oscillations. In all cases of the 10 %-oxygen inhalation, Biot's type did not appear.

389

DIFFERENCE BETWEEN THE LEFT AND THE RIGHT DEPRESSOR NERVE OF NEWBORN RABBITS REGARDING THE STRUCTURE AND FUNCTION.
H. NOMURA, T. SHIMIZU.
Dept. of Physiol., Fujita-Gakuen Univ., Sch. of Med. Toyoake

The postnatal development of the depressor nerve which is related to the brain ischemic bradycardia was studied in a total of 65 rabbits aged 2-190 days. Depressor, vagus and sympathetic nerves were cut off bilaterally to a length of 20 mm in the middle of cervical region. Diameters of these nerve trunks were immediately measured under a microscope. Then myelinated fibers contained in the depressor nerve were counted in the maner, a fun-shaped specimen method, devised by Fukuyama. In 59 of 65 animals, the left depressor nerve contained more myelinated fibers than the right one. An average of numbers of myelinated fibers in 1-week old group was 152±35.0 in the left and 72±21.4 in the right. In 25-week old group, 183±44.3 and 102±21.7 of myelinated fibers were found on the left and the right depressor nerve respectively. These anatomical differences support differences in function observed in previous studies, and the depressor nerve, particularly the left one well develops already at the birth.

390

BAROREFLEX SENSITIVITY OF ESSENTIAL HYPERTENSION AND THE SEX DIFFERENCES OF BAROREFLEX
HINO,Y. SAITO,T. MURAYAMA,H. SUGIYAMA,Y. NAKAYAMA,A. MIZUNO,T. TONOOKA,M. IRIE,S. HATOGAI,F. KATAGIRI,M. YUMURA,Y. DEGUCHI,F. MAKITA,K. YAMADA,K. SATO,C. AND INAGAKI,Y. Dept. III Inter. Med., Sch. Med., Univ. Chiba.

We studied the baroreflex sensitivity in normotensive and hypertensive young and middle-aged adults. In middle-aged the bororeflex sensitivity of male were compared with the female. The baroreflex sensitivity was assessed by the slope of the regression line relating the rise of mean arterial pressure to the prolongation of the R-R interval for the intravenous injection of noradrenaline or neosynephrine. The baroreceptor slope was significantly reduced in labile and fixed hypertension in both young and middle-aged group. Beside that, the slope was reduced with increased age and raised mean blood pressure, and no significant difference of the sensitivity between middle-aged male and female was found, but the correlation coefficent of the former was obviously greater than that in latter. We suggested baroreflex dysfunction in the pathophysiology of essential hypertension and our method must be given careful consideration to the sex differences.

391

EFFECTS OF NITROGLYCERIN ON EXERCISE HEMODYNAMICS IN PATIENTS WITH CARDIAC DISEASE
FUKUDA, T., HIGAKI, S., YAMAMOTO, K., SEKIYA, T. AND NAKAMURA, Y.
Department of Medicine, Yohkaichiba City Hospital, Yohkaichiba Chiba 289-21

Hemodynamic responses to bicycle exercise in the supine position were studied before and after 0.3 mg of sublingual nitroglycerin(NTG) in 24 cardiac patients without any evidence of peripheral venous congestion. At 5 min. after NTG, resting systolic blood pressure(SBP), mean pulmonary arterial(PAm) and its wedge(Pw) pressures, cardiac index (CI), stroke index(SI) and stroke work index(SWI) decreased and heart rate(HR) increased significantly, while diastolic pressure(DBP) and systemic(SVR) and pulmonary (PAR) vascular resistances were unchanged. NTG suppressed the elevation of SBP, DBP, PAm and Pw induced by exercise significantly but had no effects on HR, CI, SI, SWI, SVR and PAR. Such changes were constantly observed 10 min after cessation of exercise. The results indicated that NTG acted dominantly on venous capacitance vessels and had little effects on resistance vessels of cardiac patients showing no pulmonary and peripheral venous congestion. Although NTG improved exercise capacity and pulmonary congestion induced physical exercise in most patients with left heart disease, including mitral stenosis, reducing left ventricular end-diastolic pressure, and hence cardiac output, deteriorated the symptoms of patients with moderate to severe outflow obstruction of the left ventricle.

392

ESTIMATION OF BLOOD PRESSURE FROM COUNTER PRESSURE MEASURED BY ORDINARY USED CUFF METHOD.
OKAI, O., HIGUCHI, Y. AND MAKINO, K. Dept. of Physiol., Kyorin Univ. Sch. of Health Science, Hachioji, Tokyo

A trial was made to estimate blood pressure from pressure detected by ordinary used and water-filled cuff which was applied to the upper arm in man. We supposed that a parallelism existed between blood pressure observed and counter pressure of the cuff. Then, flow(F) was calculated from the counter pressure of 50 mmHg. In this case it is satisfied that $V = R_2/(R_1+R_2)$-----(1). Rewriting this eq.(1) we get $R_2= VR_1/(1 - V)$ ------(2). Thus we can calculated pressure; $Pc = (k_1 \cdot R_1 + k_2/C+k_2 \cdot R_2)F$-----(3), where R_1, R_2 and C are aortic, peripheral resistances and compliance, which were obtained at the counter pressure of 50 mmHg, respectively. k_1, $k_2$and k_3, for the first time, are adjusted that pressure measured by the auscultatory method may be coincide to the pressure calculated by this method. If circulatory condition is changed we can calculate the changed R from eq.(2) and the changed Pc from eq.(3). By this method pressure may be calculated within acceptable error in the range of 80 mmHg to 150 mmHg in man because aortic resistance and compliance are almost constant in this range in dog as already reported.

393

ARTERIAL MECHANICS WITH OR WITHOUT VASCULAR SMOOTH MUSCLE ACTIVATION.
FUKUSHIMA, T., SAKAGUCHI, M.* , KAWAI, Y., OHHASHI, T. AND AZUMA, T. Dept. of Physiol. and Res. Lab. for Cardiovasc. Diseases, Shinshu Univ. Sch. of Med., Matsumoto, 390, *Dept. of Elec. Eng., Nagano Tech. College, Nagano, 380

Mechanical properties of the common carotid and renal arteries were studied with cylindrical preparations isolated from dogs. These preparations were filled with Krebs solution containing no norepinephrine (control state or 10^{-5}M norepinephrine (activated state). Pressure-diameter and pressure-length relationships were recorded to compute stress-strain, relative wall thickness-pressure, internal cross sectional area-pressure, Young's modulus-pressure and compliance-pressure relations. Activation of vascular smooth muscle altered significantly mechanical properties of the renal artery but hardly affected those of the common carotid artery. At an internal pressure of 100 mmHg, for example, the tangential wall stress and internal cross sectional area of the renal artery in the activated state were reduced by 50%, and Young's modulus by 90%. Hence, the relative wall thickness became doubled and the distensibility increased by about ten times that in the control state.

394

ON THE EFFECTIVE PACE ALLOCATION IN TWO MINUTES MAXIMAL MOVEMENT.
ITOW, H., YOSHINO, T. AND MURAOKA, I.Physical Education, Education, Waseda Univ.

In this experiment we aimed at looking after more practical pace allocation in I500 m speed skating race. For this purpose we used bicycle ergometer which causes an action similar to the way of the muscular action on speed skating. We charged the subjects with two minutes maximal on three different paces, and scored the performance, heart-rate, respiration frequency, O_2requirement, O_2intake, O_2debt, etc. as the indicator, and we examined the pace allocation in two minutes maximal movement.For the subjects we chose three persons who are all first class speed skaters

Through this experiment we found the four facts.

395

GENERATION OF OXYGEN DISSOCIATION CURVE AND P_{50} VALUE OF HUMAN WHOLE BLOOD, USING A NEWLY DEVELOPPED ULTRAMICRO-SILICONRUBBER TONOMETER AND LEX-O_2-CON WITH MODIFIED SYRINGE AND NEEDLE.

HASEGAWA,H. AND SATO,M.Serology Division, National Cancer Center Research Institute, Tsukiji, Tokyo

The authors developped a new method of ultramicro-tonometry of whole blood of 40 μl in each: small siliconrubber tonometry tubes were handmade ,the tonometry was conducted in the modified old Astrup tonometer. The CO_2 content of the bombes was uniformly 40 or 50 mmHg(two series), but the O_2 concentration ranged around 20,23,26,30 and 34 mmHg respectively. The O_2 content of the blood was measured by LEX-O_2-CON. The transfer of blood was made with reconstructed Hamilton syringes which otherwise have dead space at the tip and joint of the needle and at the side-hole. The optimum time of tonometry was concluded to be 15 min. in our method. The duplicate measurement errors were 0.45mmHg(S.D.), the normal values of P_{50} were 25.8 ± 0.2 mmHg, the Bohr constant was -0.483. As for the postsampling errors, the preservation of the whole blood over 4 h. in the room temperature should be avoided, since P_{50} decreased with blood pH.

396

THE RELATIONSHIPS BETWEEN BLOOD FLOW RATE AND SALIVARY SECRETION OF THE RAT SUB-MANDIBULAR GLAND NEMOTO, A., UEHA, T., HOSOI, K. and KIDA, T., Dept. of Oral Physiol., Josai Dental University, Sakado-shi, Saitama.

One of the submandibular glands (SMG) of a rat (SD strain) was perfused by the method devised by Sprecher et. al., and the other gland (nonperfused gland) was used for control. Perfusion speed was fixed either 0.044 ml/min or 0.086 ml/min and the blood flow rate through and the salivary flow rate from the SMG were measured. Simultaneously, salivas were collected from both of glands and the concentrations of Na^+ and K^+ in these samples were measured. Secretion of the saliva was evoked by the intraperitoneal injection of pilocarpine (5 mg/kg body weight). Blood flow rate through the SMG was increased with the increase of perfusion speed. Pilocarpine also increased the blood flow rates through the SMG. Thus, salivary flow rates were increased in parallel with the rate of blood flow through the SMG. The relationship between the salivary flow rate and the concentration of K^+ in the saliva from the control gland was similar to that from the experimental gland. Different from the control experiment, however, the concentration of Na^+ in the saliva from perfused SMG was not increased with the increase of salivary flow rate. When ouabain was added in the perfusion solution, salivary flow rate was decreased, but no change was observed in the relationship between electrolyte concentrations and salivary flow rate.

397

EFFECT OF EOSINO-PHILS AND NEUTRO-PHILS BY THERMAL AND TOOTH PAIN STIMULUS.

KAZUTAKA GOSHI, TAMOSTU KASAHARA, SHINICHI OHKUBO.
DEPARTMENT OF PHYSIOLOSY, DENTAL-CLINIC,HOUSE OF REPRESENTATIVES.

It has been widely discussed that the number of the leucocyte in the blood circulation fluctuates by various stimulations. In addition to the finding that the number increases / decreases by somatic diseases, it is also said that the numerical fluctuation is caused by the disturbances, mental and / or psychological, and the peripheral pain-stimulations. By using a male rabbit of 3Kgs. in weight, we carried out several experimentations to find out the characteristics of eosinophil and neutrophil. We gave them thermal shocks as mental disturbances and the teeth amputations and the stimulations to dental pulp as peripheral pain. We measured the numerical fluctuation of eosiniphil and neutrophil during the experimentations and we would like to report our findings.

398

REDUCED DEFORMABILITY OF RED CELLS AT LOW TEMPERATURE

KIKUCHI, Y., KOYAMA, T. AND MIKAMI, T.* Div. of Physiol., *Div. of Biocontrol, Res. Inst. of Appl. Electr., Hokkaido Univ., Sapporo

Flow characteristics of heparinized whole blood through a Nuclepore filter membrane (5 μm pores) were studied at various temperatures. A marked increase in the flow resistance of human blood was observed below 18°C. It was almost impossible to make whole blood to flow through the filter at 10°C. Further, this change in the flow resistance was observed to be reversible. When the temperature was raised above 18°C again, whole blood recovered its initial low resistance to the flow through micropores. The change was small in the region from 20 to 37°C. For the purpose of comparison, fish (yellow tail) blood was studied under the same conditions. No sudden change was observed between 10 and 37°C. The flow resistance gradually increased as the temperature was decreased. The marked increase of the flow resistance of human blood through micropores was interpreted as a result of a reduced deformability of red cells and an increased number and strength of red cell aggregations at low temperature.

399

FUNCTIONAL IMPAIRMENTS OF IN VIVO AGED HUMAN ERYTHROCYTES.

MAEDA, N., KON, K., SUDA, T. and SHIGA, T. Dept. of Physiol., Sch. of Med., Ehime Univ., Ehime.

The rheological functions of in vivo aged human erythrocytes were investigated in relation with the morphological and biochemical changes. The erythrocytes were fractionated into the younger and older cells (ca 10 % of total, respectively) by the density gradient centrifugation of Dextran T-40 or Percoll.

(1) Morphologically, the older cells were smaller (in diameter and volume) than the younger cells, and showed the less biconcavicity. (2) The loss of lipids (with keeping a constant cholesterol/phospholipids molar ratio) without change of protein content in the erythrocyte membrane, and the decreases of 2,3-DPG and ATP (and the increase of ADP and AMP) in the cytoplasm were observed during in vivo aging. (3) The increased oxygen affinity of older cells due to the decrease of 2,3-DPG was observed. (4) The membrane fluidity (observed by the motion of fatty acid spin labels) was decreased in the older cells, probably due to the alteration of membrane organization and/or the decreased ATP content. (5) The deformability (measured by the micropipette aspiration technique) decreased in the older cells, probably due to the decreased membrane fluidity and the increased internal viscosity (mainly due to hemoglobin). (6) Finally, the increased suspension viscosity of older cells (measured by a cone-plate viscometer) resulted from the decreased membrane fluidity and the decreased deformability.

400

Effect of guanine nucleotides on adenylate cyclase(AC) activity and c-AMP dependent protein kinase(PK) in the frog bladder epithelial cells.

Shimada,H., Mishina,T. and Marumo,F. Dep. of Int. Med. Kitasato Univ. Kanagawa

The effects of guanosin triphosphate(GTP) and its analog Gpp(NH)p to vasopressin-induced osmotic water flow (Vp-induced osmotic WF) and sodium active transport were examined. Gpp(NH)p enhanced Vp-induced osmotic WF of the frog bladder membrane, but had no effect to short circuit current(SCC). To investigate this mechanism, AC, PK and c-AMP binding to PK were assayed. Crude homogenate(for AC) and its cytosol fraction(for PK) of the frog bladder epithelial cells were used for the enzymes. Gpp(NH)p or Vp enhanced AC activity, mainly alternating of its Vmax values, and their effects were additive. Pk activity was determined by the methods of Schlondorf and Franki using [γ32P]ATP and histone II-b as a substrate. 1μM of GTP and Gpp(NH)p activated PK activity in the absence or in the presence of c-AMP (up to 0.01μM). The half-maximal activation of GTP in the absence of c-AMP occured at 0.3μM. However, it was disappered at the presence of 2μM c-AMP. Gpp(NH)p-induced increment of PK activity was diminished by c-AMP dependent PK inhibitor. There was no effect of GTP (0.2-200μM) for the binding [3H]c-AMP to PK. These results suggest that enhancement of Vp-induced osmotic WF by guanine nucleotides will be caused by partly the direct action of GTP and Gpp(NH)p to PK.

401

Gγ AND Aγ GLOBIN-CHAINS BIOSYNTHESIS BY ADULT AND UMBILICAL CORD BLOOD ERYTHROPOIETIC BURSTS AND RETICULOCYTES. TERASAWA,T.,KASAI,S. AND OGAWA,M* Dept. of Physiol. Tohoku Dental Univ. Koriyama,Fukushima. *Dept. of Medicine, Medical Univ. of South Carolina, Charleston, SC, USA.

We examined γ-globin chain biosynthesis by adult and umbilical cord blood erythropoietic bursts in methylcellulose clonal culture and γ-chain synthesis by cord blood reticulocytes. Globin chains were labeled with ^{14}C-amino acids and quantitated by using autoradiography or fluorography. Alpha, beta, and Gγ and Aγ chains were separated by isoelectric focusing in polyacrylamide gels containing 8M urea and 3% Nonidet P-40(a nonionic detergent). Time course examinations of the γ-chains synthesized by the bursts revealed no changes in the Gγ : Aγ ratio between day 10 and 18 of culture. The ratio of Gγ/(Gγ + Aγ) in cultures of adult circulating erythroid precursors was 0.38 ± 0.09, which corresponds to the known ratio in adult peripheral blood erythrocytes. The relative Gγ-chain biosynthesis in the cord blood bursts and reticulocytes were 0.56 ± 0.02 and 0.66 ± 0.008, respectively. Both are intermediate between the accepted newborn and adult ratios. Natal erythropoietic precursors appear to be in the transitional stage with respect to the switching of Gγ:Aγ ratios.

402

OXYGEN EQUILIBRIUM CURVE OF EMBRYONIC HAEMOGLOBIN PORTLAND ($\zeta_2\gamma_2$)
Kiyoshi NAGAI, Yasunori ENOKI & Susumu TOMITA (Department of Physiology, Nara Medical University, Kashihara 634, Nara)

Hb Portland is an embryonic haemoglobin which appears only in the early stage of human development but persists in the blood of an infant with Bart's hydrop foetalis, the homozygous state for α-thalassaemia, type I. In this condition, the red cells contain Hb Bart's (γ_4) as the major component with Hb Portland ($\zeta_2\gamma_2$) as a minor component and some traces of Hb H (β_4). Hb Portland was purified from the blood and the oxygen equilibrium curves were determined. The oxygen affinity of Hb Portland is higher than Hb A but haem-haem interaction is substantially present. The alkaline Bohr effect measured as $\Delta\log P_{50}/\Delta pH$ is nearly halved which may be attributable to the replacement of His-122 with Asx in Hb Portland

403

ISOLATION AND PROPERTIES OF HUMAN GLYCOSYLATED HEMOGLOBINS. ENOKI, Y., KANEKO, A., OHGA, Y. AND TOMITA, S. Dept. of Physiol., Nara Med. Univ., Kashihara

Four minor hemoglobins, Hb A_{Ic}, A_{Ib}, A_{Ia-2} and A_{Ia-1}, were isolated from normal adult hemolysates and their structures and functions were compared with each other and with Hb A_0. The isolated hemoglobins were homogeneous by ultracentrifugal analysis and gel electrophoresis in which Hb A_0, A_{Ic}, A_{Ib}, A_{Ia-2} and A_{Ia-1} migrated with decreasing order of net positive charges. Hybridization analysis showed the charge differences to derive solely from the β subunits. Hb A_{Ia-2} and A_{Ia-1} showed the presence of one and two mol phosphorus covalently bound to the proteins, respectively. The intrinsic oxygen affinities and the effects of such allosteric effectors as anions, DPG, H^+ and CO_2 were all decreased in the order of Hb A_0, A_{Ic}, A_{Ib}, A_{Ia-2} and A_{Ia-1}. Subunit cooperativity was potent in Hb A_0 (Hill's exponent n=2.81) and A_{Ic} (n=2.65), less potent in Hb A_{Ib} (n=2.19) and much depressed in Hb A_{Ia-2} (n=1.76) and A_{Ia-1} (n=1.51), irrespective of the presence or absence of the effectors. From these results, conformations of the minor hemoglobins were argued to be more shifted to and fixed in the T structure.

404

ROLE OF α_2-MACROGLOBULIN ON BLOOD COAGULATION AND FIBRINOLYSIS

MIURA,R., OGAWARA,M., SEKI,T., YOKOUCHI,M. AND MATSUDA,T. Dept. of Physiology, Division of Clinical Physiology (II), Tokyo Metropolitan Institute of Gerontology, Tokyo.

It has been emphasized that antithrombin III is the most important inhibitor of thrombin and α_2-plasmin inhibitor is the most important antagonist of plasmin among five kinds of inhibitors of blood coagulation and fibrinolysis which exist in blood in physiological condition. The purpose of this study is to investigate role of α_2-macroglobulin which acts as antithrombin as well as antiplasmin. Comparison of antithrombin and antiplasmin activity between normal human plasma and purified α_2-macroglobulin separated from human plasma according to method of Roberts et al. revealed that about 36% of thrombin neutralized by normal human defibrinated plasma and about 30% of plasmin inhibited by normal human plasma in 20 seconds at 37°C were attributable to action of α_2-macroglobulin. From these results, it is concluded that effects of α_2-macroglobulin on blood coagulation and/or fibrinolysis should not be ignored especially in cases of DIC in whom levels of antithrombin III and of α_2-plasmin inhibitor markedly decrease and in patients with nephrotic syndrom in whom concentration of α_2-macroglobulin in plasma markedly increases.

405

EFFECTS OF SK-POTENTIATOR AND FIBRINOGEN ON SK-PLASMINOGEN COMPLEX IN THE PRESENCE OF TRANEXAMIC ACID

TAKADA, A. AND TAKADA, Y. Dept. of Physiology, Hamamatsu University School of Medicine, Hamamatsu-shi, Shizuoka, 431-31

There are two kinds of SK-potentiators which are eluted in two different peaks on Sepharose 4B gel filtration. SK-potentiator A which is of larger molecular weight (M_r 240,000) is composed of peptide chains similar to β and γ-chains of fibrinogen on SDS-PAGE, and crossreacts with anti-FDP-Y fragment in the γ-region on immunoelectrophoresis. The addition of tranexamic acid to the mixture of plasminogen and streptokinase (SK)(called SK-activator activity) resulted in decreased extent of hydrolysis of TAMe. The addition of SK-potentiator to the mixture of SK, plasminogen and tranexamic acid prevented the decrease in SK-activator activity caused by tranexamic acid, thus SK-potentiator counteracting with the effects of tranexamic acid. Fibrinogen potentiated SK-activator activity, but did not prevent the decrease of the activity caused by tranexamic acid. Fibrinogen added to SK and plasminogen prior to tranexamic acid prevented the decrease in SK-activator activity. From these data it is suggested that SK-potentiator and fibrinogen bind with lysine binding sites of plasminogen part of SK-activator, and SK-potentiator binds with SK-plasmin(-ogen) complex faster than fibrinogen.

406

EFFECTS OF ω-AMINOACIDS ON THE ACTIVATION BY UROKINASE OF VARIOUS PLASMINOGEN PREPARATIONS

TAKADA, Y. AND TAKADA, A. Dept. of Physiology, Hamamtsu University, School of Medicine, Hamamatsu-shi, Shizuoka, 431-31)

Since there are many forms of plasminogen (plg) whether native (Glu-plg) or conformationally changed (Lys-plg and Acid treated plg), the effects of ω-aminoacids on those plasminogens were studied. Increase in the concentration of ω-aminoacids first resulted in increase in the activation rates of Glu-plg of which the peak values were obtained at 1 mM for tranexamic acid, 10 mM for 6-aminohexanoic acid (6AHA), and 100-1,000 mM for lysine. Further increase in the concentration of tranexamic acid and 6AHA resulted in decrease in the activation rates. The activation rate of Lys-plg slightly increased with increase in the concentration of tranexamic acid. The activation rate of Acid treated plg decreased with increase in the concentration of tranexamic acid and 6AHA. In the clot, the activation rate of Glu-plg first slightly decreased and then increased with increase in the concentration of ω-aminoacids.
In conclusion, interaction of ω-aminoacids and fibrin with lysine binding sites of plasminogen may result in different effects on the activation rate by UK, depending upon different forms of plasminogen. Role of lysine binding sites in the regulation of fibrinolysis may be very important in vivo.

407

STUDIES ON REACTIONS OF PERFUSED RAT-LIVER BY CLOTTING OR FIBRINOLYTIC ENZYME ADMINISTRATION. SAKAI,J. SAEDA,Y. YAMAMOTO,H. and SUGIE,I. Dept. of Physiol., Aichi Med. Univ., Nagakute-cho, Aichi.

This study was carried out to clarify the physiological function of the liver on streaming clotting or fibrinolytic enzyme. Isolated rat-liver was perfused with saline or Krebs-Ringer solution, and, perfusate and bile were collected for the calculation of enzymatic activities which were measurement by chromogenic substrate. By administration of Human Urokinase(600-60IU/ml) for 10 min., UK-activities of perfusate have not almost change except for a little time-lag. In the case of 5U/ml Bovine Thrombin perfusion, Thrombin-activities of perfusate were significantly appeared an increase during its administration and after that. However, in the case of 1 or 0.5U/ml Bovine Thrombin perfusion, Thrombin-activities were a decrease. Perfusion of Bovine Fibrinogen or Human Plasmin, and collected bile were also investigated.

From these studies, there seems to be explained that reactions of rat-liver on Human UK or Bovine Fibrinogen perfusion were not significant but rat-liver reacted with Bovine Thrombin and Human Plasmin. It is suggested that rat-liver secreted thrombin like substance on thrombin perfusion, and detoxicated enzyme activities on Human Plasmin.

408

THE INHIBITORY EFFECT OF GARLIC OIL ON PLATELET AGGREGATION (II). OSHIBA, S. ARIGA, T. SAWAI, H. IMAI, H. AND ENDOH, E. Dept. of Physiol. Nihon Univ. Sch. of Med., Itabashi-ku, Tokyo 173

We reported in a previous paper that garlic oil shows strong inhibitory action on the secondary aggregation of platelets. In the present investigation we attempted to isolate an effective component from garlic oil and identify its chemical structure by gas chromatography, mass spectrography and nuclear magnetic resonance (NMR). In addition, we tried to synthesize this effective component and studied the effects of a synthesized compound upon platelet aggregation. The results obtained are as follows: 1) It was recognized that the garlic oil is composed of more than ten components. 2) One component which occupied 4% showed a strong inhibitory action on platelet aggregation. This component was determined to be allyl methyl trisulfide by mass spectrography and NMR. 3) We tried to synthesize this component according to Oaks Method and succeeded to obtain a compound containing 24% of allyl methyl trisulfide. 4) This synthesized component exibited a potent inhibitory action on ADP-induced aggregation of rabbit platelets and epinephrine-induced human platelets aggregation at a concentration of 10^{-4} M and 10^{-5} M respectively. 5) Another component which has similar inhibitory action was found in the synthesized compound.

409

DETERMINATION, PHYSIOLOGICAL SIGNIFICANCE AND PHYSICOCHEMICAL PROPERTIES OF HUMAN FIBRINOGEN SUBFRACTIONS. SASAKI, S. AND KITO, K. Dept. of Physiology, Fujita-Gakuen Univ. School of Med., Toyoake, Aichi, Japan, Meito-Sangyo Co., Nagoya.

A new method for determining high molecular weight (HMWF) and low molecular weight (LMWF) subfractions of plasma fibrinogen using glycine solution was developed. The method is based on the fact that the subfractions are precipitated separately by glycine with appropriate ionic strength. The method is simple and accurate enough to be used in clinical laboratories. The method was tried at normal and pathological human plasmas. The results were basically in good agreement with the results previously reported by other researchers who used SDS gel electrophoresis. The ratio of HMWF to LMWF was approximately 7/3 in normal persons. In the cases of liver dysfunctions, HMWF was decreased and LMWF was increased. Physicochemical and biological properties of the fractions were also investigated. The only difference of the chemical structure between the two fractions is that one of the two alpha chains of LMWF has only half length of normal chain lacking its C-terminal side half. To sum up, the HMWF is an effective coagulant while LMWF is a poor coagulant. From the results reported here, it is reasonable to suppose that LMWF is derived from HMWF by the action of plasmin in the blood stream. However, the possibility is also remained that the LMWF is synthesized in the place other than liver in the body.

410

FIBRIN-BINDING AND IMMUNOCHEMICAL PROPERTIES OF DIFFERENT MOLECULAR FORMS OF URINARY AND TISSUE CULTURED UROKINASE

SUMI, H. KOSUGI, T. MATSUO, O. AND MIHARA, H. Dept. of Physiol. Miyazaki Medical College, Miyazaki

1. High molecular forms of human urinary and kidney tissue cultured urokinase (HMW-UK ; MW 53,000, 97% active sites, THMW-UK; MW 53,400, 54% active sites) were highly purified using affinity chromatography on [N^{α}-(ε-aminocaproyl)-DL-homoarginine hexyl ester]-Sepharose followed by isoelectric focussing and Sephadex G-100 gel filtration. 2. HMW-UK was found to have a much higher affinity to fibrin-Sepharose compared to LMW-UK. The fibrin-binding activity was not inhibited by DFP treatment. 3. LMW-UK had a single polypeptide chain, while HMW-UK had two polypeptide chains (MW 31,000 and MW 18,000) linked by a disulfide band. The functionally-active heavy chain (H-chain; 87% active sites) and the inactive light chain (L-chain) were first prepared from HMW-UK by mild reduction with 2-mercaptoethanol and alkylation with iodoacetate. 4. Specific rabbit antiserum against each purified material was prepared with Freund's complete adjuvant. It was found that anti H-chain antiserum strongly inhibited not only the fibrinolytic activity (fibrin-plate) of H-chain, but also the activities of HMW-UK and LMW-UK. In contrast, no inhibitory effect was observed with anti L-chain antiserum on H-chain or on LMW-UK, but L-chain antiserum partially inhibited HMW-UK. 5. The immunological identity of HMW-UK and THMW-UK was confirmed by double immunodiffusion.

411

APPEARANCE OF Na^+ AND HCO_3^- IONS IN THE PLASMA OF DOG'S WHOLE BLOOD WHEN EXPOSED TO CO_2 GAS

TANASE, K., OGAWA, A., ASAHI, T., SHIMABUKURO, S., HIRAKAWA, S. 2nd Dept. Intern. Med., Gifu Univ. Sch .Med., Gifu 500

We examined whether sodium ions are released from red blood cells when dog's whole blood was exposed to a CO_2 gas mixture(60%N_2,25%O_2,15%CO_2) for various time-period up to 30 minutes at 37±1 ℃. Blood samples were collected at 5 minute intervals,and the whole blood was examined for pH,pO_2,pCO_2,while blood plasma was examined for $[Na^+]$,$[Cl^-]$,and $[K^+]$. The results were as follows:(1)For time-periods up to 5(or 10) minutes after the start of passage of the above CO_2 gas,approximate net efflux of Na^+ averaged 0.407 pmol/cm^2/sec, assuming a total surface area of 1.51×10^{-6} cm^2 for a single red blood cell(RBC),and a RBC count of 500×10^4/mm^3. The net efflux of HCO_3^- averaged 0.737 pmol/cm^2/sec,while net influx of Cl^- averaged 0.480 pmol/cm^2/sec. (2)The sum of the net efflux of Na^+ and the net influx of Cl^- agreed with the net efflux of HCO_3^-,within error of ±14%(coefficient of variation) under various conditions. (3)In view of the time-course changes in plasma concentration of Na^+,HCO_3^- and Cl^- as well as approximate net fluxes of these ions,we postulated that at least two channels are in operation,(a)chloride shift and (b)transport of Na^+ and HCO_3^- ions from RBC to blood plasma. If ΔA means an increment of A ion concentration in plasma,we found that $-\Delta Cl^- \fallingdotseq \Delta Na^+$ and $\Delta HCO_3^- \fallingdotseq 2\cdot\Delta Na^+$ in the case of the above constitution of gas. With this method,we strengthened our postulation with studies,using acetazolamide(20mg/Kg),SITS(10^{-4} M/L),and CO_2-rich gas(50%N_2,25%O_2,25%CO_2).

412

RELATION BETWEEN OXYGEN DEBT AND SODIUM EXCRETION

OGO, K. AND *INOMOTO, T. Physiol. and Hygi., Fac. Educ. Kumamoto Univ., Kumamoto, *Dept. Morphol., Inst. Const. Med., Kumamoto Univ., Kumamoto

Previously we reported that the Na diuresis was caused by full speed running. In this time, the relation between oxygen debt and the urinary substances, at the time when the muximum oxygen intake by bicycle ergometer was measured, was investigated with seven male sprinters. There was a very wide variation in oxygen debt in each subject. Urinary Na, K and Cl, on the average, decreased after exhaustive exercise, but there were wide variations. The mean of urine osmolality at the 30 minutes after exercise was decreased but did not always decrease individually. The change of urinary Na after exhaustive exercise (30 min./Rest) correlated with oxygen debt (r= 0.858) and that of osmolality correlated with oxygen debt contrary (r=-0.961). It is suggested that a decrease in excretion rate of urine after physical exercise with small oxygen debt depends on not only the decrease of glomerular filtration but also the increase of tublar reabsorption, and that as a result of the reduction of tublar reabsorption of Na accompanied with high oxygen debt, the rate of decrease of Na in urine after exercise becomes small.

413

EXCRETION AND ACCUMULATION OF UREA GIVEN IN THE LARGE AMOUNTS TO THE DOG.

TANAKA,Y., NAKAYA,S., HONJO,R. & YAGI,S. Dept of Physiol. II, Schl of Med., IWATE Med. Univ., Morioka.

Six dogs weighing about 10 kg, each anesthetized with thiopental and given with many loads of urea (3 to 15 g/kg B.W., i.v.) at a rate of 30 to 14 g/hr for 2 to 10 hours by the i.v. infusion of 30 % aq. solution containing so much glucose 20 % as to protect the animals from hemolysis and hematuria, were examined on the renal activities during the experimental period of 6 to 16 hours before the death and then were excised of 15 different organs into 95 % ethylalcohol at the mixing ratio of about 1 to 7 ml per 1 g wet tissue. Another 2 dogs with no load of urea were treated similarly.

In the tissue urea contents (mg/g) obtained by Fearon's colorimetry of the alcohol extracts, the blood and the urine, not only viscera such as the liver, pancreas, intestines, spleen, kidney, lung and heart but also the trunk tissues like the skin and muscles were found at the same level of 0.3 to 10 mg/g corresponded with the increase of the plasma level of 0.3 to 24 mg Urea/ml, except for the stomach of 0.01 to 2 mg/g and for the bones of 0.3 to 2 mg/g. In the sum of these values multiplied by the weight were taken about 60 % of those given amounts, of which another 25 % or more were recovered in the urine but 15 % or less remained in the blood.

414

RENAL ACTIVITIES OF THE DOG GIVEN THE LARGE AMOUNTS OF UREA.

NAKAYA,S., TANAKA,Y., HONJO,R. & YAGI,S. Dept of Physiol. II, Schl. of Med., IWATE Med. Univ., Morioka.

During the load test of urea under anesthesia as above-mentioned by Tanaka et al, 6 dogs each having the left kidney prepared to observe the renal tissue pO_2 of 5 different parts (outer & inner cortex, outer & inner medulla and pelvis, respectively, 3 & 5, 10 & 15 and 35 mm deep from the capsule surface) with Yagi's oxygen electrodes, excreted about 25 % of the given amounts of urea at the rate of 0.1 to 6 g every 30 minutes by the volume of 1 to 200 ml and by the concentration of about 1 to 5 g/dl corresponding to the increase of the plasma urea from 0.03 to 2.4 g/dl. However, between 0.5 and 1 g/dl of the plasma urea were found those figures of the excretion rate concentrated into the peak values of 2 to 6 g per 30 minutes and oppositely those of the urea clearance got down from the supernormal level of 1 to 3 ml/min/kg to the subnormal.

Then, those values of pO_2 in the electric term which were integrated into the figures of mV-hours every second at a time interval of 30 minutes taken for collecting the urine were found in a tendency for the deeper zone of the medulla to be so much higher as the more increased excretion but for the outer cortex to be rather lower in the normal to supernormal phase of the urea clearance and even to do a rise in the subnormal clearance.

415

CHARACTERISTICS OF INSPIRATORY INHIBITORY REFLEX CAUSED BY THE CHEST WALL VIBRATION IN MAN.

HOMMA, I., KOBAYASHI, K., KOBAYASHI, Y., NAGAI, T. AND SAKAI, T. Dept. of Physiol. The Jikei Univ. Sch. of Med. 3-25-8 Nishishinbashi Minato-ku Tokyo Japan

The effect of lower chest wall vibration on ventilation was studied in normal man. Two vibrators, frequencies 100Hz, were applied bilaterally over the 7th to 10th intercostal spaces anterior to the mid-axillary line. The vibrators were triggered by chest wall movement during the inspiratory phase once, intermittently, every 3 to 4 breaths. The subjects were not told what expect during the procedure and began breathing of 4 grades of CO_2 mixed gases, 3%,5%,6% and 7% respectively. Tidal volumes of 'vibrated' breaths were decreased compared with preceding control breaths and respiratory frequencies were increased. As consequences of increased frequencies and decreased tidal volumes of 'vibrated'breaths minute ventilations in 'vibrated' and 'non-vibrated'breaths were almost equal. This reflex may contribute to control the depth and the rate of breathing in man.

416

FLUCTUATION OF REFLEX HYPOXIC DRIVE DURING THE MENSTRUAL CYCLE.

TAKANO, N. Physiol. Lab., Dept. of School Health, Fac. of Education, Kanazawa Univ., Kanazawa 920

Oxygen tests were applied to nine women to estimate the contribution of the reflex hypoxic drive to total ventilation and to see how it changes during the menstrual cycle. The oxygen test was such that O_2 was breathed for 30 sec, by which ventilatory depression was measured breath-by-breath. The maximum depression was considered to be the reflex hypoxic drive (HD) and expressed as a % of control ventilation. HD was 10.3% (SE±0.72, N=24) during the follicular phase and increased to 15.1% (SE±0.90, N=24) during the luteal phase. Based on this result, we estimated that a 10% increase in $\dot{V}_A$ occurring during the luteal phase, which has been observed in our previous study (Takano et al., Pflügers Arch., 1981), is accounted for in half by the increase in HD and in another half by increases in other drives such as CO_2 drive. These results suggest that progesterone brought into the blood during the luteal phase might increase the hypoxic responsiveness of the peripheral chemoreceptors.

417

PULMONARY MICROCIRCULATORY RESPONSE TO REGIONALLY APPLIED HYPOXIA AND HYPERCAPNIA

HORIMOTO, M. AND KOYAMA, T. Div. of Physiol., Res. Inst. Appl. Elect., Hokkaido Univ.

The effects of regional hypoxia and hypercapnia on the blood flow velocity in pulmonary microvessels, which were observed on the lung surface, were studied in anesthetized bullfrogs, associated with the change in the vessel diameter. Before and after the application of hypoxic or hypercapnic gas mixture on the circular area of 6 mm-diameter of exposed lung surface, hyperoxic or normoxic gas was poured as a control. The flow velocity was successively measured during the experiment by use of a laser Doppler microscope and both mean flow velocity (MV) and pulsatile amplitude (PA) were determined from the flow velocity contour. To examine the response of each pulmonary microvessel to hypoxia and hypercapnia, the vessel diameter was measured through the microscope, while the gas mixture was poured on the small area of 1 mm-diameter.

Both MV and PA in alveolar microvessels were reduced during hypoxia and hypercapnia but were restored to their initial control values with the reintroduction of the control gas. The reduction of MV and PA in capillary flow were -11 and -35% during hypoxia and were -13 and -44% during hypercapnia. Since the time course of the velocity change coincided with that of the diameter change in arterioles, the decrements of MV and PA presumably resulted from the vasoconstriction of the pulmonary arterioles.

418

ARTIFICIAL PACEMAKING OF BREATHING MOVEMENT BY MEDULLARY STIMULATION IN ADULT LAMPREY.

Kawasaki, R., Col. Bio-med. Tech. Niigata Univ.

A single, or repetitive (less than 5 Hz) pulses (4-8V, 0.3 msec) applied extracellularly to the medial part of the medulla produced one-to-one movement of branchial baskets (Bb), which is similar in shape, and as well as in bilateral synchronization, to spontaneously occurring one; the driving stimuli reset the rhythm of breathing movement. Double pulses applied at various intervals (1.0-200 msec) produced one-to-one or two-summated movement of Bb, revealing that refractory period is less than 10 msec; applied pulses never produced active immediate relaxation of Bb. EMGs recorded from branchial muscles always correlated to the phase of contraction of Bb. High frequency stimulation (more than 5 Hz) produced sustained compression of Bb (expiratory arrest). After repetitive stimulation, spontaneous breathing movement transiently disappeared (Bb sustained in relaxation; inspiratory arrest); driving pulses applied during this period however produced one-to-one movement of Bb. Inspiratory arrest also was produced by intravenous application of d-tubocurarine. These results can be explained by considering an analogy between an respiratory rhythmogenesis in the lamprey and cardiac pacemaking in crustacean heart.

419

FUNCTIONAL ORGANIZATION OF BRAIN STEM RESPIRATORY NEURONS WITH RESPECT TO RHYTHMOGENESIS IN THE MEDULLA OBLONGATA OF THE RABBIT.

HATTANMARU, Y., GOTO, K., TAKANO, K. AND HUKUHARA, T., Jr. Dept. of Pharmacol. II, Jikei Univ. Sch. Med., Minato-ku, Tokyo.

In aiming to elucidate the functional relation of brain stem respiratory neurons to the respiratory rhythm generating mechanisms the stability of the spontaneous unitary discharges of respiratory neurons was studied with special regards to their anatomical localization in the brain stem. Experiments were performed in 40 paralyzed rabbits being maintained by artificial ventilation under monitoring end-tidal O_2 and CO_2 levels. Coefficient of variation (CV) for period of volley was calculated for each neurons. CV implied the stability of spontaneous periodic burst discharge of respiratory neurons. CV for 85 units varied in a wide range from 1.3 to 14.4%. Correlation coefficient of autocorrelation of respiratory unit activities varied from 0.09 to 0.92. A significant correlation between CVs for volley period and autocorrelation coefficients was proved for 85 respiratory units ($r=-0.74$, $p<0.001$, $N=85$). Inspiratory ($N=2$) as well as expiratory ($N=4$) which were discharging stably with a smaller CV for volley period (1.3-1.9%) and a larger correlation coefficient (0.83-0.92) were exclusively located in the lateral region of the bulbar reticular formation. The result suggests that these 6 bulbar respiratory neurons are playing an essential role as the members of the primary respiratory neuron group in generating the respiratory rhythms in the bulbar mechanisms.

420

PHASE RESPONSE CURVES OF THE RESPIRATORY NEURONS IN RABBIT.

KUSACHI, R., MIYAMURA, Y., KOMATSU, A., YAMASHITA, Y. AND KITANO S. Dept. of Physiol. and Dept. of Anesthesiol., Tokyo Women's Medical College, Shinjuku-ku, Tokyo 162.

In vagotomized and paralyzed rabbits, short stimulus trains (250 Hz, 11 pulses) were applied to the nucleus parabrachialis medialis at various time in the respiratory cycle and phase response curves of phrenic nerve and bulbar respiratory neurons in the obex level were investigated. When stimulus train was delivered during the inspiratory phase, transient inhibition was observed in discharges of phrenic nerve and inspiratory neurons except early inspiratory ones. When stimulus train was applied during the later inspiratory phase, cessation of inspiratory bursts of phrenic nerve and inspiratory neurons occurred. Early expiratory neurons were activated by stimulation during respiratory cycle but in early phase of inspiration.

The results suggest that early expiratory neurons act as an off-switch for the inspriratory neurons, while early inspiratory neurons do so for the expiratory neurons.

421

CERVICAL AND MEDULLARY RESPIRATORY ACTIVITY IN THE CAT.

M. AOKI. Dept. of Physiol., Sapporo Med. Coll., Sapporo.

In order to elucidate functional relations between the cervical and medullary respiratory neurons, spontaneous breathing patterns were altered in two different ways and resultant changes in the discharges of simultaneously recorded respiratory units were examined. Recordings were made from the intermediate zone of the gray matter of the cervical cord and the nucleus ambiguus, using tungsten microelectrodes in lightly anesthetized or decerebrated cats under spontaneous breathing. Both cervical and medullary inspiratory-type cells showed a similar burst discharge in synchrony with the inspiratory phase of the respiratory movement. 1) When an animal was connected to a ventilator and spontaneous breathing was synchronized with artificial respiration, the mean discharge frequency of cervical units decreased quickly, with concurrent reduction of the number of spikes within a burst, and cells often ceased to fire. By contrast, the discharge frequency of medullary units decreased gradually, and bursts persisted during artficial ventilation. 2) When a respiratory stimulant (doxapram) was given i.v. to increase the rate and amplitude of respiration, cervical units displayed both a greater increase in discharge frequency, and in the number of spikes per burst than medullary units. These results suggest that cervical respiratory neurons are more directly related to the generation of the spontaneous respiratory movement.

422

CHANGES IN RESPIRATORY PATTERN OF THE RAT BY ANESTHESIA

FUKUDA, Y. AND HONDA, Y., Dept. of Physiol., Chiba Univ. Sch. Med., Inohana, Chiba

End-tidal P_{CO_2} (P_{ETCO_2}), ventilation and respiratory neural activities of cranial and phrenic nerves were recorded in the rat anesthetized with halothane. When anesthesia level was deepened, minute ventilation was decreased accompanying by a rise in P_{ETCO_2} although the CO_2 output was reduced. Halothane induced a progressive decrease in respiratory frequency (f) with almost constant or even slight increase in tidal volume(V_T). Decrease in f was caused largely by the prolongation of expiratory time (T_E). Changes in inspiratory time (T_I) were small and the mean V_T/T_I ratio remained unaltered. Tidal inspiratory discharges in vagal (laryngeal), hypoglossal and phrenic nerves were well maintained or even augmented when the level of anesthesia was deepened. Injection of pentobarbital Na caused also similar changes in respiratory pattern. These changes in respiratory pattern induced by anesthesia were in contrast to the simultaneous decrease in V_T, f and V_T/T_I ratio and apparent changes of both T_I and T_E in other species. Decrease in T_I/T_{I+E} with constant V_T, peak phrenic activity/T_I ratio indicated that in the rat, respiratory timing mechanism was preferentially influenced and mechanisms regulating the overall tidal activities of inspiratory output neurons in the medulla seemed to be resistant to anesthesia. Roles of Hering-Breuer reflex in the determination of respiratory pattern were discussed.

423

EFFECT OF INACTIVATION OF SINUS NERVE BY COLD BLOCKING ON INSPIRATORY ACTIVITY IN ANESTHETIZED AND VAGOTOMIZED CAT.

S. KUWANA AND T. NATSUI
Dept. Physiol., Teikyo Univ. School of Med., Itabashi-ku, Tokyo.

Integrated phrenic nerve discharges were recorded as an output of respiratory activity in anesthetized, vagotomized cats paralyzed and artificially ventilated. The effect of cold blocking of the carotid sinus nerve (CSN) on phrenic activity at varying end-tidal P_{CO_2} under normoxia or hyperoxia was investigated. Phrenic nerve discharges reduced during blockade. Reduction ratio (RR) was 100 % at P_{CO_2} level of threshold P_{CO_2} +3 mmHg and decreased with increased P_{CO_2}. Then, RR became to be constant to 17 % at above +25 mmHg under normoxia and 9 % at above +10 mmHg under hyperoxia.

P_{CO_2}-phrenic amplitude curve in CSN-intact rose steeply at the lower P_{CO_2} level, and at higher P_{CO_2} the curve flattened out. When this flat amplitude was taken as 100 %, diminished effect by blockade was 15 % under normoxia and 7 % under hyperoxia throughout the P_{CO_2} range that we studied. These results indicate that CSN conducts a constant respiratory drive, being independent of P_{CO_2}, and that relative contribution of peripheral drive is large in respiratory system at lower P_{CO_2} level.

424

ESTIMATION OF IN VIVO HALDANE EFFECT COEFFICIENT.

TAZAWA, H., TAMURA, M., NIIZEKI, K. AND MOCHIZUKI, M. Dept. of Physiol., Yamagata Univ. Sch. Med., Yamagata 990-23.

The in vivo Haldane effect coefficient (in vivo HE), which implies the amount of CO_2 output attributable to blood oxygenation in the pulmonary capillaries, was estimated in 5 healthy young adults. Simultaneously, the CO_2 dissociation curve (CO_2DC) of deoxygenated and oxygenated bloods of individual subjects was determined with Natelson micro-blood analyzer. A subject rebreathed air and 3 % O_2/N_2 gas for 20 sec, respectively, in a body plethysmograph and thereafter performed Valsalva maneuver to determine lung gas volume. From the O_2-CO_2 rebreathing curves measured with a glow discharge gas analyzer, blood Pco_2's (Pa_{co2}=PA_{co2} and Pv_{co2} from Defares' method), $\dot{V}co_2$ and $\dot{V}o_2$ were determined. Then, $vaDco_2$ in normoxia and hypoxia was estimated from blood Pco_2's and CO_2DC. $avDo_2$ was calculated from $\dot{V}o_2$ and $\dot{Q}$, where $\dot{Q}$ was obtained from $\dot{V}co_2$ and $vaDco_2$. The average value of cardiac index of 5 subjects was 3.4 and 3.2 for normoxic and hypoxic gas rebreathing, respectively. The in vivo HE, which was estimated as a ratio of $vaDco_2$ difference between normoxia and hypoxia plus arterial Cco_2 difference between normoxia and hypoxia to the $avDo_2$ difference between normoxia and hypoxia, was 0.291 $\pm$ 0.053 (N=5). The value for each subject agreed well with his in vitro HE which was estimated directly from CO_2DC (0.280 $\pm$ 0.045, N=5).

425

pH MEASUREMENTS BY MEANS OF A FLUORESCENCE TECHNIQUE AND ITS APPLICATION TO STUDIES ON CO_2 HYDRATION REACTIONS.

UCHIDA, K., NIIZEKI, K. and MOCHIZUKI, M. Dept. of Physiol., Yamagata Univ. School of Med., Yamagata 990-23

Fluorescence intensity of 4-methylumbelliferone (4-MU), excited at 346 nm and observed at 454 nm, increases with increasing pH and vice versa in the pH range 6 to 8. A dilute 4-MU solution (40 μM/l) of which the solvent consisted of nearly the same ions as in plasma was mixed with laked RBC at different ratios. Half-times of the pH change were measured by monitoring the fluorescence intensity of the sample layer after a sudden exposure to a gas containg 11 or 57 torr of CO_2 and 24 torr of O_2. The half-time for rise (57 $\rightarrow$ 11 torr) is always longer than that for decay (11 $\rightarrow$ 57 torr) and they increase linearly as the laked RBC ratio increases. The extrapolated half-times to the pure RBC are 5.5 and 4.4 sec for rise and decay, respectively, for 35 μm layers. The time course of the pH was calculated by solving numerically the following one dimensional diffusion equation and assuming the Henderson-Hasselbalch equation: $\alpha' \partial P_{CO_2}/\partial t = [\alpha D_{CO_2} + (\alpha' - \alpha) D_{HCO_3^-}] \partial^2 P_{CO_2}/\partial x^2$, where α is CO_2 solubility in RBC and $\alpha' = dC_{CO_2}/dP_{CO_2}$. In order to fit the calculated half-times with the observed ones, the diffusion coefficient of bicarbonate ions, $D_{HCO_3^-}$, was required to depend on C_{CO_2}.

426

CHANGES OF RESPIRATORY RHYTHMICITY INDUCED WITH PHARMACOLOGICAL AGENTS.

SHIMADA, K., IKUNO, H., MIYAOKA, Y. AND YAMAZAKI, H. Dept. of Oral Physiol., Niigata Univ. Sch. of Dent., Niigata.

Effects of picrotoxin and strychnine on respiratory rhythmicity were investigated in urethane-anesthetized, vagotomized and paralyzed rabbits being maintained by artificial ventilation. Respiratory rhythmicity was disturbed by i.v. application of picrotoxin, and phrenic activity discharged almost continuously. But auto-correlogram of integrated phrenicogram revealed two types of rhythmicity. One type resembled normal pattern, and the other showed higher frequency and smaller amplitude than normal. Small amount of strychnine increased amplitude and frequency of synchronization of phrenic activity which was observed during normal respiratory state. The synchronization changed sometimes into strychnine bursts. This finding suggests that both synchronization of phrenic activity and strychnine burst are brought by input from a system of non specific neurons other than respiratory center. When strychnine was applied into only respiratory pattern generator structure, tonic phrenic activity was observed, and rhythmicity of respiration disappeared completely, and any strychnine burst was not brought.

427

Estimation of homeostatic control activity in chemical regulation of ventilation with increasing dead space. Honda, Y., Yoshida, A., Hayashi, F., Sasaki, K., Masuda, Y., and Oyabu, Y. Dept. Physiol. Chiba Univ. Sch. Med., Chiba.

Eight healthy subjects were tested by breathing through plastic tubings with volumes of 250, 500 and 750 ml, respectively. Averaged increments in P_{ACO_2} (ΔP_{ACO_2}) were observed as 2.69 ± 1.44, 4.88 ± 1.64 and 6.29 ± 1.82 mmHg, respectively. On the other hand, ΔP_{ACO_2} expected from the measured "gain" of each subject were 1.23 ± 1.78, 2.66 ± 1.35 and 4.96 ± 2.49 mmHg, respectively. The difference between observed and calculated ΔP_{ACO_2} seemed to be due to low P_{CO_2} - ventilation response in tube breathing. When $\dot{V}_{CO_2}$ was calculated from body weight by using allometric coefficient, overall "gain" of P_{CO_2} - ventilation feed back system could reasonably be estimated from the measured ΔP_{CO_2}. Estimated "gain" from actual $\dot{V}_{CO_2}$ and ΔP_{ACO_2} were 18.0 ± 17.7, 19.3 ± 12.1, and 22.9 ± 9.8, respectively, whereas the one from allometric coefficient and actual ΔP_{ACO_2} were 20.6 ± 11.4, 22.1 ± 13.4, and 25.5 ± 11.1, respectively. When no ventilatory response was elicited in response to increasing dead dead space, expected P_{ACO_2} increments were 34.1, 84.4, and 145.3 mmHg, respectively.

428

TRANSIENT RESPONSES OF RESPIRATORY AND CIRCULATORY SYSTEMS AT THE START AND END OF EXERCISE. MIYAMOTO,Y.and MIKAMI,T. Dept.Bio-Med.Control,Res.Inst.Appl.Electr.Hokkaido Univ.,Sapporo.

Cardiac outputs,ventilation volumes and metabolic rates were simultaneously measured in healthy men before, during, and after a step work load of light to moderate degrees. Stroke volumes,heart rates and cardiac outputs were determined automatically with the aid of a computer from an impedance cardiogram. Respiratory and motion artifacts appearing on the impedance signal were canceled adopting an ensemble averaging technique in which the R-wave of ECG was utilized as a trigger pulse to start the sampling. Breath frequencies, tidal volumes, minute ventilations,end-tidal pressures of O_2 and CO_2, O_2 consumptions,CO_2 outputs and gas exchange ratios were also monitored on the breath-by-breath basis by the other computer system where the second impedance plethysmograph measured respiratory signal and a mass-spectrometer analyzed the gas composition of expired air. It was found that the transient responses of the respiratory and circulatory variables may be simulated by an exponential function. The time constants of cardiac outputs ranged from 30 to 60 sec and increased with increasing work loads. The time constants of ventilation distributed within a narrow range between 60 and 80 sec and were independent of work load. These responses initiated within 5 sec after the start or end of exercise. There was no difference between "on" and "off" responses.

429

EFFECTS OF PHYSICAL TRAINING ON THE VENTILATORY RESPONSES TO HYPOXIA AND HYPERCAPNIA.
MIYAMURA, M. and H. MATSUI
Lab. Work Physiol., Res. Cent. Hlth. Phys. Fit. Sports,
Nagoya University, Chikusa-ku, Nagoya

Ventilatory responses to hypoxic and hypercapnic stimulation was determined in the 8 healthy male students before and after physical training for 30 weeks.
Maximum oxygen uptake and maximum ventilation were measured during maximal treadmill exercise. Hypoxic drive was expressed as the difference of ventilation (ΔV_E) when subject breathed with room air and low oxygen (about 10 % O_2) during submaximal bicycle exercise for 7 min. In addition, hypercapnic ventilatory response curve was determined by the rebreathing method.
It was observed that maximum oxygen uptake after training was increased significantly, and the slope of ventilatory response curve to CO_2 was decreased after training, while hypoxic drive does not changed before and after training.
These findings indicate that physical training for 30 weeks have an effect on not only maximum oxygen uptake, but also the slope of hypercapnic ventilatory response curve.

430

THE EFFECTS OF ISOPROTERENOL ON LIPID METABOLISM IN LIVER AND SALIVARY GLANDS OF YOUNG MICE. HONDA,S., NAKAMURA,H., INOMATA,K*. AND KURAHASHI, M., Dept. of Oral Physiol. and Physiol*., Higashi-Nippon-Gakuen Univ. Sch. of Dent., Ishikari-Tobetsu, Hokkaido, 061-02

The present study was conducted to determine the effects of isoproterenol(IP) administration on the cholesterol and fatty acid metabolism of salivary glands(submandibular, sublingual and/or parotid gland).
After IP(0.3mg/mouse) was administrated s.c. dairy to young male ICR-JCL mice for 58days, the animals were injected with acetate-1-^{14}C, one hour before killing the mice.
The results are as follows: in salivary glands,IP treatment resulted in hypertrophy, decreased cholesterol and fatty acid content,increased cholesterol and fatty acid biosynthesis, and decreased stearic acid of fatty acid composition. In liver, fatty acids content were considerably decreased, whereas cholesterol content and biosynthesis, fatty acid biosynthesis and composition were unchanged. From these results, it is concluded that changes in lipid metabolism in salivary glands after IP administration are closely related to hypertrophy.

431

INHIBITORY EFFECT OF CELLULOSE-PHLORIZIN ON THE GLUCOSE ABSORPTION IN THE SMALL INTESTINE OF RAT. KASAGI, T. Dept. of Nursing, Tottori Univ. Col. of Med. Care Technol. Yonago 683

A novel compound, "cellulose-phlorizin", which was synthesized by coupling phlorizin to insoluble cellulose (MW. 90,000) via a "spacer arm" was examined for its ability to block the active transport of glucose by means of the circulating method in vivo. The state of the glucose absorption was detected by measuring the decreasing amount of glucose (1mM) in the circulating solution, to which phlorizin (0.083mM) or cellulose-phlorizin (equivalent to phlorizin of 0.083mM) was added.
Phlorizin showed the inhibitory effect on glucose absorption at rates of 68% (for 15min) and 53% (for 60min), while for the novel compound these rates were 57 and 53%, respectively. Cellulose did not show any noticeable effects itself. Then, we are led to conclude that the present novel compound has an inhibitory potency as powerful as for phlorizin.

432

STUDIES ON PENETRATION PHENOMENA THROUGH INTESTINAL MEMBRANE — relationship between intestinal penetration and normal bacterial flora — NAKANO,S.,YOSHIOKA,T.,NARUSAWA,M., NAGAMI,K. Dep. of Physiol., The Tokai Univ. Sch. of Med., 259-11 Isehara, Kanagawa.

We have investigated a series of experiments on penetration of insulin as activepolypeptides, L-tryptophane and its related active transport of glucose and Na^+ through everted intestine of a rat. In the present study, also using our divised circulation apparatus, intestinal penetration phenomena were investigated under each following condition. The obtained experimental results are as follows: 1) In Germ-free(G-f) rats of Fischer strain, histological features and intestinal penetration of the above substnces were no defined change in comparison with conventional(C-V) rats. This phenomena showed different findings from Wistar strain rats. 2) Intestinal penetration of the G-f rats orally monoassociated with Escherichia Coli(E-C) or Bacteroides distasonis was suppressed in comparison to C-V rats. 3) On the other hand, the patterns of penetration of the representative substances used to everted intestine in C-V rats showed a certain similarity to those obtained in E-C monoassociated rats. 4) In the immunoelectrophoretical observation on the sera or intestinal mucosa derived from G-f rats, the intensity of precipitating lines obtained in β and γ regions decreased in comparison with E-C monoassociated rats or C-V rats. 5) As the results it will be suggested that the intestinal absorption of various substances would be influenced by the existence of intestinal bacterial flora.

433

THE cSt OF THE PILOCARPINE REFLEX OF RABBITS' SALIVATION

KAMOGAWA,H.,KOUNO,M.,MURATA,M.,KOBA,T.,HIRABA,H.,SAKAI,T.,HIROSE,H.AND SAIKI,M.
Dept.of Physiol.,sch.Dent.univ.Nihon

The authurs made a new viscometer which can measures a 3UOul sample three times and had a trail of it's accuracy.

Firstly, they measured the cSt(centimeter stokes) of Aqua Puriticante from 31°C to 49°C with the new viscometer, and evaluted it's accuracy by comparing the mewsured and the theoretical values, which subsequently turned out to be satisfactory.

Secondly, they measured the cSt of salivation for 30minutes after injecting the Pilocarpine(1mg/kg) into the retroauricular veines of a rabbit(about 3kg of weight) with an artificial parotid fistel.

Results were as follows:

1. The cSt was hight 5 minutes after injection of the Pilocarpin.
2. The cSt did not indicate any signiticant difference between salivation of right and left parotid.
3. The cSt values of a three days experiment remained the same

434

SECRETORY MECHANISM OF D-GLUCOSE IN RAT SALIVARY GLAND. TAKAI, N., YOSHIDA, Y. AND KAKUDO, Y. Dept. of Physiol., Osaka Dental Univ., Higashi-ku, Osaka.

The mechanism of glucose secretion in rat three major salivary glands was studied. The concentration of glucose in parotid and submandibular saliva evoked by parasympathetic, sympathetic and Substance P stimulation was less than 1.0mg/dl, but in sublingual saliva evoked by parasympathetic and Substance P stimulation was much higher than in submandibular saliva. Sympathetic stimulation had not only any effect on the glucose secretion but also on the salivary secretion in sublingual gland. And the relations between the glucose concentration in sublingual saliva and salivary flow rate revealed the rectangular hyperbola, but no statistical correlation was found as to the concentration of glucose between blood and saliva. Ouabain and Diethylstilbestrol raised glucose concentration in submandibular saliva, but have no effect on sublingual salivary glucose level. Mannitol which did not enter the intracellular space was secreted in submandibular and sublingual glands in the same pattern as glucose secretion. The above findings suggest, 1)intercellular pathway of glucose secretion is present in submandibular and sublingual glands, especially it plays an important part in sublingual gland, 2)and the glucose reabsorptional function, which is secondary transport depending on sodium influx of the luminal membrane of the duct cells, is present in submandibular gland, but is lacking in sublingual gland.

435

COMPARATIVE PHYSIOLOGY OF THE PANCREATIC EXOCRINE SECRETION IN THE HERVIVORA, THE CARNIVORA, THE OMNIVORA AND AVES. HARADA, E. & NAKAGAWA, R.,Dept. Physiol., Fac. Vet. Med. Hokkaido Univ., Sapporo 060, KATO, S., Vet. Med., Coll. Dairying, Ebetsu, 069-01

Secretory responses induced by vagal stimulation (15Hz, 5ms, 5mA), intra-venous injection of pancreozymin (2U/Kg) and intra-intestinal infusion of the synthesized trypsin inhibitor (200mg/Kg) were examined in the exocrine pancreata of the pentobarbital anesthetized rat, pig, rabbit, sheep, mink, duck and chicken. Among these animals tested, the vagally-induced secretory response of the pig was the largest, whereas the pancreozymin-induced response was prominent in the rat. The pancreozymin -induced responses of the mink, rabbit and sheep were larger than the vagally-induced responses. Aves showed a higher resting level of pancreatic juice flow and the vagally -induced response was similar to the pancreozymin-induced response.

The components of amylase, trypsin and chymotrypsin in the pancreatic juice were different for each species; Omnivora showed a higher ratio of amylase, carnivora had a higher ratio of trypsin and chymotrypsin. Rabbit showed a higher ratio of trypsin. Sheep showed a lower amylase and a higher chymotrypsin. Aves showed a higher ratio of amylase and chymotrypsin. The results show that pancreatic exocrine secretion adapts to diet composition, gastric function and food intake behavior in each species.

436

EFFECTS OF TONICITY AND DIVALENT CATIONS ON CATECHOLAMINE SECRETION FROM FROG ADRENALS. KITA, H., NARITA, K. & YASUGI, E. Dept. of Physiol., Kawasaki Med. Sch., Kurashiki, Okayama

Catecholamine (CA) secretion induced by exposure to K^+-rich solutions was studied using the in vitro frog adrenal. Above 40 mM the secretion was an increasing function of $[K^+]_o$ up to 120 mM which was the highest concentration examined. In the absence of extracellular Ca^{2+}, the stimulation with high $[K^+]_o$ was ineffective. Hypertonic solutions made by adding 100, 200 and 300 mM (540 mosM) sucrose or osmotically equivalent amounts of NaCl inhibited the secretion of CA in response to 40 mM K^+, the higher tonicity producing the stronger inhibition. There was no difference between the actions of sucrose and of NaCl in depressing the response. The high K^+-induced secretion was Ca^{2+}-dependent and the relation between log(CA secretion) and log($[Ca^{2+}]_o$) gave a straight line with a mean slope of 0.64 in the range between 0.1 and 1 mM. An average Michaelis constant of 0.84 mM was obtained by Lineweaver-Burk plots. In the range from 0.25 to 0.5 mM $[Ca^{2+}]_o$, the secretory response was always larger when the solution contained 0.1 mM 4-aminopyridine. Up to 10 mM Mn^{2+}, Co^{2+} or Ni^{2+}, when included in place of Ca^{2+}, suppressed the excess K^+-evoked responses and only Mn^{2+} diminished the basal secretion as well.

437

EFFECTS OF OSMOTIC STIMULI AND VOLUME STIMULI ON UNIT ACTIVITY OF PARAVENTRICULAR NEUROSECRETORY CELLS AND THEIR INTERACTIONS WITH ANGIOTENSIN II (AII). NEGORO, H. AND AKAISHI, T. Dept. of Physiol., Niigata Univ. Sch. of Med., Niigata.

Unit activity was recorded from antidromically identified PVN neurosecretory cells in the rat and the effect of hypertonic (0.3 M) NaCl or hemorrhage (1 ml/100 g body weight) on the activity was examined. Fifty-one % of 106 identified units were excited both by hypertonic NaCl and by hemorrhage, 25 % of them were excited only by hemorrhage, 20 % of them were not affected either by hypertonic NaCl or by hemorrhage, 4 % of them were inhibited by hemorrhage and 1 % of them was excited only by hypertonic NaCl. The injection of hypertonic NaCl during subthreshold stimuli of hemorrhage (0.5 ml/100 g) induced a marked potentiation of the response to the hypertonic NaCl of the unit activity. Intraventricular injection of AII potentiated the response of the unit activity to the osmotic stimuli but did not affect the response to the hemorrhage. In addition, AII antagonist (Sar^1-Ala^8-AII, 1-2 μg) inhibited the effect of osmotic stimuli but not that of hemorrhage. These results suggest (1) that osmotic stimuli and volume stimuli converge on more than one half of the PVN neurosecretory cells, (2) that the neurosecretory cells could be controlled by interaction between osmotic and volume stimuli and (3) that AII is involved in osmotic control rather than volume control of the neurosecretory cell activity.

438

MODIFYING EFFECTS OF LACTATION ON THE PHASE ANGLE OF PLASMA CORTICOSTERONE RHYTHM OF BLINDED PUPS. WATANABE, K., HONMA, K. AND HIROSHIGE, T. Dept. of Physiol., Hokkaido Univ. Sch. of Med., Kita-ku, Sapporo 060

We previously reported in a mother-pups exchange experiment that about half of the blinded pups showed the phase angle of the foster mother, while the rest that of the original mother ('scatter effect'). To clarify the effect of lactation, further two experiments were designed. (1) Restricted nursing: pups born from LD mother were nursed by the LD mother only during light phase (L group) or only during dark phase(D group). (2) Full time nursing: pups born from LD mother(LD pups) and from DL mother(DL pups) were nursed all time by pairing them with the light phase of either of LD or DL mother during the lactation period. Only D group showed a typical scatter effect at the 4th postnatal week. However, the scatter effect in D group was abolished by the end of 6th week. In Exp. (2), both LD and DL pups showed consistently phase angles of their original mother. These results indicate that an oscillator for plasma corticosterone rhythm starts to oscillate prenatally and its phase angle is set by the original mother.

Furthermore, it appears that the foster mother may transiently modify pup's rhythm mainly through discord between maternal nursing and pup's feeding phases.

(Supported in part by Grant-in-Aids Nos. 544023 and 520901 from the Ministry of Education, Science and Culture of Japan)

439

COMBINED EFFECTS OF MELATONIN AND ARGININE-VASOTOCIN ON THE CANINE PITUITARY RESPONSE TO LUTEINIZING HORMONE RELEASING HORMONE

MIENO, M. OGAWA, ER. IIMORI, M. AND YAMASHITA, K. Dept. of Pathophysiol., Atom. Dis. Inst., Nagasaki Univ. Sch. Med., Nagasaki 852.

We have demonstrated that pineal factors melatonin and arginine-vasotocin (AVT) have a direct inhibitory effect on the anterior pituitary gland of the dogs. The combined effects of melatonin and AVT on the LH-RH-induced release of luteinizing hormone (LH) from the anterior pituitary gland of the dog have in this study been determined using the rate of secretion of 17-oxosteroids by the testes of anaesthetized dogs in vivo as an index of LH secretion.

Melatonin (100 μg/kg) and AVT (0.01 μg/kg), injected into the carotid artery, were almost equally effective in suppressing the effects of LH-RH. The administration of the half the dose of melatonin for this given inhibitory effect with half the corresponding dose of AVT caused roughly a given effect. It seems to be that in the dog, melatonin and AVT have an additive inhibitory effect rather than competing with one another on the anterior pituitary gland. This suggests that the two substances act different sites.

440

CIRCADIAN ADRENOCORTICAL RHYTHM IN THE ADRENALECTOMIZED RAT WITH EITHER AN AUTOTANSPLANTED ADRENAL OR AN ACCESSORY ADRENAL GLAND

TAKAHASHI,K., MURAKAMI,N., AND TAKAHASHI, Y. Depts. of Medical Chemistry and Psychology Tokyo Metropolitan Institute for Neurosciences, Fuchu-city, Tokyo

Circadian rhythm of blood corticosterone(CS) in adrenectomized rat with (AT), or without, adrenal autotransplants was investigated. Blood samples were obtained individually at 4-h intervals for a 24-h period per week for 5-7 consecutive weeks by the tail tip incision method.

CS responses of the autotransplanted adrenal gland to ACTH gradually increased with time after the implantation, and by 5 weeks had attained a level comparable to that of intact rats. Concurrently with this change, circadian adrenocortical rhythm in AT became evident and they were able to respond to a reversed photoperiodic enviorment. The effects of constant illumination or food restriction on the corticosterone rhythm in AT were indistinguishable from that of intact rats in every aspects.

In some of the adrenectomized rats, the daily rhythm of the blood CS levels reappeared 5-7 weeks after surgery owing to the hypertrophy of accessory adrenal glands. However, the accessory adrenal gland remained quiescent in the AT. This fact admonishes that, in long term experiments with adrenalectomized rats, an analysis of the accessory adrenal glands at the termination of the experiment can not be ignored for evaluation.

441

THE ROLE OF AMINERGIC NEURAL PATHWAY IN THE SEX-STEROIDS MODIFICATION OF SLEEP RHYTHM

YAMAOKA,S. Dept. of Physiol., Saitama Med. Sch. Moroyama-cho, Saitama, 350-04.

We have demonstrated that the circadian sleep rhythm shows the sexual cycle dependent alteration and gonado-hormone induced changes in female albino rats, and that this mechanism correlates with the positive feedback mechanism of sex-steroids via forebrain limbic system. There are vast reports which demonstrate the correlation of noradrenergic tracts with the positive feedback mechanism of gonadal hormones. And Yanase has demonstrated that adrenaline auguments the estradiol(E_2) sensitivity for female sexual behavior. In the present results, the intraventricular administration of 6-hydroxydopamin(6-OHDA) or the posterior deafferentation of hypothalamus(PDM) caused the reduction of night appearance of paradoxical sleep(PS). 20μg E_2 administration of ovariectomized (OVX) PDM or OVX-6OHDA treated rats showed the delay of E_2 induced elimination of night PS appearance. The propranolol but not phenoxybenzamine injection with E_2 for OVX rats abolished the E_2 effect. On the other hand, 2μg E_2 and 1mg progesteron(P) treatment 72 after E_2 did not show any changes in the most of OVX rats, but simultaneous adrenaline injection with E_2 showed the elimination of night PS appearance on the night of P treatment. From these results, it is suggested that the E_2 induced elimination of night PS appearance may correlate the β-adrenergic tracts and adrenaline also enhances E2 sensitivity and results the P induced night PS elimination.

442

MODIFICATION OF THE CORTICOSTERONE CIRCADIAN RHYTHM BY RESTRICTED FEEDING SCHEDULE

HONMA, K., WATANABE, K. AND HIROSHIGE, T. Dept. Physiol., Sch. Med., Univ. Hokkaido, Sapporo, 060

The modification of the circadian rhythm of plasma corticosterone (B) by restricted feeding schedule (RF) was examined in free-running or entrained state in the rat. Characteristic changes, namely attenuation of a circadian peak in plasma B level ('masking'), extraordinary secretion of B just before the time of daily food supply (feeding peak) and rapid decrease in plasma B level after food supply were already observed 4 days after the initiation of RF. Usually these modifications disappeared rapidly after the cessation of RF. However in some rats 'masking' and feeding peak continued to exist over 3 weeks afterwards. Participation of the brain cortex in the modification was excluded by the observation of unchanged B response to RF when a 25 % KCl solution was applied to the cortex through chronically implanted cannulae (cortical spreading depression). It is concluded that an oscillation induced by RF does not influence an operation of the circadian oscillator but modifies an overt B rhythm. The modification persists not only during RF but also even several weeks after the RF cessation. Probably the brain cortex does not participate in the genesis of the modification. (Supported in part by Grant-in-Aids, Nos. 544023 and 520901 from the Ministry of Education, Science and Culture of Japan)

443

EFFECTS OF MASTOPARAN (A WASP VENOM PEPTIDE) ON THE RELEASE OF CATECHOLAMINES AND ADENINE NUCLEOTIDES FROM CULTURED ADRENAL CHROMAFFIN CELLS.

KURODA,Y.,YOSHIOKA,M.*,KUMAKURA,K**,KOBAYASHI,K. AND NAKAJIMA,T*** Dept. of Neurochemistry, Tokyo Metropolitan Inst.for Neurosciences, Tokyo 183, *Fac. of Pharmaceutical Sciences, Univ. of Tokyo, Tokyo 113, **Life Science Inst.,Sophia Univ.,Tokyo 101,***Inst. of Medical Engineering, Tokyo Medical and Dental Univ., Tokyo 101.

Adrenal chromaffin cells were isolated from fresh bovine adrenal glands and cultured. The release of endogenous catecholamines(CA) and adenine nucleotides(AN) from the chromaffin cells was measured by high pressure liquid chromatography. Mastoparan (a mast cell degranulating peptides,10 μg/ml) increased the release of both CA and AN. In contrast, a similar histamine releasing peptide, granuliberin R, at the same concentration did not change significantly the release. The ratios of adrenaline/noradrenaline released spontaneously or by mastoparan (both 2.7) are remarkably similar to that in chromaffin granules, reported by Winkler (1978). The ratio of CA/AN in chromaffin granules isolated bovine adrenal glands (3.1) is also very similar to that in spontaneous release (3.0), suggesting that both compounds are released by exocytosis of the granules.

444

EFFECTS OF HORMONES ON THE NEUROTUBULIN CONTENT IN DEVELOPING RAT BRAINS.

TAKAHASHI,T., GOTO,K., KANEDA,T. AND MIYAMAE,S. 2nd Dept. of Physiol., Kanazawa Med. Univ., Uchinada-cho, Ishikawa.

In normal developing rat brains, the level of neurotubulin per unit DNA was increased in soluble fraction from cerebrum and hypothalamus and decreased in that from cerebellum during the first 10 days of birth.

Thyroid hormone(T_3) administration raised the neurotubulin level in cerebellum from 10-day-old rats, when T_3(50 ng/g body weight)was injected for 10 days. The treatment of corticosterone and growth hormone showed no effects on the neurotubulin level in 10-day-old rat brains.

When thyroidectomy was performed at the first day old, the neurotubulin level reduced in the three portions of brains from 30-day-old rats. But, in the case of thyroidectomy treated at 10 days old, the neurotubulin level did not changed.

In neonatal rat brains, the thyroid hormone seems to play an important role on the neurotubulin synthesis.

445

SECRETION OF ADRENALINE FROM THE PERFUSED RABBIT ADRENALS BY NITROPHENOL DERIVATIVES.
YAMAGAMI,K., NISHIMURA,S. AND SORIMACHI.M., Dept. of Physiol., Kagoshima Univ. Sch. Med., Kagoshima

Nitrophenol derivatives including 2,4-dinitrophenol(DNP, 0.1 mM) induced exocytotic secretion of adrenaline from the perfused adrenals. Secretion was dependent on the concentration of Ca and was saturated at 2 mM of Ca. When the glands were perfused with Ca-free medium and were stimulated with Ca introduction plus DNP, the response was blocked by pretreatment of the glands with DNP and monoiodoacetate(MIAA), but not by MIAA alone, indicating that the stimulating effect of DNP is energy-dependent, but is not related to its uncoupling activity. The latter was also shown by the fact that secretion was induced by trinitrophenol having no uncoupling activity. The response appears to depend on intracellular Na, since it was reduced in the absence of external Na, on one hand, and was potentiated in the presence of ouabain, on the other. The response was markedly potentiated in the presence of high K. This potentiation was confined to the stimulation by DNP, since the response to carbachol, histamine or high K(150 mM) was diminished under the same condition. The results suggest that DNP increases Ca influx therby inducing secretion, but the mode of action is different from other secretagogues so far known.

446

SECRETION OF CATECHOLAMINES FROM THE PERFUSED CAT ADRENAL GLANDS BY SUCROSE MEDIUM IN THE PRESENCE OF CALCIUM IONS.
SORIMACHI,M., NISHIMURA,S. AND YAMAGAMI,K. Dept. of Physiol., Kagoshima Univ.Sch.Med., Kagoshima

Na deprivation was previously shown to induce secretion of catecholamines(CA) from the glands perfused with Ca-free, Mg-free medium. When the glands were treated with Na-free(sucrose) medium containing EGTA, the response to Ca was reduced, the longer the period, the larger the inhibition, and the second response to Ca was abolished. The response was reversed when perfusion of Na-containing medium was interpolated. Ouabain treatment potentiated the response provided Mg was included in the medium. These results suggest that secretion is due to Ca entry in exchange for internal Na, the level of which is expected to be raised in the absence of divalent ions. On the other hand, sucrose medium containing 0.1 mM Ca induced exocytotic secretion of CA even when the glands were perfused with medium containing 2 mM Ca. The response was blocked by Ca channel blockers. However, the following findings are suggestive of involvement in the response of secretory mechanism other than reversed Na-Ca exchange; 1) other Na substitutes are ineffective in inducing secretion, 2) the different ratio of adrenaline to noradrenaline, 3) more sensitive to inhibition by tris, choline or Mg 4) persistence of the response during perfusion with sucrose medium.

447

PARTICIPATION OF PLASMA-BORNE ANGIOTENSIN IN DEHYDRATION-INDUCED WATER INTAKE AND VASOPRESSIN RELEASE.
YAMAGUCHI, K., SAKAGUCHI, T. AND KOBAYASI, S.
Dept. of Physiol., Niigata Univ. Sch. Med., Niigata

The possible existence of an intrinsic renin-angiotensin system (RAS) has been proposed in the brain tissue. The present study was undertaken to examine whether endogenous angiotensin - which has been suggested to participate in increased water intake and vasopressin release under dehydration by stimulating the central nervous system- is derived from the brain or from the circulating blood or from both. Water deprivation for 46 h in the rat markedly raised plasma angiotensin II (AII) concentration ($P<0.002$) from 61.6 $\pm$ 11.5 (mean $\pm$ SEM) pg/ml to 322.8 $\pm$ 49.5 pg/ml. However, neither the AII concentration of the ventricular perfusate nor that of the hypothalamus was affected. Both the perfusate and the tissue were extremely poor in AII (<35.5 pg/ml and <46.7 pg/g wet tissue, respectively). The AII content in the hypothalamus of the dehydrated rat remained unchanged even after bilateral nephrectomy which significantly decreased plasma AII concentration ($P<0.002$). These results may suggest that angiotensin formed in the circulating blood rather than in the brain is involved in the dehydration-induced water intake and vasopressin release, and that the activity of a possible intrinsic brain RAS is unaffected by that of the renal RAS.

448

EFFECT OF CATECHOLAMINE ON cAMP ACCUMULATION, cAMP-DEPENDENT PROTEIN KINASE AND α-AMYLASE RELEASE IN RAT PAROTID SLICES. YOSHIMURA, K., NEZU, E. AND CHIBA, A. Dept. of Physiol. Hokkaido Univ. School of Dentistry, Sapporo

The role of cAMP and cAMP-dependent protein kinase(PKase) in α-amylase(A) release by catecholamine(CA) was studied in rat parotid slices in vitro. Isoproterenol was much more potent in stimulating A release and cAMP accumulation than were norepinephrine(NE) and epinephrine. At low concentration, each of the agonists stimulates A release without detectable accumulation of cAMP. The effect of NE on cAMP was markedly increased by isobutyl-methylxanthine(IMX) and this effect was correlated well with the degree of inhibition of phosphodiesterase. The effect of low dose of NE on A release was potentiated by IMX, but that of high dose was not. The effect of 1 μM NE on A release was much higher than that of 0.2 μM NE plus IMX, while the reverse took place in cAMP accumulation. These results suggest that if cAMP is a mediator of A release, cAMP in cell is compartmentalized in at least two pools and small increase in much smaller compartment may be related to A release. Consistent with this idea, cAMP accumulation by NE was much more sensitive to inhibition by β-adrenergic blockers than was A release by NE. Conditions for homogenization of parotid tissue and assay of PKase were examined. Changes in PKase activity by NE correlated relatively well with the changes in A release by NE.

449

The characterization of rat growth hormone secretagogues. Suzuki, M., Ishikawa, K. and Kakegawa, T. Dept. of Physiol., Inst. of Endocrinol., Gunma Univ., Maebashi

To analyse thyroid hormone action on rGH secretion, the effects of 3 secretagogues were examined by a perifusion technique and microinjections into lateral ventricle (LV) and ventromedical hypothalamus (VMH). Clonidine, an agonist to α_2-adrenoceptors (2.25 and 11.25 μM) had no effect on GH secretion of anterior pituitaries from eu-, hypo- and hyperthyroid rats in the perifusion experiments, while the drug injection iv (15 μg /100 g body weight) induced a clear rise in plasma rGH. On the contrary, DB-cAMP (0.98 mM) could stimulate anterior pituitaries from normal rats to release GH, while the pituitaries from thyroidectomized (Tx) and T_4-supplemented (Tx-T_4) rats failed to respond to the stimulation. Also, prostaglandin E_1 (50 μM) stimulated GH release of the pituitaries from normal, Tx and Tx-T_4 rats. These results indicate that clonidine affect GH release entirely through the CNS, while the latter two secretagogues stimulated directly the pituitary. However clonidine failed to stimulate the GH release when administered into LV (3 μg) or VMH (1 μg) under urethane anaesthesia. This seems to be due to urethane which is one of potent stressors. Presumable clonidine could not overcome the urethane effect, for α-MT pretreated, conscious rats could respond to the drug stimulation.

450

MECHANISM OF HISTAMINE ACTION ON ALDOSTERONE SECRETION OF THE PERFUSED DOG ADRENAL GLAND. AIKAWA, T., HIROSE, T., MATSUMOTO, I. AND SUZUKI, T. Dept. of Physiol., Nagasaki Univ., Sch. Med., Nagasaki

The left adrenal gland of hypophysectomized-nephrectomized dog was perfused in situ with Krebs Ringer bicarbonate glucose solution (KRBG, saturated with 95% O_2 + 5% CO_2, K^+=3.6 mM). After perfusion with KRBG containing 0.033, 0.1, 1 and 10 μM histamine over 5 min, the secretory rate of aldosterone and cortisol significantly increased at 1 and 10 μM and that of corticosterone at 10 μM. The secretory response of these 3 steroids to 10 μM histamine was almost completely depressed by continuous infusion of 10 or 100 μM pyrilamine maleate, but not by that of 100 μM metiamide. On the other hand, after i.v. injection of Comp. 48/80 (75 μg/kg), blood histamine increased from 0.18 ± 0.02 μM(n=8, mean ± S.E.M.) to 0.74 ± 0.17 μM and the secretory rate of adrenal aldosterone also significantly increased in hypophysectomized-nephrectomized dogs. These results suggest that histamine acts via H_1 receptors on adrenal cortical cells and a direct effect of histamine on the adrenal cortex may play a pathophysiological role in stimulating aldosterone secretion.

451

EFFECT OF LONG PHOTOPERIOD ON THE TESTICULAR CONTENTS OF POLYAMINES IN THE JAPANESE QUAIL AND GOLDEN HAMSTER. S. MATSUZAKI, Dept. Physiol. Inst. Endocrinol. Gunma Univ., Maebashi

Changes in testicular concentrations of polyamines and nucleic acids were studied in both Japanese quail and golden hamsters. When immature animals were exposed to a long photoperiod (16 hr light and 8 hr darkness), the testicular weight and DNA increased greatly for the first few weeks. In the quail testis the concentrations of putrescine, spermidine and spermine increased 7-, 3- and 2-fold respectively within a week after exposure to the long photoperiod. The putrescine level remained elevated thereafter, while the spermidine level declined and returned to the initial level at 25 day. The change in RNA concentration was very similar to that of spermidine concentration. Repeated injections of ovine follicle stimulating hormone (oFSH) resulted in an increase in testicular weight and polyamines, but ovine luteinizing hormone was without effect. In the hamster testis, the putrescine level decreased while the spermine level increased gradually during postnatal development. The spermidine showed a biphasic change, which resembled the circulating level of FSH. These data suggest that pituitary FSH stimulates both testicular growth and biosynthesis of polyamines, especially spermidine.

452

EFFECT OF THYROTROPIN-RELEASING HORMONE ON RAT MYOMETRIUM.
TONOUE,T. Dept. of Pharmacology, Tokyo Women's Med. Coll. Tokyo.

The effect of TRH in vitro was observed on electormyograms and isometric tension changes in the uterine horn isolated from the rat. TRH induced a transient prolongation of duration of spike bursts in the electromyogram and an increased tension in contraction of diestrous uterine horns. No distinct response to TRH was elicited in preparations from rats other estrous stages. TRH produced a contraction associated with a burst of spike potentials in the quiescent horn from the estrogen-primed ovariectomized rat. Priming with progesterone was not a prerequisite for responsiveness to TRH but modified the response of the estrogen-primed uterus. In a medium with a high calcium concentration, diestrous uteri were quiescent but a transient contraction associated with a burst of spike potentials was induced by TRH. In a calcium-free medium, TRH failed to elicit any response in the diestrous uterus but acetylcholine induced a contraction without associated spike potentials. It appears that TRH stimulates calcium-influx into the uterine smooth muscle in which responsiveness is dependent on the estrogen-priming.

453

INFLUENCE OF ESTRADIOL ON SEX DIFFERENTIATION OF GONAD IN QUAIL EMBRYO.
YAMAMOTO, N. Dept. of Physiol., Sch. of Med., Gifu Univ., Gifu.

The effect of estrogen on the gonadal sex differentiation of the quail embryo administered with 0.02mg estradiol during early embryogenesis was studied. The sex linked marker gene, sw, was used for the determination of genetic sex of embryo. The gonad of the genetic female was accelerated remarkably in its ovarial differentiation. However, the testicular development of the genetic male was not only retarded but also modified into ovarial development. The epithelial tissue of the left female gonad was highly competent to precipitate hypertrophy, whereas that of the right gonad was rather incompetent to the administration. The medullary mesenchyme in the female gonad was competent to be accelerated in the lacunal formation. On the other hand, the left male gonad was modified into an ovarial structur which showed the secondary proliferation of cortical cord. But its primary sex cord showed degeneration to some extent; in some case, medullary lacunarization was observed. And the size of the left male gonad was increased to or over that of the control, while the size of the right male gonad was decreased. Such a change of relative size in the male gonad was similar to that seen in the female.

454

CATHECHOLAMINE'S EFFECT ON EARLY PHASE OF ESTROGEN INDUCTION OF FEMALE SEX BEHAVIOR.

YANASE,M. AND MURAKAMI,N. Dept. of Physiol., Yamaguchi Univ. Sch. of Med., Ube, Yamaguchi

Estradiol benzoate (EA) and progesterone (P) induction of female sex behavior was expressed by lordosis quotient (LQ), a percentile number of female's lordosis responses to male's 20 mounts. 50 μg of adrenaline (AD) or 1.5 mg of apomorphine (AP), a dopamine (DA) agonist increased LQ 2 days after EB followed by P, only when given during 4 h after the EB-treatment. These effects were blocked by 100 μg of propranolol, a β receptor blocker, or 0.1 mg of haloperidol, a DA antagonist. Therefore, cathecholamine systems in the brain may be involved in the regulation of brain EB sensitivity for the female sex behavior through their effects on the early phase of EB action.

455

EFFECT OF PORTAL INJECTION OF D-GLUCOSE ANOMERS ON EFFERENT PANCREATIC VAGUS DISCHARGE.

SAKAGUCHI, T., YAMAGUCHI, K. AND FUKUDA, A. Dept. of Physiol., Niigata Univ. Sch. Med., Niigata

The levels of efferent discharge of the pancreatic vagus nerve in the rat were significantly increased after portal injections of α-D-glucose, β-D-glucose and optically equilibrated D-glucose (OEDG) and the glucose solutions in order of potency were β-D-glucose, OEDG and α-D-glucose. The effect of the three glucose solutions was abolished after hepatic vagotomy. The injection of vehicle, isotonic solution caused no change in the discharge. Since D-glucose in blood has been known to exist as an equilibrium mixture of the two anomers (36% α-anomer and 64% β-anomer), the results suggest that a vagal system existing between the liver and the pancreas may be predominantly activated by β-D-glucose in the portal blood. Considering the result together with our previous finding that hepatic vagal stimulation affected plasma levels of insulin, it may be suggested that such a system participates in the regulation of insulin secretion.

456

CLUSTER ANALYSIS OF GLUCOSE TOLERANCE

NAGAI,T.,OHTAKE,K.,MORI,H. Dept. of Physiol.,Kobe Univ. Sch. Med.
KITAMURA,S. Fac. of Engineer.,Kobe Univ.

Periodically sampled blood glucose and insulin time series data through glucose tolerance test from 140 patients of Diabetes Mellitus and other metabolic diseases (including normal subjects) were processed by one compartment model of blood glucose regulation. Rate constants gotten from that model, and glucose and insulin level of 120 minutes were used for parameters that represent a status of each subject. By cluster analysis of these parameters 9 clusters were gotten and each one was enoughly able to represent a type of glucose tolerance.
This is a new method for classifying a glucose tolerance abnormality.

457

MECHANISM OF GLUCOCORTICOID ACTION ON PROSTAGLANDIN E (PGE) GENERATION BY HUMAN PERIPHERAL BLOOD MONONUCLEAR CELLS (PBMC). YAMAMOTO, M., OGAWA, K. AND MATSUI, N. 2nd Depart. Res. Inst. Environ. Med., Nagoya Univ., Nagoya

We have shown some evidence that PGE released from PBMC may be important in the pathogenesis of autoimmune thyroid disease, and that cortisol (F) suppresses PGE generation. The mechanism of the suppression of PGE is suggested through inhibition of phospholipase A_2, using mouse fibroblast, but little is known in PBMC. The effect of F in PBMC, therefore, is studied in this report.

PBMC was obtained from healthy male donors, and cultured for 3 days in 16% FCS-DME. PGE in the medium was assayed by RIA. Physiological concentration (10^{-8}-10^{-6}M) of F suppressed PGE generation. Phospholipase A_2 inhibitor para-Bromo Phenacyl Bromide (p-BPB) also suppressed PGE generation at the concentration of 10^{-6}-10^{-5}M. Suppression by 3×10^{-5}M p-BPB was partially overcome by exogenous arachidonic acid (ArA), but the suppression by 10^{-6}M F was not. 3×10^{-5}M p-BPB showed no effect on ^{3}H-thymidine uptake. ^{3}H-ArA incorporation by PBMC was enhanced following 20h pre-incubation with F, while the enhancement was not shown during 0-60 minute culture with F. F enhanced radioactivity accumulation during 24h culture with ^{3}H-ArA, whereas p-BPB reduced it. These data suggest that inhibitory effect of F on PGE generation does not simply result from phospholipase A_2 inhibition.

458

ACTION OF ANTIINFLAMMATION & PROMOTION OF WOUND HEALING WITH CORTISOL-CARNOSINE-SYSTEM

NAGAI K.,SEGAWA M., ISHIZUKA T.
SECTION OF PATHOPHYSIOLOGY,INSTITUT OF DENTAL RESEARCH,NIHON UNIVERSITY

Carnosine works in the direction of protein assimilation, whereas cortisol works towards protein dissimilation. It is maintained by the present author that carnosine-cortisol system is involved in the maintenance of homeostsis that is responsible for the physiologic function of connective tissues. In a difficult extraction of the mandibular third molars, it takes 200 to 250mg for inhibiting and, at the same time, promoting the extracted wound when carnosine is singly administered. But when carnosine -cortisol system is combined, an amount of 10mg carnosine and 10g has been confirmed to be sufficiently effective. Pharmacological effects of this carnosine-cortisol system are in their antiinflammatory and promotive actions of spontaneous healing. For this reason, unlike previous antiinflammatory and anti-granulation chemicals, the carnosine-cortisol system may be said to be a unique preparation that will prove to be most effective in the field of oral surgery.

459

RELATIONSHIP BETWEEN VOLUNTARY MUSCULAR EXERTION AND RESPIRATION BY MEANS OF RESPIROMETER.

MIYASHITA, M., MIURA, Y., FUNASE, K. AND SATO, Y.
Inst. of Health and Sport Sci., Univ. Tsukuba, Ibaraki

The respiratory phase and volume in the voluntary muscular exertion were examined by means of Benedict-Roth's Spirometer. The vertical motion of spiro's bell was recorded as electrical potential. Subjects were required to grip the hand-dynamometer voluntarily to the maximum, and as quickly as possible.

The results were as follows: 1), The respirogram's pattern was divided into 5 types in the voluntary exertion, and that of the quick motion was divided into 4 types. 2), The inspiratory phase was observed upon the onset of the voluntary exertion and its over-tidal volume ranged from 21 to 2279ml. The respiratory phase at the maximum grip strength was breath-holding in the inspiratory phase, and its over-tidal volume ranged from 477 to 2574ml. Although the respiratory phase of the quick motion was the inspiratory one as well as the voluntary exertion , there was no tendency about the inspiratory volume both at the onset and at the maximum strength of the quick motion.

460

VOLUNTARY SINGLE HUMAN MOTOR UNITS

KURATA, H. and OGAWA, Y., Lab. of Sports Med., Jikei Univ. Sch. Med., Chofu, Tokyo
MASUDA, M. and MORIMOTO, S., Dept. of Physiol., Jikei Univ. Sch. Med., Minatoku, Tokyo

Firing characteristics of voluntary human motor units (MUs) were studied before, during and after isotonic contractions. Action potentials of single human MUs were recorded by use of coil-shaped inserted electrodes in the medial vastus muscle. In the isotonic contractions at 10, 20, 50, more than 50°/s and maximal knee angular velocity loaded 2.0, 5.75 or 9.5kg of after loading weight at the ankle joint, the interspike intervals of single MUs were prolonged just after the onset of muscle shortening. The threshold forces of single MUs were decreased after repetitive isotonic contractions at 10 (x5s in every 10s) and 50°/s (xls in every 2s) knee angular velocity loaded 2.0 or 9.5kg of after loading for 5 - 10min. When the muscles were suddenly unloaded to be allowed movements beyond 1, 10 or 20cm or more at the ankle joint during sustained isometric contractions at various force levels, the interspike intervals were prolonged after the unloading for 500ms. During this period, the MUs tended to be fired at the decreasing phase of the oscillatory force. The threshold forces of single MUs were changed due to the unloading during successive sustained contractions at same force levels. It is suggested that the reflex control by the gamma system play an important role in this type of motor control.

461

MU RECRUITMENT PATTERN DURING ISOMETRIC CONTRACTION BY MEANS OF THE SURFACE MYOELECTRIC POWER SPECTRA

NAGATA, A., MURO, M.* & MORITANI, T.**, Dept. of Bio-dynamic, Tokyo Metropolitan Univ., Tokyo, *Tokyo College of Pharmacy, **Texas Univ., Arlington, USA.

The aim of this study was directed towerd the elucidation of MU recruitment characteristics based upon the changes in the myo-electric signals from different MUs during iso metric contractions at various fractions of MVC. Eight male subjects volunteered for this study performed isometric contractions at 20,40,60, and 100%MVC with their biceps brachii and rectus femoris muscle on a separate day. Myo-electric signals were picked up by two miniture electrodes over the motor point area of the muscles. The mean power frequency(MPF) was calculated based on the EMG power spectral density which was obtained through the generation of auto-correlation function of the myo-electric signals and the fast Fourier transformation(FFT). Reliability of this method was tested by correlating the MPF obtained at two separete occations and found to be highly acceptable ($r = 0.961$, $p < 0.0001$). Results indicated that there were significant changes in the MPF during isometric contractions at various levels of MVC, suggesting the existance of significant degree of MU recruitment shift. A typical set of data with respect to the spectra at different fractions of MVC is shown below in which increasing contributions of higher frequencies as a result of increased "phasic"MU activities seem apparent.

462

PHYSIOLOGICAL RESPONSES OF ATHLETES AND NONATHLETES DURING WALKING AND IMMERSION OF THEIR LEGS INTO HOT WATER BATH IN 30 °C.

TSUJITA, J., MAYUZUMI, M., TANAKA, N. AND HORI, S. Dept. of Physiol. Hyogo Coll. of Med., Nishinomiya.

Physiological responses during walking on an uphill treadmill and those during immersion of their legs in a hot water bath were observed on 20 young male athletes and 12 nonathletes. Experiments were performed in summer at around 3 p.m. in the room of 30 °C, 70 % R.H. and a wind velocity of 17 cm/sec. The subjects, dressed in shorts only, walked on a treadmill at a fixed speed of 90 m/min and an angle of 3 degrees for 30 min. On the other days, subjects dressed in shorts only immersed both legs into a stirring water bath of 42 °C for 60 min. The rise in core temperature, sweat volume and increase in heart rate for athletes during a treadmill walking were considerably less than those for nonathletes, while differences in physiological responses between two groups during immersion of legs into hot water bath were small. Heavier subjects showed tendency of great differences between rise of core temperature and sweat volume during a treadmill walking and those during immersion of legs into hot bath. These differences might be caused by smaller heat load per body weight for heavier subjects due to smaller ratio of skin surface area of legs to body weight.

463

URIC ACID METABOLISM AT EXERCISE IN HYPERURICEMIA (2nd report)

ITO,A., FUJITA,S., MIKAMI,T., YAMADA,T., KURIBAYASHI,T., SUMIDA,S. and IKAWA,S.* Institute of Health and Sport Science, Tsukuba University, Ibaraki-ken. *Clinical Laboratories of Medicine, Jikei University, Minatoku, Tokyo.

Hyperuricemia's serum uric acid(SUA) showed decrease after 30~40%$\dot{V}O_2$max. exercise (First report). This report was evaluated diurnal rhythm in SUA. The work load was 30~40%$\dot{V}O_2$max.ex.(added 20 min., A.M. and P.M.). And was evaluated in normal male students,the effects of 30~40%$\dot{V}O_2$max.ex. immediately after 100%$\dot{V}O_2$max.ex.. The results was as follows: 1) Hyperuricemia's SUA diurnal rhythm (keeped bed rest) showed lower values in the morning and higher values after the noon,but SUA levels in the afternoon of daily work and exercise day showed decrease. 2) The effect of light ex. immediately after exhaustive ex. showed lower levels compared with control. 3) Their serum CPK activities showed higher levels,but uric acid clearance was found higher. 4) Serum essential amino acid at light ex. showed decrease,but 3-methyl histisin showed increase.

464

URINARY ELECTOLYTE FLUCTUATION AT EXERCISE WITH MUXIMUM OXYGEN DEBT.

INOMOTO, T. AND *OGO, K. Dept. Morphol., Inst.Const. Med., Kumamoto Univ., Kumamoto, *Physiol. and Hygi., Fac. Educ. Kumamoto Univ., Kumamoto

Relationship between oxygen debt and changes of renal reabsorption or excretion of electrolyte and water were investigated observing fluctuation of urinary Na^+,K^+,Cl^-,Creatinine and voiume after 300-meter full speed running.

The muximum oxygen debt correlated with the running speed($r=0.679, P<0.01$). The volume of 30 minutes after exercise urine increased than that of rest time. This diuresis can't be due to increase of GFR,becouse the exeretion rate of creatinine was not found changed remarkably. At the same time,Na^+ excretion rate increased and its change was closely related with the maximum oxygen debt. It indicated that the tubular Na^+ reabsorption was depressed, and that the permeability of water was redused.At rest,K^+ is secreted conjugately with Na^+ reabsorption and competitively with H^+ion at distal tuble. After exercise, K^+ excretion in urine was decreased accompanied with Na^+-diuresis and acidosis by exercise. In ordinary,urinary Cl^- changed with same manner as Na^+, but after exercise, Cl^- excretion was decreased by increase of HCO_3^- of excretion, consequently Na^+-Cl^- balanse was losed largely.

465

Changes in Water Content in Plasma and Erythrocytes of Mice due to Prolonged Exercise

Goto, E., Kogawa, H., Sudo, K., Imai, H. and Kageyama, K.*
(Dept. of Health Science, Osaka Kyoiku Univ., Tennoji-ku, Osaka; *Med, Sch. Osaka City Univ.)

It is postulated that the water content in erythrocytes decreases along with the aging in circulating blood. In the present investigation the water content in plasma and packed cells of trained and nontrained mice was directly measured by Gas-Liquid Chromatography. The intracellular water content increased evidently following prolonged physical exercise, while the water content in plasma did not undergo any significant change. These results indicate that young erythrocytes, containing a large amount of water, emerge in the circulation during prolonged exercise.

466

HYPOXIA INDUCED CHANGE IN HEART RATE AND HEAT BALANCE: EFFECTS OF HYPOXIA ACCLIMATION

HAYASHI, M., SUGANO, Y. AND NAGASAKA, T. Dept. of Physiol., Kanazawa Univ., Kanazawa

Acute exposure to hypoxia (9.5% O_2) produced a tachycardia in hypoxia-acclimated rats (HX: 12% O_2 for 2 months) and a bradycardia in control rats (CT). The rats were exposed to hypoxia (9.5% O_2) after either parasympathetic blockade (PSB), beta-adrenergic blockade (BAB) or double blockade (DB). After PSB, acute hypoxia increased HR in both groups. The increase in HR was significantly higher and more persistent in HX rats, in which a great enhancement of the beta-adrenergic stimulation was suggested. After BAB, hypoxia produced a significant decrease in HR in both groups to the same extent. Excitation of the vagal nerves was suggested. After DB, hypoxia slightly increased HR in both groups. Hypoxia produced reduction of heat production and colonic temperature in CT rats without a significant change in HX rats. After BAB, hypoxia decreased heat production in HX rats.

467

EFFECTS OF PHYSICAL RESTRAINT AND PARTIAL BODY SUPPORTING ON HEAT BALANCE IN THE RAT

NUNOMURA, T., SHIBATA, H., HIRATA, K. and NAGASAKA, T. Dept. of Physiol., Kanazawa Univ., Kanazawa

Metabolic responses to chronic exposure to simulated weightlessness were measured in rats. Weightlessness was simulated either by confining the rat in a metal mesh restrainer or by suspending the animal in a harness. Metabolic rate was increased in the rat after suspension and physical restraint. The increase in metabolic rate was significantly higher in the suspended rats than in the restrained animals. The elevated metabolic rate gradually decreased through 28 days of continuous simulated weightlessness. However, metabolic rate was consistently higher than the control value in the suspended rats. Similar changes in the total heat loss were observed in the experimental animals. Wet weight of the adrenals was significantly higher in the rat continuously suspended for 28 days. Mass of the M. soleus was decreased only in the rat after chronic suspension. Mass of the M. gastrocnemius and M. tibialis anterior were not observed after chronic suspension and restraint. Food intake and body weight were greatly decreased in the rat after suspension. The increased metabolic rate could not be explained on the basis of energy intake or skeletal muscle mass; body suspension itself accounts for a significant increase in metabolic rate.

468

ADRENERGIC MECHANISM INVOLVED IN THERMAL SWEATING IN MAN.

OHARA,K., OKUDA,N.,SATO,H. AND ISOBE,Y. Dept. of Physiol., Nagoya City Univ. Med. School. Nagoya

Effects of locally applied sympathomimetic agents were studied in man upon sweat glands activities responding to the central sudomotor impulses which were elicited by heat exposures in a room of 38 -40 °C. Sweating was recorded continuously in forearm by VAISALA hygrometers using sweat capsules of i.d. 10 mm. Potentiation of subliminal central impulses (or facilitation of neuro-glandular transmission) were observed in skin areas of intradermal administration of 0.1 ml of adrenaline 10^{-6}-10^{-8}, noradrenaline 10^{-7}-10^{-8}, phenylephrine 10^{-6}-10^{-8} or isoproterenol 10^{-5}-10^{-6}. The potentiation effects were similar to those by intradermal methacholine 10^{-7}-10^{-8}, being observed by earlier appearance of enlarged synchronized sweating waves in the test areas as compared in the control area(0.9 % NaCl sol.) High local skin temperature caused enlargement of sweating waves responding to suprathreshold central impulses, while only slight facilitatory effects on impulse transmission. It was suggested for thermal sweating in man that minimal dose of adrenergic agonists, when previously exist locally, may exert facilitatory effects upon neuro-glandular transmission of the m subliminal central sudomotor impulses.

469

EFFECTS OF POPULATION DENSITY ON DEVELOPMENT OF CHICKEN PECTORAL MUSCLE
TAKAHASHI,F.,YAMANE,Y.,HATASE,O*.,MATSUI,H**.,TOKUDA,M**. AND KUROSAKI,T.** Div. of Food., Sanyo-Gakuen Jr.Coll.,Okayama, Dep.of Physiol.Kagawa Med.Sch.,Kagawa*; Dep.of Physiol. Okayama Uni.Med.Sch.Okayama**

Two chicken female groups were bred for 9w in open house at Okayama; in summer (Exp.1), early autumn (Exp.2), and autumn (Exp.3), 1980. The birds were divided into 2 groups; 1st group, 15 chickens per 3.3m^2(A) and 2nd group, 60 chickens per 3.3m^2(B), respectively. Their pectoral muscles were used for studying the post-mortem changes. 1) Average of body weight and food intake decreased as population density increased. 2) The pH changes of muscles were less in (B) than in (A). 3) In early post-mortem phase, the myofibrillar fragmentation of (B) was higher than that of (A), but in later phase, these values were opposite to it. 4) Ca^{2+}-activated myofibrillar ATPase and actomyosin ATPase activity were not so different, but myofibrillar ATPase activity of (B) at 0h post-mortem time in low ionic strength solution with 0.3mM EGTA was higher than that of (A) in Exp.1. 5) These differences were remarkable in summer system. These results suggest that the increase in population density inhibits the development of muscles and that certain physico-chemical changes in Z-line or Z-I junction of myofibril might occur during the post-mortem storage.

470

CHANGES IN PITUITARY-THYROID HORMONES AND CATECHOLAMINES IN MEN UNDER HELIOX HYPERBARIC ENVIRONMENTS.
TAMURA,Y., OKAZAKI,S., SUEDA,K., OGAWA,K., YAMAMOTO,M. AND MATSUI,N. 2nd Div., Res. Inst. Environ. Med., Nagoya Univ., Nagoya; NAKAYAMA,H. AND TAKEUCHI,H. Marine Sci. & Technol. Center, Yokosuka

Changes in serum thyroid hormones and urinary excretion of catecholamines (CA) were examined and compared with changes in body temp. during exposure to heliox hyperbaric environments at room temp. which makes subjects feel comfortable. Compressions (P_C) were performed by He, mixed with O_2 (0.4 atm) and N_2 (0.8 atm), up to 16-21 ATA (4 men, 11 days at 32°C), 26-31 ATA (3 men, 14 days at 32°C) and 31 ATA (4 men, 14 days at 31.5°C). Thyroid hormones did not change during 16 ATA at 32°C, while serum TSH and T_4 elevated during 21-31 ATA. At 31.5°C, TSH, T_4, T_3 and rT_3 significantly elevated during 31 ATA decompression (P_d) period. Urinary CA excretion did not change during 16-21 ATA, but increased during 26 ATA and reached the maximal value during 31 ATA. Adrenalin fraction of CA increased again at the end of Pd. Transient decrease in noradrenalin was observed on each P_C day, probably due to acute O_2 increase. Skin temp. decreased significantly during 21-31 ATA at 32°C and more remarkably at 31.5°C, while rectal temp. elevated during Pd following 21 ATA and during 26-31 ATA and Pd. Thus, heliox environments above 21 ATA at 31.5-32°C lowered skin temp. and elevated heat producing hormones, inducing increase in heat production.

471

CARDIAC OUTPUT RESPONSE IN MAN DURING HYPOBARIC EXPERIMENTS.
S. MORI, M. SAKAKIBARA, A. TAKABAYASHI, S. TAKAGI, G. MITARAI. Dept. of Aerospace Physiol., Res. Inst. Environ. Med., Nagoya Univ., Nagoya.

Effects of hypobaric hypoxia on cardiac output (CO) was studied by impedance cardiography in 6 non-atheletes (group A) and 12 volunteers from members of the Himalayan Mountaineering expedition (group B), during stepwise 0.5-1 hour exposure to simulated altitudes of 3,000 (14.4 %O_2), 4,500 (11.9 %O_2), and 6,000 m (9.6 %O_2) in a decompression chamber. A tendency to decrease in resting stroke volume was noticed in both groups during exposure. The resting CO tended to increase above 4,500 m in group B while it tended so at 6,000 m in group A. Moderate exercise with a bicycle ergometer (300 kpm, 3 min + 450 kpm, 3 min) which was given to 5 subjects of group B unaltered the CO at 3,000 m; acceleration of heart rate was fully compensated by a fall in stroke volume. But at higher altitudes, CO was increased markedly with the same work load. This CO increase at high altitudes was mainly due to elevation of heart rate until the heart rate reached a peak of 150-160/min. Two volunteers stayed at 4,500 m for taking a overnight sleep. One of them showed a lowered CO pattern similar to that for the control sleep at 0 m, but the other did not. Neither the baseline thoracic impedance nor the hematocrit value changed significantly during sleep in both subjects.

472

ANAEROBIC GLYCOLYSIS OF RABBIT AORTA MASUMURA, S., HASHIMOTO, M., HASHIMOTO, Y. and SATŌ, T. Dept. of Physiol., Shimane Medical Univ. Izumo 693, Shimane

In arterial wall, lactate accumulation is dominant under anaerobic conditions. (the Pasteur effect). Indeed, we found that when rabbit thoracic aorta was incubated in an organ bath at 37°C for 3 hr under anaerobic conditions (95 % N_2, 5 % CO_2), the lactate level remarkably increased above 10 times the level of this metabolite observed under aerobic conditions (95 % O_2, 5 % CO_2). In the process of lactate accumulation, the activities of phosphofructokinase (PFK) and lactate dehydrogenase (LDH) increased by 40 - 90 % of the enzymatic activities observed under aerobic contractions. Thus, it is probable that PFK and LDH play the leading role as regulator of glycolysis and site of operation of the Pasteur effect.

In a previous study, it was found that adrenaline stimulated lactate production and glycolytic enzymes in the contracting aorta under aerobic conditions. However, this catecholamine failed to stimulate the glycolytic activity when lactate in the aorta accumulates remarkably under anaerobic conditions. This finding suggests that lactate accumulation in rabbit aorta supress the activation of glycolytic enzyme in the contracting materials.

473

EFFECTS OF VARIOUS INTENSITY OF MAGNETIC FIELDS ON THE ALBINO RATS DURING AND AFTER HYPODYNAMIC EXPOSURE. SUDOH, M., NAKAYA, M., ABE, M. AND SAIKI, H. Space Med. Lab. Jikei University, Minato-ku, Tokyo

Hypokinetic albino rats of Wister King strain, induced by orthostatic suspension technique, were exposed for 3 weeks to geomagnetic field (Ca 640mG,GMF), low magnetic field (Ca 4mG,LMF) by active shielding and high magnetic field (Ca 200G,HMF) by ferrite magnet, respectively. And after their liberation to ambulatory life under GMF, the recovery process were observed for 7 weeks. Several physiological parameters, such as body weight, blood pressure, daily urinary excretion rate of K^+ and Ca^{2+}, resting metabolic rate, and urine volume, were determined through all periods, before and during hypodynamic exposure period, and recovery period after the liberation. The data of 3 different intensity magnetic field exposure groups were compared each others. The findings on each parameters were summarized as follows: 1. HMF have a tendency to increase the effects of hypodynamics exposure in such parameters, as urine volume and resting metabolic rate. 2. LMF have tendency to attenuate the effect of hypodynamics exposure in such parameters as urine volume and K^+, Ca^{2+} excretion rate. After liberation, the recovery to the control value is attained earlier at LMF than GMF and HMF. 3. Decreasing of resting metabolism was found in all the subjects of each group during the orthostatic hypokinetic exposure by suspension technique with special shelter.

474

ON THE DISTURBANCE OF THE SENSORY AND CIRCULATORY FUNCTIONS IN THE FINGER TIP OF THE WORKERS USING VIBRATING TOOLS. TAKASHIMA, S. SATO, S. FUNAHASHI, A. AND AZUMA, T. Dept. of Physiol., Sch. Med., Univ. Mie, Tsu

Functions of the periphral sensory and circulating systems in the finger tip of the workers using vibrating tools and healthy subjects were investigated by testing depth sense, two-point discrimination, pain sense, vibratory sense, and nail press test. In addition, motor function in the upper limb of the workers and healthy subjects was studied by examining pinch strength, hand grip strength, hold hand grip time and tapping test. These peripheral nervous functions were compared before and after hand immersion in cold water (5°C, 10 min.). The results showed that significant disturbance of all peripheral functions, except for hold hand grip time, were observed in vibrating tools workers. On the other hand, degree of symptoms due to vibratory work (asymptomatic, numbness and blanching) was significantly correrated with the lowing of the peripheral functions. These peripheral functions, especially the ciculatory function on the nail press test, were deteriorated markedly by the cold water immersion. These findings suggest that vibratory work seems to affect functions of the peripheral nerves at the finger tip.

475

OXYGEN UPTAKE IN SUBMANDIBULAR GLAND SLICES

SAKAMOTO, S*, KOMABAYASHI, T., ENDOH, S., KOFUNE, K., SEKIGUCHI, K., KAWAJIRI, Y. AND TSUBOI, M. * Dept. of Physiol., Showa Univ., Sch. of Med., Shinagawa, Tokyo Dept. of Physiol., Tokyo Coll. Pharm., Hachioji, Tokyo

Oxygen uptake in rat submandibular gland slices was measured by utilizing adrenaline, noradrenaline and pilocarpine. Oxygen uptake significantly increased by an addition of these agonists. The increase of oxygen uptake was not observed in Ca^{2+}-deficient slices (treated with 2 mM EGTA for one hour). The reversibility of oxygen uptake by these agonists was recognized by an addition of 5 mM Ca^{2+}. When K^+ was removed from the experimental medium, no considerable change was observed in oxygen uptake. On the other hand, when choline and Li^+ were substituted for Na^+ , the increase of oxygen uptake was significantly blocked.

These results suggest that oxygen uptake induced by these agonists is dependent on the presence of Ca^{2+} or Na^+.

476

OXYGEN UPTAKE AND AMYLASE OUTPUT IN RAT SUBMANDIBULAR GLAND SLICES TREATED WITH ISOPROTERENOL

TSUBOI, M., KOMABAYASHI, T., SAKAMOTO, S*, ENDOH, S. AND KOFUNE, K. Dept. of Physiol., Tokyo Coll. Pharma., Hachioji, Tokyo * Dept. of Physiol., Showa Univ., Sch. of Med., Shinagawa, Tokyo

The effect of noradrenaline, phenylephrine, isoproterenol and pilocarpine on oxygen uptake and amylase output was investigated in rat submandibular gland slices treated with isoproterenol. The change of submandibular gland weight was not observed by continuous injections(s.c.) of isoproterenol(2.5 mg/100g) for 3 days, but was apparently observed by the injections for 6 days. In the slices treated with isoproterenol for 6 days, oxygen uptake and amylase output due to noradrenaline and phenylephrine significantly decreased as compared with those in nontreated slices, but dose response was observed both in the treated and nontreated slices. On the other hand, oxygen uptake and amylase output due to isoproterenol and pilocarpine considerably decreased as compared with those in nontreated slices, and dose response was not observed.

These results suggest that the decrease of response was caused by the change of receptors in acinar cells.

477

SEASONAL CYCLES OF GLYCOGEN CONTENT AND SIZE OF PINEALOCYTES IN THE WILD MOUSE, PEROMYSCUS LEUCOPUS : A SEMIQUANTITATIVE HISTOCHEMICAL STUDY.

KACHI, T. Department of Anatomy, Asahikawa Medical College, Nishikagura, Asahikawa

A seasonal change of the pineal body was examined using 39 wild mice, PEROMYSCUS LEUCOPUS, captured in the wood in Madison, Wisconsin, U.S.A., from 1976 to 1977. Histological sections of pineal bodies were stained with PAS and hematoxylin. The glycogen content of pinealocytes was estimated by the hitting point counting method -- glycogen score --, and the cell size by the nuclear density. Seasonal changes were statistically significant in both the glycogen score ($p<0.005$) and the nuclear density ($p<0.001$). The glycogen scores at 9 AM were 78.7±17.3 (M±SD) in winter (Dec., Feb.), 30.6±15.2 in spring (Apr., May), 47.7±28.8 in summer (Jul.) and 18.6±14.3 in fall (Sept., Oct.). The nuclear densities were 54.7±3.2, 43.8±6.9, 36.3±5.3 and 46.5±8.8 respectively, indicating that pinealocytes were largest in size in summer and smallest in winter. In fall, the glycogen score showed a trend of diurnal change, with values at 6 PM being higher than those at 9 AM, but in winter it did not. However, the nuclear density showed a circadian change ($p<0.02$) in winter, being smallest in value at 1 PM and greatest at 9 PM. It is concluded that the pineal body of the wild mouse shows a marked seasonal cycle in the glycogen content and the cell size of pinealocytes.

(Supported in part by grant from the Ministry of Education, Science and Culture.)

478

EFFECTS OF PRECHIASMATIC ANTERIOR HYPOTHALAMIC KNIFE-CUT ON THE CIRCADIAN RHYTHMS OF FEEDING, DRINKING AND LOCOMOTOR ACTIVITY IN THE RAT. KUBO, K., YAMASAKI, M. AND SASAKI, T. Dept. of Physiol., Inst. of Constitutional Med., Kumamoto Univ., Kumamoto.

The effects of prechiasmatic anterior hypothalamic knife-cut with a half-dorm shaped knife on the circadian behavioral rhythms were studied in female rats being fed with a powder diet and housed under LD 12:12 schedule in a metabolic cage with a running wheel. An automatic digital recorder with photosensors and a microcomputer was used for the simultaneous recording of feeding, drinking and locomotor activities. Duration of feeding and drinking behaviors and number of wheel revolutions were determined. The knife-cut resulted in a loss of the typical light-dark pattern of behavioral rhythms, while it did not affect the amount of daily food intake. During the light phase, the rats with the knife-cut consumed more than 30% of the total daily food intake, and showed a variable degree of increases in feeding, drinking and locomotor activities. Two rats, in which the septal region and fornical pathways were largely destructed, showed a free-running pattern of behavioral rhythms. In some cases, a deviation of the pattern and phase of feeding rhythm from the rest of the behavioral rhythms was noticed. These findings suggest that the neural connections between the hypothalamus and the forebrain structures are involved in the maintenance and integration of circadian behavioral rhythms in the rat.

479

TOLERANCE TO HEAT AND COLD FOLLOWING A MOVE FROM SUBTROPICAL CLIMATE (OKINAWA) TO TEMPERATE CLIMATE (KUMAMOTO). Sasaki,T., Tsuzuki,S. and Koga,R. Dept. of Physiol., Inst. of Constitutional Med., Kumamoto Univ., Kumamoto.

Progress of acclimatization was studied by observing tolerance to heat and cold after moving from Okinawa to Kumamoto. Fifteen male subjects who were born and raised in Okinawa and who stays in Kumamoto for 2-20 years, along with 6 male students as control who were born and raised in Kumamoto.

Tolerance to cold was studied by exposing thinly clothed subjects to an environment of 10°C for one hour, and by observing the increase in heat production (ΔM) and the fall in mean skin temperature (ΔT). The cold tolerance was evaluated by an index, $\Delta M/\Delta T$, a lower value of which stands for higher tolerance. The cold tolerance for the first winter was high, but after that no difference was made between the two groups.

Tolerance to heat was studied by immersing both legs in a water bath of 42°C for one hour and observing sweating functions. No difference in the density of active sweat glands per unit surface area was detected between the two groups, but the loss of water and electrolytes was considerably small in subjects from Okinawa. The tendency was found to be maintained for more than five years.

480

ENDOCRINE FUNCTION OF PANCREAS IN TEMPERATURE ACCLIMATION

DOI, K., OHNO, T* AND KUROSHIMA, A. Dept. of Physiol., Asahikawa Med. Coll. Nishikagura Asahikawa, and*Div. of Nutr.,Physiol., Hokkaido Educational Coll., Asahikawa

Role of endocrine function of pancreas in temperature acclimation was investigated in rats. Plasma glucagon level increased and plasma insulin level decreased in cold-acclimated rats (CA). On the other hand, opposite results were obtained in heat-acclimated rats (HA). In pancreas there were observed no changes in glucagon and insulin in CA, while decrease in glucagon and increase in insulin in HA. Insulin/Glucagon molar ratio (I/G) in plasma declined in CA and rose in HA. Acute cold exposure elevated plasma glucagon, but did not affect plasma insulin. Pancreatic glucagon and insulin were not influenced by acute cold exposure. Plasma I/G decreased, while pancreatic I/G was not modified. Plasma I/G was inversely correlated with both blood free fatty acid and glucose levels.

It is well established that relative concentrations of these two pancreatic hormones, that is, I/G, play a major role in determining direction of metabolism. The present results, taken in toto, suggest that endocrine pancreas is closely associated with metabolic acclimation to cold as well as heat through regulating metabolic direction to catabolic phase in cold acclimation and anabolic phase in heat acclimation.

481

DEVELOPMENT OF THERMAL SALIVATION IN YOUNG RATS. FUJIYA FURUYAMA & KOKICHI OHARA. Dept. Physiol., Nagoya City Univ. Med. Sch., Nagoya 467.

Rats(0,]5, 30, 60, 90,]80, 360days) were exposed to 42.5°C. Survival time, body water loss, saliva spreading, and wet weight of submandibular gland were measured. Strain difference in development of heat tolerance was observed. Heat tolerance of the heat tolerant rat strain(HTR) developed just after weaning and continued for many months. HTR was more heat tolerant than Sprague-Dawley(SD) which included many heat tolerant individuals. Newborn rats(0 days) tolerated heat slightly longer than sucking babies(]5 days). Body water of heat nontolerant rats(30-90 days) was lost more than of babies and older rats(]80-360 days) during heat exposure. HTR and SD lost their body water more than heat nontolerant strains. Saliva spreading was graded by the modification of method of Maling et al. Saliva spreading developed after weaning and was more active than older rats(]80 days). In HTR and SD it showed high activity through all the ages. Wet weight of submandibular gland/]00 of body weight decreased according to age, in spite of highly activity of thermal salivation. These findings suggested that development of heat tolerance depend on the development of salivation system after weaning, because response to heat stimulation was observed in]5 days old rats even in heat nontolerant strain. The other factor affecting thermoregulation in heat can not be excluded, because of strain difference between HTR and SD. These factors are controlled genetically.

482

CHARACTERISTICS OF β-ADRENERGIC RECEPTOR IN BROWN ADIPOCYTES OF TEMPERATURE-ACCLIMATED RATS

KURAHASHI, M. AND KUROSHIMA, A. Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa

Characteristics of β-adrenergic receptor in brown adipocytes of temperature-acclimated rats were investigated by the use of adrenergic β-antagonist (-)-[^{3}H]dihydroalprenolol (DHA). Both acute cold exposure and cold acclimation significantly decreased number of DHA binding sites. Heat acclimation significantly decreased number of DHA binding sites, while acute heat exposure did not affect it. In these experiments, equilibrium dissociation constant of DHA was not influenced. These results indicate that β-adrenergic receptor of brown adipocytes responses to thermal stimuli with changes in number of binding sites, but not in affinity. Changes in β-adrenergic receptors of cold-acclimated as well as cold-exposed brown adipocytes could not explain enhanced thermogenic response of brown fat to norepinephrine in cold acclimation, but such changes would appear to be adaptive to increased secretion of norepinephrine through down regulation. Decreased number of β-adrenergic receptor, probably caused by hypothyroidism due to heat acclimation, could explain depressed thermogenic response of brown fat to norepinephrine in heat acclimation.

483

ZYMOGRAPHICAL STUDIES OF LPL INCREASING IN BROWN ADIPOSE TISSUE OF MOUSE UNDER COLD-EXPOSURE

KOBAYASHI, K., KUSUMI, H.* AND MATSUSHITA, H. Dept. of Physiol. and Kidney Center*, Wakayama Med. College, Kyuban-cho, Wakayama

Two types of LPL were found in lipase zymograms. One was named F-LPL which did'nt bind with any substances and the other was named S-LPL which was binding form of LPL with heparin or heparin-like substances of cell membrane. F-LPL existed fundamentally in several organs e.g. BAT, heart and white adipose tissue. S-LPL was observed to increase in BAT after cold-exposure and easily released from BAT to circulation by heparin injection, and such LPL releasing into circulation as 'post-heparin lipolytic activity (PHLA)' was also observed as S-LPL in zymogram. S-LPL could be easily shifted to F-LPL in vitro by addition of protamine, and F-LPL also be shifted to S-LPL by heparin.

It is conceivable that the increased LPL in BAT of mouse under cold-exposure may be located on the surface of cell membrane binding with heparin-like glycosaminoglycan, and may be coincident with so-called 'heparin releasable LPL'. Therefore, S-LPL can be easily released into circulation as PHLA after heparin injection in consequence of competition between injected heparin and LPL-binding site of cell membrane.

The increase of S-LPL was not showed in BAT of obob mouse which had a poor resistibility for cold stress.

484

COMPUTER ANALYSIS FOR COLD VASOMOTOR FLUCTUATIONS.
UEDA,G., TAKEOKA,M. AND KOSHIHARA,Y. Inst. of Adapt. Med., Shinshu Univ. School of Medicine, Matsumoto, Nagano

Vasomotor fluctuations take place in the rabbit's earlobe when the tip is immersed in -4 to -7°C liquid. The computers used in the analysis of waves were DEC PDP 11/60 and HITAC 8800/8700 and L340. The programs were written in Fortran language and each contained 100 to 200 steps. In the first place auto-correlation coefficients were obtained and the results were compared with visual impressions for the pattern of fluctuation, in which as wave characteristics the height X and the period Y were noticed. Secondly, the coefficients of variation (CV) for X and Y, were calculated successively for each pattern. One pattern generally consisted of about 10 waves. The meaning of CV was enlarged by using grand means and standard errors. The inverse of CV was regarded as measures of regularity. Thirdly, the contracted parameter W was obtained by principal component analysis. The time course of W was also obtained. In addition, the physiological meaning and relation of CVX and CVY in the left and right sides were considered by variance analysis. All the methods were performed either by the remote-batch or the real-time processing.

485

This study was done to examine the physiological loads by exercises under a hot and cold environmental temperatures.

Five normal males were subjected to run (60% of $\dot{V}O_2$ max) on the treadmill for 30 min. in a cold(6±0.9°C), a mild(18.6±1.3°C) and a hot(32.9±1.1°C) environments, respectively.

Mean heart rate during run was 156.4±10.8 beats per min. under a hot environment, but was 140.9±8.8 in a cold and 140.9±13.9 beats per min. in a mild environment. There were no significant differences in the oxygen intake during run in these three environments. Diastolic pressure after run in a cold and mild environments remained normal but was found very decreased (74.0-29.2 mmHg) in a hot environment. Plasma angiotensinⅡ, aldosteron, WBC counts and blood glucose level increased conspicuously in a hot environment and at the same time urine volume, sodium output in urine and glomerular filtration rate were found decreased significantly.

486

EFFECT OF ALCOHOL AND ITS METABOLITIES ON THE HATCHING PROCESS OF CHICKEN EGGS
SEKI,S. KAWAMOTO,K. NANBA,H. YUYAMA,N. ASABA,H.AND WATANABE,N. Dept. of Oral Physi., Kanagawa Dent. Coll., Yokosuka

Alcohol orally taken is metabolized first to acetaldehyde and then to acetic acid. To study the toxicity of these three agents, They were injected into eggs during incubation.

The course of chicken egg development was divided on the basis of observations covering 21 days, into three stages-early, middle, and terminal. Lethal eggs occurred mainly in the early stage. The toxicity was the highest for acetaldehyde, followed by ethanol and acetic acid in decreasing order. Chickens with some deformities were found among those hatched from eggs so treated. Hypoplasia of the eye was noted in some of the ethanol-treated chickens.

A strong resemblance was shown between the deformities in the chickens during the early stage of development and the fetal alcohol syndrome in man at the third month of gestation.

487

AMINO ACID REQUIREMENT IN ADULT MEN. KISHI, K., KOMATSU, T. AND INOUE, G.
Dept. Nutr., Sch. of Med., Univ. of Tokushima.

Rose reported low value of 3.5 gN/day for amino acid requirement of adult men with excess energy intake of 55 kcal/kg. In the present study, we determined amino acid N requirement for N equilibrium at maintenance energy intake of 45 kcal/kg and compared with egg protein N requirement. Total 15 young men were given amino acid mixture of egg pattern as N source for two weeks and the same amount of egg protein N for one week successively. Intake N levels were 75, 100 and 130 mg/kg. N balance was improved by changing amino acid diet to egg protein diet at 100 and 130 mg/kg of N intake. Fecal N output was lower but total urinary N, urea, amino N and especially ammonia excretions were higher on amino acid diet than on egg protein diet. Following regression equations were obtained between N balance (Y: mg/kg) and N intake (X: mg/kg); amino acid diet, $Y = 0.347X - 44.3$ ($n=13$, $r= +0.72$) and egg protein diet, $Y = 0.252X - 21.6$ ($n=15$, $r= +0.58$). From these equations, N requirement for zero N balance were estimated as 127.6 and 85.7 mg/kg on amino acid N and egg protein N, respectively. It was concluded that the utilization of egg protein was better than that of corresponding amino acid mixture.

488

EFFECT OF HEIGHT RATIO ON THE BASAL METABOLIC RATE.
HIGUTI, K. AND INOUE, M. DIV. OF FOOD AND NUTRITION, NAKAMURA GAKUEN COLL., FUKUOKA

The BMR in forty-nine college normal female subjects was measured with a electrometabolor(type 600, Fukuda). It was found that the BMR was closely related to height ratio which is defined as height in centimeters divided by body weight in kilograms. There was close relationship between the BMR in kcal per day and height ratio(correlation coefficient $r=-0.70$, the standard error of estimate from the regression line $S_{yx}=66.3$ kcal per day). Correlation coefficient between the BMR in kcal per kg per day and height ratio was $r=0.75$, $S_{yx}=1.0$ kcal/kg/day. Moreover, we examined data on metabolic rate of seventy-seven adult males reported by Takahira in 1925 and found that there is close relationship between the BMR in kcal per day and height ratio($r=-0.79$). A close resemblance between the effect of age on the BMR and the effect of age on height ratio was noticed. We proposed a formula height ratio(h/w), which provides the most simple statistical fit of basal metabolic rate to height and weight.

489

DIGITAL VASCULAR HUNTING REACTIONS TO LOCAL COLD IN AIR.

WATANUKI, M., IHZUKA, H., HORI, S. AND KADOWAKI, I.* Dept. of Physiol. Hyogo Coll. of Med. Nishinomiya, *Dept. of Hygiene, Kyoto Pref. Univ. of Med. Kyoto.

Digital vascular hunting reactions to local cold in air were compared with those observed in ice water. Experiments were performed on 40 male university students in winter at around 3 p.m. in the room of 25 °C and 70 % R.H. The left hand was inserted palm downwards and finger extended slightly up to the wrist into the cold chamber of -10 °C and a wind velocity of 20 cm/sec for 30 min. On the other days, the left finger was dipped in stirred ice water up to its base for 30 min. In both series of experiments, the skin temperatures of the back of the distal phalanx were recorded with copper and constantan thermo-couples. In both series of experiments, the temperature of first rise after cold exposure and mean skin temperature during cold exposure tended to be higher and time of temperature rise during cold exposure tended to be shorter as the skin temperature of finger before cold exposure rised. These results indicate the finger temperature before cold exposure was dominant factor in determining sensitivity of appearance of cold induced vascular dilation. Values of temperature rise and mean skin temperature during cold exposure in air correlated positively with corresponding values in ice water. The individual differences in reactivity of blood vessels observed in ice water were much greater than those in ice water.

490

DIFFERENCES OF THERMOREGULATION BETWEEN INFANTS AND ADULTS

ARAKI,T*., TSUJITA,J**., TOHORI,M**. AND HORI,S**. *Dept. of Hygiene, Kobe Univ. School of Med. **Dept. of Physiol. Hyogo College of Med.

The differences in physiological responses between infant school children and young male students during heat and cold exposure. The experiments were carried out in the controlled climatic chamber. As an heat exposure, an air temperature was changed from 20 °C to 40 °C taking 20 min., and after then fixed 40 °C during 20 min., while as a cold exposure, that was changed from 28 °C to 15 °C taking 13 min., and after then fixed 15 °C during 32 min. The relative humidity was controlled at 50 % in the both experiments. Rectal temperature, skin temperature at 8 sites and heart rate were recorded continuously in the both experiments. The onset of sweat at 5 sites was measured at heat exposure. In adults, metabolic rate was measured at two times, before and after exposure, in tne both experiments. The skin temperature increased during the heat exposure and decreased during the cold exposure remarkably in the children more than it was in the adults.

491

METABOLIC MAPPING OF THE BRAIN STEM DURING LOCAL THERMAL STIMULATION OF HYPOTHALAMUS IN UNANESTHETIZED RATS.

MORIMOTO,A., SAKATA,Y., TAKASE,Y. and MURAKAMI,N. Dept. of Physiol., Yamaguchi Univ. School of Med., Kogushi, Ube

The [^{14}C] deoxyglucose method developed by Sokoloff provides a means to measure the rate of glucose utilization simultaneously in all the macroscopic structures of the brains. Because functional activity and energy metabolism appear to be closely correlated in the nervous system, local alterlations in glucose utilitation accompany and reflect local changes in functional activities in the brain. In the present study we utilized this method to ascertain what changes occur in the metabolic rates of different regions of the brain stem during thermoregulatory response induced by a local cooling or warming of hypothalamus in unanesthetized rats. Hypothalamic warming increased a local metabolism in ventral thalamus and decreased in habenula, while cooling increased in dorsomedial thalamus and habenula. Metabolism in hypothalamus altered not so much during thermal stimulation, but in ventromedial hypothalamus local cooling slightly increased metabolism.

492

EFFECT OF LOCAL COOLING OF VARIOUS REGIONS OF THE BODY ON SWEAT RATE. ASAYAMA, M., SUGENOYA, J., MIYAGAWA, T. AND OFAWA, T. Dept. of Physiol., Aichi Med. Univ., Nagakute Aichi.

The relative sensitivity of different portions of the body surface to cold stimuli was investigated by measuring the magnitude of sweat response. Five male subjects were exposed to an ambient temperature between 38 and 40°C for 2 to 3 hr. Rectal, tympanic and skin temperatures and the sweat rate at an unstimulted area were continuously measured. A cold stimulus was applied to an area ranging 100 to 200 sq cm with a cooled thermode. A total of 20 areas of different regions was tested. The skin temperature at the cooled area was decreased from the control level of 35°C to 20-25°C by the end of the stimulation period. The change in sweat rate was corrected for differences in size of the stimulated area and those in change of the skin temperature and was compared with that in response to cooling the chest area. The forehead showed a much greater sensitivity than the other areas including other facial areas such as cheek and chin. The present results indicate that thermal sensitivity may differ at various skin areas not only in different body regions but also within a certain region, and this should be taken into account for calculation of the mean skin temperature of physiological significance.

493

FURTHER OBSERVATIONS ON THE SPECIES DIFFERENCE OF NICOTINE SENSITIVITY OF SUDOMOTOR NERVE TERMINAL IN THE DIGITAL PADS OF PRIMATES.
AOKI, T. AND IZUMI, H. Dept. of Physiol., Tohoku Univ. Sch. of Dent., Sendai

The sensitivity of peripheral sudomotor nerve to nicotine was investigated in the digital pads of 6 species of primate. In chimpanzee and grand galago typical axon reflex sweating was produced by local injection of nicotine, indicating the high sensitivity of sweat nerves to nicotine. In contrast, crab-eating, pig-tailed, red-faced and bonnet monkey, all of which are macaque, failed to respond to nicotine. Cholinesterase (ChE) in sudomotor nerves was examined histochemically. In harmony with previous report, the nerves insensitive to nicotine as in these macaques contained both AChE and BuChE, whereas the nerves in chimpanzee and galago, which were sensitive to nicotine, showed only AChE reaction, suggesting that BuChE might play some role in blocking nicotine reception. The effect of inhibition of BuChE in sweat nerves, which could be achieved by intravenous or local injection of iso-OMPA, a selective BuChE inhibitor, was tested in some macaques. No discernible effect was observed on the nicotine sensitivity. Thus it seems unlikely that BuChE is directly associated with the interference of nicotine reception mechanism. It may be that nicotine receptor site is surrounded by a diffusion barrier, in which BuChE is casually localized. The lack of nicotine receptor in nerve terminals also cannot be excluded. Definite elucidation must await further studies.

494

BODY HEAT BALANCE DURING HIDROMEIOSIS. OGAWA, T., ASAYAMA, M., MIYAGAWA, T. AND SUGENOYA, J. Dept. of Physiol., Aichi Med. Univ., Nagakute, Aichi.

Hidromeiosis occurs in association with wetting the skin. Heat-acclimatized men can be near thermal equilibrium in spite of progressive reduction of sweating. In the present study, three male subjects were exposed to hot, humid environments of various degrees for 2 and a half hours in each season of autumn and winter, and body heat balance was examined in the course of hidromeiosis. Whole body sweat rate (the rate of weight loss) and the rate of sweat dripping were measured and evaporation rate was calculated. Rectal and skin temperatures were measured continuously and metabolic rate every 30 min. Hidromeiosis was revealed in association with substantial dripping of sweat. Evaporation rate was hardly affected by hidromeiosis which caused only the reduction of dripping rate. Rectal temperature was either retained constant or only slowly elevated during hidromeiosis except in extremely hot and/or humid conditions. The change in metabolic rate was mild and inconsistent. Seasonal differences in body heat balance during heat exposure were conspicuous only at a high humidity, although evaporative heat loss was alike in the two seasons. Since hidromeiosis does not affect body heat balance, it appears to be a reasonable phenomenon in a sense of preservation of body fluid, but this concept contradicts with phenomena associated with heat acclimatization such as increased sweat rate and decreased hidromeiosis.

495

BLOOD FLOW IN SKIN AND MUSCLE, EVALUATED BY SIMULTANEOUS THERMAL MEASUREMENT WITH TISSUE TEMPERATURE AND HEAT FLOW, AND ^{133}Xe CLEARANCE.

TAMURA, T.*, KUSANO, H.*, TOGAWA, T.*, MORI, Y.** AND KAWAKAMI, K.**. *Inst. for Med. & Dent. Eng., Tokyo Med. & Dent. Univ., ** Dept. of Radiol., Sch. of Med., Jikei Univ.

The regional blood flow in the calf was determined simultaneously by thermal measurement and by the ^{133}Xe clearance tachnique. Calf blood flow (Ft) by thermal measurement was accounted for by the equation of the form $Ft=(Cd\dot{T}d + H - Mo)/\rho c(Ta - Td)$, where Cd is thermal capacitance of calf compartment, $\dot{T}d$ is the change of calf tissue temperature, Ta is arterial blood temperature, Td is calf tissue temperature, Mo is estimated metabolism of the calf tissue and ρc is the product of density and specific heat of blood. Ten healthy men were chosen for the experiments. Total calf blood flow was measured by thermal measurement, and calf skin and muscle blood flow were measured by ^{133}Xe clearance method. Obtained total calf blood flow was 1.10-5.17 ml/(100ml calf·min), muscle blood flow was 0.92-7.27 ml/(100ml muscle·min) and skin blood flow was 1.79-15.87 ml/(100ml skin·min). On the basis of the results, an estimate has been made of the proportions of the calf volume which can be ascribed to skin and muscle respectively. Estimated muscle and skin blood flows were correlated with total calf blood flow by thermal measurement.

496

INFLUENCE OF MEDIOBASAL HYPOTHALAMUS STIMULATION ON PREOPTIC-ANTERIOR HYPOTHALAMIC THERMOSENSITIVE NEURONS.

HORI, T., KIYOHARA, T., OHSAKA, T., SHIBATA, M., NAKASHIMA, T. Dept. Physiol., Saga Medical College, Saga 840-01.

Single-unit responses of preoptic-anterior hypothalamic thermosensitive neurons to electrical stimulation of the mediobasal hypothalamus (MBH: ventromedial and arcuate nuclei) were studied in urethane-anesthetized male rats. Out of 188 units studied, 69 units responded to a rise in hypothalamic temperature with an increased rate of firing (warm-units) and 28 units responded with a decreased rate of firing (cold-units). The remaining 91 units did not respond to temperature changes (insensitive units). Thirty-nine per cent of these neurons (46.4% of warm-units, 50.0% of cold-units and 29.8% of insensitive units) were markedly inhibited by MBH stimulation with latencies up to 51.2 msec. Orthodromic excitation of spontaneous activity was observed in 17.6% of the units (13.0% of warm-units, 14.3% of cold-units and 22.0% of insensitive units). Response latencies ranged between 1.0 and 41.3 msec. The high incidence of orthodromic responses in the preoptic-anterior hypothalamic thermosensitive neurons to MBH stimulation suggests that rostrally directed axons either originate in or pass through the MBH. A small proportion of neurons (5.3%) were antidromically activated by MBH stimulation and the estimated conduction velocity of these neurons ranged from 0.10 to 0.67 m/sec.

497

RESPONSE OF NEURONS IN THE FEEDING CENTER AND THE SATIETY CENTER TO PREOPTIC THERMAL STIMULATION IN RATS.

YAMAMOTO, K., NAKAYAMA, T., ISHIKAWA, Y. AND IMAI, K. Dept. of Physiol., Osaka Univ. Sch. Med., Kita-ku Osaka, 530

The effects of preoptic thermal stimulation were observed on neurons in the lateral hypothalamic area (LH) and the ventromedial hypothalamus (VMH) in rats. In LH, 12 neurons out of 22 inhibited by iontophoretically applied glucose were facilitated by preoptic cooling, 4 were facilitated by warming and 6 were not influenced. In VMH, 16 neurons out of 22 facilitated by glucose were facilitated by warming, 4 were facilitated by cooling and 2 were not influenced. In contrast, most of the LH and VMH neurons which did not respond to glucose were not influenced by preoptic thermal stimulation. Thus, neurons inhibited by glucose in the feeding center are facilitated by a fall in preoptic temperature and neurons facilitated by glucose in the satiety center are facilitated by a rise in preoptic temperature.

These results indicate that changes in brain temperature are detected by the thermosensitive neurons in the preoptic area and then the temperature information seems to be conveyed to LH and VMH, especially to those neurons responsive to glucose. This means that thermal signal influences feeding mechanism within the hypothalamus.

498

ACTIVITY OF HYPOTHALAMIC THERMOSENSITIVE NEURONS AND THERMOREGULATORY BEHAVIOR DURING CORTICAL SPREADING DEPRESSION IN THE RAT. SHIBATA, M., HORI, T., KIYOHARA, T. AND NAKASHIMA, T. Dept. of Physiol., Saga Med. Col., Nabeshima, Saga 840-01, Japan.

The effect of cortical spreading depression (CSD) on single-unit activity of the thermosensitive neurons in the preoptic and anterior hypothalamus (PO/AH) was examined in urethane-anesthetized rats. The firing rate of 22 of 25 warm-units tested started to decrease when ipsilateral single CSD, elicited in the occipital cortex, entered the frontal cortex. By contrast, all 13 cold-units examined began to increase their firing rate when CSD invaded the frontal cortex. Critical areas of the frontal cortex were determined by observing the time courses of corresponding responses of units to CSD induced in different parts of the cortex. Area 8 and a part of area 13 of Krieg were most critical for both warm-units (n=7) and cold-units (n=2). Finally, the effect of unilateral CSD on skin-cooling behavior was studied in rats with an unilateral lesion in the PO/AH. A single CSD contralateral to the lesion produced a strong and prolonged inhibition of cooling behavior. On the other hand, CSD ipsilateral to the lesion caused only a slight reduction in the rate of cooling. These results suggest that the frontal cortex may influence thermoregulatory behavior and thermosensitive neurons in the preoptic and anterior hypothalamus in the rat.

499

TEMPERATURE AND LOCAL BLOOD FLOW OF THE HYPOTHALAMUS IN HEAT-AND COLD-ACCLIMATED RABBITS. N. OHWATARI, T. INOMOTO, M. KOSAKA. Dept. of Environment. Physiol. and Epidemiol., Inst. for Tropical Medicine, Nagasaki Univ., Sakamoto-machi, Nagasaki

This study was designed to explore the role of extrahypothalamic deep body thermosensitivity in central mechanisms of thermal acclimation. In an environmental control chamber, heat-and cold-acclimated rabbits were submitted to surgical procedures for measuring local cerebral blood flow and temperatures of the hypothalamus, reticular formation and spinal cord. A hydrogen clearance method was used to measure changes in cerebral blood flow during external heating and cooling of stereotaxically restrained conscious rabbits. Blood flows were calculated from the initial slope of the hydrogen clearance curves. Hypothalamic blood flow was increased by 20% during external heating as compared with cooling of normal rabbits. After intravenous injection of LPS-pyrogen (from E. coli), the cerebral blood flow was either increased or decreased, with similar biphasic shifts in hypothalamic temperature. However, increased and decreased cerebral blood flow observed in thermally non-acclimated rabbits vanished in heat-and cold-acclimated rabbits during external thermal stimulation as well as during pyrogen-induced fever. This suggests that blood flow changes in central thermosensitive tissues may play an important role in both thermoregulatory mechanisms and in the process of thermal acclimation.

500

THE EFFECT OF AGING ON OPERANT THERMOREGULATORY BEHAVIOUR.
ASAKI, Y. and IRIKI, M.* Dept. of Physiol., Tokyo Metrop. Inst. of Gerontol.,
*Dept. of Physiol., Med. Univ. of Yamanashi.

Thermoregulatory mechanism is one of the most important regulatory mechanism to maintain the homeostasis of the body. Analysis of thermoregulatory mechanism of free moving animals can be performed through operant thermoregulatory behaviour which is classified into behavioural thermoregulation.
The effect of aging on operant thermoregulatory behaviour in rats was investigated in order to elucidate the accuracy of the regulation. The experiments were performed with adult rats of 3-6 months old and aged rats of 24-25 months old. After they learnt control of external heat source thoroughly, experiments for 60 min were performed by means of Skinner box of heat escape type with infrared lamps and cold wind, detecting the temperature of abdominal cavity, tail skin and ambit, and the response frequency of reinforcement. Even core temperature, controlled variable of a feedback control system, of the aged rats was more unstable than those of adult rats especially during the latter half of 60 min experiments.
The results indicate decline of thermohomeostasis function reducing extraneous disturbance on operant thermoregulatory behaviour in aged rats.

501

VASOMOTOR RESPONSES TO SCROTAL THERMAL STIMULATION IN HEAT-AND COLD-ACCLIMATED RATS.
TSUCHIYA, K. Dept. of Environment. Physiol. and Epidemiol., Inst. for Tropical Medicine, Nagasaki Univ., Sakamoto-machi, Nagasaki

Scrotal skin was heated selectively by a water perfused thermode, of which temperature was changed stepwise 30°C to 42°C (2°C/3min) in heat-, cold- and thermally non-acclimated Wistar rats anesthetized with pentobarbital (50mg/kg, i.p. and 13mg/h,i.v.). Changes in heart rate and arterial blood pressure were recorded during thermal stimulation in three groups of animals, respectively. Heart rate and blood pressure were decreased during scrotal heating, and mean value of heart rate decreased markedly in scrotal temperature at 38°C in three groups. Heart rate of cold-acclimated rats was set on the higher level as compared with that of control rats in time course of the experiments. On the other hand, heart rate of heat-acclimated rats was the lower as compared with the control animals. The most strong change of heart rate due to thermal stimulation was recorded in heat-acclimated rats and weak change in cold-acclimated rats. Decreasing responses of heart rate to scrotal heating were also observed in bilaterally vagotomized rats, though the mean value of heart rate shifted to higher level as compared to intact rats. It is concluded that cutaneous thermoreception in rat scrotum changes the activity of autonomic nervous system which control the vasomotor functions and that thermal acclimation affects on these responses.

502

CHANGES IN SKIN TEMPERATURE AND THERMAL SENSATION DURING A LIGHT EXERCISE.
OSADA,Y.,OGAWA,S.,AND YOSHIDA,K.* Dept.Physiol.Hygiene,the Inst.Publ.Health, and *Dept.Publ.Health, Sch.Med.,Showa Univ.,Tokyo.

Six young females, wearing Bikini-type swimming suits, were exposed to ET* 20, 22, 24, 26, and 28°C for 90 min on separate days. Humidity was 50% and the air velocity was less than 20 cm/s. Subjects kept rest on a bicycle ergometer for 60 min and then took an exercise at the speed of 60 r.p.m. for 30 min. Neither cool nor warm sensation was obtained at 26-28°C at the end of rest period while at 22°C at the end of exercise. Such a difference could not be explained by the change in skin temperature because the warm sensation developed very rapidly by the start of exercise but the mean skin temperature did not change considerably. Body heat, calculated by the heat balance equation using variables such as metabolic rate, rectal and skin temperatures, body weight loss, etc., showed positive relations with thermal and comfort sensations during the rest period but the relation was lost during the exercise. The reason of this discrepancy between rest and exercise situations might be that heat balance equation was applicable only to the steady state of rest posture and other equation was needed for exercise condition and/or that heat balance at the end of exercise period in this experiment was of rather transit nature yet.

503

FALL IN FOREARM SKIN TEMPERATURE DURING UPHILL AND DOWNHILL WALKING.
OHNUKI, Y., NAKAYAMA, T. AND NIWA, K. Dept. of Physiol., Osaka Univ. Sch. Med., Kita-Ku, Osaka, 530

Thermoregulatory responses were observed in 7 male subjects during uphill and downhill walking at different speeds between 0.5 and 9 km/hr. The total heat productions (H) in the former and the latter exercise are metabolic heat production (M) - work (W) and M + W, respectively. During 60 min exercise at 20°C, r.h. 40%, rectal temperature increased to levels dependent on M, but independent of H. Sweat rate varied in proportion to H, but not to M. During 10 min exercise, the environmental conditions (28°C, 40%) and work intensities were set so that changes in skin temperature could be observed without an involvement of sweating. The results indicated that the fall in forearm skin temperature was correlated to M, but not to H. Our previous studies showed that cutaneous vasoconstriction persisted during exercise and increased work intensities spread surface area of lowered skin temperature. These findings suggest that the rise in core temperature during exercise results from the decreased dry heat loss due to fall in skin temperature.

504

INFLUENCE OF BAROMETRIC PRESSURE ON TEMPERATURE REGURATION : STUDIES AT 2 ATA.

KONDA, N., SHIRAKI, K. AND SAGAWA, S. Dept. of Physiol., Sch. Med., Univ. of Occup. & Environ. Hlth., Kitakyushu

In a hyperbaric chamber (2 ATA), body temperature and body weight loss were measured at 30, 31, 32, 33 and 34°C of ambient temperature. Respiratory gas was collected at the start and the end of an experiment. Metabolic heat production and body heat exchange was evaluated. The reactivity of the finger vessels to extreme cold was also measured in other series of experiment. Subjects were 9 male volunteers.

The metabolic heat production was not changed by either barometric pressure or ambient temperature. As the convective heat exchange was increased at 2 ATA, the mean skin temperature was lower than that at 1 ATA in the range of ambient temperature of 30 to 33° C. The water loss from skin was relatively lower at 2 ATA at a given mean skin temperature. At the ambient temperature of 34°C, the water loss from skin was not markedly increased at 2 ATA while sweating was initiated at 1 ATA. So the mean skin temperature at 34°C, 2 ATA was as high as that at 1 ATA. Eventhough the reactivity of the finger vessels to cold was lower at a lower ambient temperature at 1 ATA, that at 2 ATA was rather enhanced. Considering facts above mentioned, the possibility of direct effects of barometric pressure on neural vasomotor mechanisms is suggested.

505

BODY HEAT BALANCE DURING A 4-DAY SATURATION DIVE AT 4 ATOMOSPHERE ABSOLUTE(ATA)

Shiraki, K., Konda, N., Sagawa. S., Nakayama, H*., and Matsuda, M*. Dept. of Physiol. Sch. of Med., Univ. Occup. Environm. Hlth, Kitakyushu, Japan.

Five male volunteers, including 3 scientists, were simulated to a dry saturation dive for 4 days at 4 ATA helium oxygen environment. Partitional calorimetry was performed during 2-hour balance period in various ambient temperatures (Ta). Heat production (M) during the period at 4 ATA was identical to that of 1 ATA air. Convective heat exchange (C) was greatly increased with a concomitant decrease in evaporative heat loss (E). The mean skin ($\bar{T}sk$) and mean body ($\bar{T}b$) temperatures were lowered significantly at 4 ATA in comparison with a given temperature at 1ATA air, and a slight reduction was observed in rectal temperature (Tre). A calculated coefficient of conductive heat transfer from the core to skin was reduced by probable vasoconstriction at 4 ATA. Sensation of the thermal neutrality of the subjects at rest in 4 ATA helium oxygen environment was around Ta=32°C.

A temporal diuresis was observed at 4 ATA, but it disappeared with increase in chamber temperature (Ta). A reverse relationship of daily urine flow was observed with mean skin temperature. An increase in urine flow at 4 ATA might be attributed to cold stress due to lowering skin temperature cuased by increased convective heat loss.

AUTHOR'S INDEX

G

H

I

N

O

T

〔会　報〕

日本生理学会昭和56年度第1回常任幹事会議事要録

日　時：昭和56年3月31日（火）午後2時～6時
会　場：徳島大学医学部第一会議室
出席者：広重　力，加藤正道，田崎京二，鈴木泰三，本間三郎，高木貞敬，本郷利憲，佐藤昌康，古河太郎，伊藤正男，星　猛，島津　浩，酒井敏夫，真島英信，塚田裕三，竹内　昭，大原孝吉，宮川　清，入沢　宏，内薗耕二，御手洗玄洋，永坂鉄夫，岡本彰祐，岩間吉也，中馬一郎，藤本　守，久野　宗，松本淳治，中山　沃，及川俊彦，後藤昌義，大村　裕，黛顯教三，勝木保次，井上五郎，高田　充
議　長：松本淳治（当番幹事）

Ⅰ．報　告

1．庶務報告（伊藤庶務幹事）：会員について，昭和56年1月より3月の期間，入会28名，退会38名（死去2名）の移動があり，現在会員総数3,123名（評議員数832名，内特別会員21名）である．

小玉作治特別会員が昭和56年3月4日逝去された．また，この一年間に国外の生理学者で日本にゆかりのある方の逝去についての報告の中でラシュトン教授，クフラー教授，デッビド・マー博士，スベチチン教授の名が挙げられた．

名取礼二氏が学士院賞を受賞された．

常任幹事会の改選が行われた（選挙管理委員長報告参照）．J. J. P. 編集委員の改選が行われ，星　猛（一般生理），真島英信（筋生理），大村　裕（中枢神経生理），本田良行（呼吸生理）の各氏が選出され，委員長は互選により入沢　宏幹事に決定された．

各財団研究援助の採択について，山田財団および日本医学会には該当がなかったが，日産学術研究助成に佐藤昌康幹事が採択された．

日本学術会議に，塚田，本間両幹事が選出され，塚田幹事は学術会議の副会長に就任された．

生理学会事務所が昭和56年5月に東洋文庫から

〒113 東京都文京区本郷3-30-10
布施ビル4階401号室
（地下鉄丸の内線本郷3丁目駅より徒歩3分）

に移転する．

2．会計報告（星会計幹事）：昭和55年度決算について，収入の部では会費，購読料，論文掲載料，広告料，会誌分冊売，預金利子，生理学実習書および用語集売上げによる印税，大会案内その他収入などにより2,030,549円増加し，支出の部では，会誌発送代，旅費，人件費，雑費（供花，J. J. P. 会費返却）などを除いて，節約により昭和55年度は2,915,803円の黒字を計上し，昭和56年度繰越金総額4,946,352円となることが説明され，以上の会計決算について，佐藤昌康，真島英信両会計監事の監査を受け，承認を得ている旨報告された．

次いで，別途の会計になっている国際交流基金の決算については，従来からの積立（昭和54年度80万円，55年度18万円）とその利子5,786円を合せて，計985,786円となっており，昭和55年度支出として，生理学実習書の英訳作業に対して米国人への謝礼30万円，英文実習書の印刷費127,500円，その発送費6,480円などにより合計433,980円支出され，現在，国際交流基金としての手持残高は551,806円であることが報告された．

3．日本生理学雑誌編集報告（塚田幹事）：昭和55年度日生誌42巻1～12号（8，9号合併）の発行回数は，計11回で8，9号は大会号として英文抄録をまとめて載せた．42巻の総頁数は676頁（41巻は730頁）となった．原著，短報は，合せて5編で若干減っている．

今まで，日生誌の1つの号に原著，短報のいずれかすくなくとも一つは，載るようにとの編集方針でやってきたが，原著，短報の全然のらない号が，やむなく出てきている現状である．

43巻1号，2号はすでに手もとに届けられたこと，3号については公表され近々手もとに届けられる予定であること，現在の編集状況は，4号，5号，6号まで原稿の目途がたっていることなどが報告された．

4. J. J. P. 編集会計報告(入沢委員長)：昭和56年3月14日の編集委員会において入沢　宏氏が新編集委員長に互選されたこと，隔月に編集委員会を開催していること，委員会の仕事内容として投稿論文の審査，J. J. P. 30巻6号～31巻3号掲載論文の決定および投稿ガイドの修正作業などを行っていることが報告された．次いで，J. J. P. 昭和55年度決算および56年度予算について説明された．

J. J. P. の方は毎年少しずつ投稿が増えて，もう少しで1,000頁のジャーナルができるようになること，それに投稿の印刷ページが増えると，それにしたがって文部省の助成の方も毎年少しずつ増え，現在500万円位の助成が得られていること，外国の購読の方は，55年度では見込みより少し減少し，その減った分が国内会員が増えたために補われていること，現在，編集部として手持ちになっている原稿，返却状況などが報告された．

5. 教育委員会報告(大村委員長)：日本生理学会編生理学実習書の内容を全世界に紹介するため，各テーマの要旨の英訳，そのうち3テーマについて全訳の冊子を委員で作成した．これを1980年7月ブタペストで開催された国際生理学会において展示すると同時に教育シンポジウムにおいて木間幹事が紹介した．またその際，委員が各テーマに沿って作成した実習内容のビデオ・テープの一つを大村幹事が上映し紹介した．なお，各委員が作成したビデオ・テープは28本あり，日本生理学会に申込めば廉価で入手できる．

日本生理学会編生理学実習書の改訂の件について，本実習書が中国において9名の学者により翻訳され，12,000部すでに出版されていることが判明した．本実習書は日本国内では4年間に1万部売れたが，現在1,500部残っており，新学期に売るように努力してほしい．

また，本実習書は56年度に改訂し，57年度に出版できるように改訂準備を行っている．英文化についても討議することになっている．第58回日本生理学会における教育シンポジウムおよびビデオ供覧について報告された．

6. 会則委員会報告(島津委員長)：特に問題となるようなことがなく，会則委員会を開催しなかった．

7. 研究費委員会報告(田崎委員長)：文部省からでている科学研究費について意見を交換した，とくに総合研究のあり方が今まで通りでいいかどうかについて話し合った．

文部省の科学研究費だけでなく，厚生省，科学技術庁など新しい研究費の財源についても検討すべきであり，次期委員会で調査することが話し合われたことが報告された．

8. 選挙管理委員会報告(島津委員長)：昭和56年1月30日常任幹事選挙開票の結果，投票総数509票，無効8票，有効501票であった．評議員数835名のほぼ6割が投票を行ったことになる．

2月14日 J. J. P. 編集委員選挙開票の結果，投票総数495票，無効9票，有効486票であった（結果は，庶務幹事報告を参照）．

9. 評議員選考委員会報告(真島委員長)：57名の推薦があり，全員適格と判定された(議題4. を参照)．

10. 生理学用語委員会報告(酒井委員長)：編集委員会は，昨年6月28日に発足，今までに3回会合を持った．依頼した専門委員から選語，修正，削除などの作業を終えて返送されたもの，1) 一般生理 2) 中枢神経系 3) 感覚 4) 筋 5) 循環 6) 消化・吸収 7) 内分泌 8) 血液 9) 温熱生理 10) 遺伝生理などであること，編集庶務委員会は，生理学用語の全体的統一整理の作業を行っていること，予定より2カ月の遅れがあることなどが報告された．

11. 国際生理科学連合報告(勝木副会長)：昨年7月13日～19日ブタペストで開催された国際生理科学連合に日本から370名の参加者があって，全体の中で，二，三番目位の多数参加国となった．総参加者数は7,000名（ミュンヘン3,000名，パリ4,000名）であった．

IUPS の会長以下，委員は交代し，次のように決った．President：Schmidt-Nielsen（米），Vice-President：Kovach(ハンガリー), Katsuki(日), Secretary：Scherrer（仏），Treasurer：Thurau（西独），Council Members：10名（名前，省略）．

会長の Schmidt-Nielsen からの手紙によると，次回2年後の IUPS congress はオーストラリアのシドニーで行われることになっているが，プログラムなどは充分本部と連絡をとって組まれる．organizing committeeは，オーストラリア5名，外国10名よりなり，この中に伊藤幹事が日本代表として入っている．この5月に第1回委員会の会合が持たれることになっている．

12. 生理科学研究連絡委員会報告(勝木委員長)：この一年間に3回会合を持ったこと，昭和57年度文部省科学研究費の特定研究の申請課題が3件提出されて

いることが報告された．また，IUPS の Schmidt-Nielsen 会長より，生理学はますます重要になってきているが，とくに IUPS の仕事として発展途上国の生理学教育に力を入れたいが，それには資金が必要で，日本の協力を依頼する旨の申し出について報告があり，議題のところで議論してほしいと勝木委員長より要請された．

13. 日本生理学教室史編集委員会報告（名取委員長欠席により酒井氏代理）：名取委員長は現在学長職にあって激務を理由に委員長を辞退したい旨の申し出および代りに酒井氏を推薦していることについて，報告があった．

14. 第59回（昭和57年）日本生理学会大会に関する報告(塚田幹事)：昭和57年3月30日，31日，4月1日慶応大学日吉校舎で開催することが報告された．

15. 第58回（昭和56年）日本生理学会大会に関する報告(松本当番幹事)：総参加者数1,250名，口演437題，ポスター72題，計509題が発表されることが報告された．

16. その他

東京都神経科学総合研究所長の佐藤昌康氏より，東京都の4つの医学系研究所の法人化問題について，本年10月から財団法人化されることが報告された．

Ⅱ．議　題

1. 前回議事録は，字句一部訂正の上，承認された．

2. 昭和56年度予算案（学会事務所移転に伴う費用を含む）が承認された．

3. 専任幹事・委員長改選の件：庶務幹事に伊藤正男，会計幹事に星　猛，編集幹事に酒井敏夫，会計監事に真島英信，島津　浩の各氏が選出された．

各委員会委員長には，次の各氏が選ばれた．島津浩(会則委員会)，菊地鎌二(教育委員会)，高木貞敬(評議員選考委員会)，御手洗玄洋(研究費委員会)，酒井敏夫(生理学用語委員会)，島津　浩(選挙管理委員会)，入沢　宏(J. J. P. 編集委員会)，酒井敏夫（日本生理学教室史編集委員会)

4. 評議員推薦について，57名の候補者全員が適格であるとの評議員選考委員会の判定が承認された．

5. 井上清恒昭和大学名誉教授の特別会員推薦について真島幹事より説明があり承認された．

6. 常任幹事辞退の件（この件は報告8のあとに繰上げて協議した）：新幹事に選ばれた名取礼二氏が辞退を希望され，伊藤庶務幹事が名取氏の欠席により，本人に代って辞退釈明の説明を行った．名取氏の辞退の件は承認され，その結果名取氏の代りに次点者を繰上げることが，庶務幹事より提案され承認された．島津選挙管理委員長より名取氏の代りに新幹事として古河太郎氏の名前が発表された．

7. 教育委員会昭和56年度活動計画が承認された．

8. 国際交流に関する件：IUPS 会長 Schmidt-Nielsen 氏より勝木副会長宛の，発展途上国への生理学教育援助のために日本の協力を得たい旨の手紙について，伊藤幹事より説明提案がなされ，議論の結果，生理学会が会員を対象として，任意の募金(1口1,000円，目標額100万円）を行うことを評議員会・総会に諮ることが承認された．

国際生理科学連合会議を1989年または1992年に日本へ誘致するかどうかについて，説明・提案がなされ，議論の結果，常任幹事会としては，開催賛成の発言が多く，評議員会・総会に諮ることが承認された．

9. 昭和56年度の活動方針について：伊藤庶務幹事より，「国際交流委員会」「生理学交流委員会」が解散されたあとを受けて，新たに「生理学の将来像に関する委員会あるいはその準備会」(仮称)の構想を今秋の常任幹事会に提案したい旨の説明があり，了承された．

10. 第60回（昭和58年度）日本生理学会大会に関する件：岩間幹事より，阪大医学部中馬，中山，岩間，歯学部河村の各教授を当番幹事として，4月上旬大阪で開催する計画が説明され承認された．

第58回日本生理学会評議員会および総会議事要旨

日　時：昭和56年4月2日　午後4時～5時30分
会　場：徳島県郷土文化会館大ホール
出席者：約400名
議長団：松本淳治，井上五郎，高田　充（当番幹事）

議長は開会にあたって，評議員会，総会を恒例どおり並行して行うことを提案し了承された．

最初に松本当番幹事より第58回日本生理学会大会に関する報告として，出席者1,383名，演題数506題（口演434題，ポスター展示72題），懇親会出席予定者343名であることが報告された．

Ⅰ．評議員会・総会報告

1) 庶務報告(伊藤庶務幹事)：現在の会員数，評議員数および特別会員について報告がなされた．(表1)

2) 昭和55年度会計決算報告(星会計幹事)：昭和55年度の決算報告（表2）がなされ，承認された．

3) 日本生理学会雑誌編集報告(塚田編集幹事)：日本生理学雑誌42巻（昭和55年度）の編集内容は次のとおりであった．42巻1～12号（8, 9号合併大会号）．発行11回，総頁数676頁．次いで43巻の編集進行状況につき，号数を発行月に合せることを努力目標としているとの説明があった．(表3)

4) JJP編集会計報告(入沢委員長)：昭和55年度JJP編集決算，昭和56年度予算案，刊行状況，JJP編集委員改選の結果などの報告があった．(表4, 5, 6)

5) 教育委員会報告(大村委員長)：日本生理学会編「生理学実習書」について，この4年間に約1万部売れ，毎年約25万円の印税を日本生理学会に納めていること，あと1,000部残っていること，本年度改訂を準備中であること，中国において12,000部翻訳されたことなどが報告された．次いで，昨年IUPSの教育シンポジウムにおいて，項目の要訳（3編は全訳）した小冊子を展示すると共に教育シンポジウムにおいて本間教授が説明したこと，大村委員長がデビオテープを供覧説明したこと，昭和56年度より，東京女子医大の菊地教授が委員長に就任することなどが報告された．

6) 選挙管理委員会報告(島津委員長)：1月30日常任幹事選挙開票により29名を選出したこと，2月14日JJP編集委員選挙開票により4名を選出したことが報告された．

7) 評議員選考委員会報告(真島委員長)：57名の評議員推薦があり，すべて適格であったと報告された．

8) 生理学用語委員会報告(酒井委員長)：新しい生理学用語集の編集活動を始めており，来年3月に出版される目途がついていることが報告された．

9) 国際生理科学連合報告(勝木副会長)：昨年7月13～19日ハンガリーブタペストにおけるIUPS会議報告，今回IUPSの会長以下，委員が変ったこと，勝木氏が2nd vice presidentに就任されたこと，理事会において，IUPSの大会のあり方について，いろんな意見が出たこと，IUPSの事業として発展途上国の生理学教育援助の件などについて報告がなされた．

10) 生理科学研究連絡委員会報告(勝木委員長)：講演会をブタペスト大会前と昨年11月1日慶応大，塚田教授の世話で「発生神経生物学について」行った．56年度秋に阪大，河村教授の世話で「脳における感覚情報処理について」講演会が行われることになっている．4月，12期より，勝木委員長に代わり本間委員長が就任されることなどが報告された．

11) 日本生理学教室史編集委員会報告（酒井委員長)：まだ所期の目的を完了していないが，再来年第60回大阪大会の際，60周年としてまとめ上げたいとの報告があった．

12) 第59回（昭和57年）日本生理学会大会に関する報告(塚田幹事)：慶応大学医学部塚田，村上により，57年3月30日，3月31日，4月1日慶応大学日吉校舎にて開催することが報告された．

13) 常任幹事会報告(松本当番幹事)：改選の年にあたり，新専任幹事，委員長の氏名が報告された．(表7，8)

14) その他：東京都神経科学総合研究所長佐藤昌康氏より東京都立の4つの医学系研究所の法人化について報告がなされた．

Ⅱ．議題

1) 昭和56年度予算案について，星会計幹事より報告・説明があり，評議員会の承認を経て総会に附議し承認された．(表9)

2) 評議員推薦について，評議員選考委員会が提案した新評議員候補者はすべて評議員会において承認

された．(表10)

3) 特別会員推薦について，昭和大学名誉教授井上清恒氏の特別会員推薦につき，伊藤会員より推薦の辞が述べられた後，評議員会より推薦することが承認され，さらに総会の賛同をえた．

4) 昭和56年度の活動方針について，「国際交流委員会」および「国内交流委員会」が昨年で任務を終え，解散したので，新たに「生理学の将来像に関する委員会または準備会」(仮称)の構想を今秋の常任幹事会に提案したい旨，伊藤幹事より説明があり，評議員会の承認を経て総会に附議し承認された．

5) IUPS事業援助の件：IUPSの新執行部の事業として発展途上国の生理学教育援助が計画され，日本からの協力を要請してきたことについて伊藤庶務幹事より説明がなされ，日本生理学会として会員を対象に募金（1口1,000円以上，任意）を行いたい旨の提案があり，評議員会の承認を経て総会に附議し承認された．

6) 国際生理学会に関する件：IUPS大会をカナダ，バンクーバー大会の次に日本へ誘致することについて伊藤庶務幹事より説明があり，討議された．その結果日本生理学会の評議員会，総会においては大多数が日本において開催することに賛成である旨を勝木副会長がIUPSの6月の理事会に伝えられることになった．

7) 第60回日本生理学会大会に関する件：阪大岩間教授より，第60回（昭和58年度）日本生理学会大会は，日本医学会総会が大阪で開催される関連で，大阪で阪大医学部中馬，中山，岩間および歯学部河村の各教授が当番幹事となって世話されることが報告され，了承された．

表1．日本生理学会庶務報告

(昭和55年12月末現在)

会員	
一般会員	2,855名
特別会員	22名
準会員	
学校図書館	135部(128件)
研究所，書店等	121部(70件)
寄贈及び交換	
外国	18部(17件)
国内	16部
合計	3,167

特別会員(22名)

東　龍太郎	勝　義孝	勝木　新次
勝木　保次	久保　秀雄	小玉　作治
黒津　敏行	斎藤幸一郎	鈴木　正夫
瀬尾愛三郎	高木健太郎	冨田　恒男
戸塚　武彦	長嶋　長節	西丸　和義
福田　邦三	福原　武	松田幸次郎
簑島　高	森　信胤	吉村　寿人
若林　勲		

表2．日本生理学会昭和55年度決算報告

(自　昭和55年1月1日
至　昭和55年12月31日)

収　入

	55年度予算	55年度決算	増減	備考
① 前年度繰越金	3,502,325円	3,502,325円		
② 昭和55年度収入	16,910,000	18,940,549		
(内訳)				
会費	12,810,000	13,131,500	＋	
購読料	1,060,000	1,384,100	＋	
論文掲載料	1,500,000	2,240,826	＋	
広告料	1,000,000	1,147,200	＋	12件
会誌分冊売	20,000	25,600	＋	7件
預金利子	70,000	128,710	＋	第一勧業銀行
日本医学会奨励金	100,000	100,000		昭和54年度
印税	150,000	364,980	＋	生理学実習書及び用語集
その他収入	200,000	417,633	＋	大会案内他
①+② 合計	**20,412,325**	**22,442,874**		
差額		2,030,549		

(表2つづき)

(内訳)	支出 55年度予算	55年度決算	増減	備考
会誌印刷代	10,400,000円	9,048,103円	−	41巻11号～42巻11号
会誌発送代	1,500,000	1,657,422	+	同上
編集会議費	80,000	39,520	−	日本生理学雑誌
校正料	250,000	234,850	−	同上
原稿査読料	30,000	18,000	−	同上
事務室使用料	732,000	732,000		12ヶ月
書庫使用料	150,000	0	−	
通信費	800,000	593,472	−	会誌外通信
振替手数料	140,000	97,765	−	
事務費	850,000	814,006	−	印刷物，コピー代
備品費	100,000	100,000		邦文タイプ本体
会合費	250,000	221,285	−	常任幹事会，委員会
旅費	900,000	1,015,840	+	同上
人件費	2,200,000	2,369,769	+	アルバイト含む
職員健康保険	60,000	46,760	−	
職員退職金積立	100,000	100,000		
国際交流基金	180,000	180,000		
雑費	100,000	116,600	+	供花，JJP 会費返却
予備費	1,590,325	111,130	−	教育委員会外国発送料他
合計	**20,412,325**	**17,496,522**		
差額		2,915,805		
昭和56年度繰越金総額		4,946,352		

表3．日本生理学雑誌42巻（55年度）編集報告

42巻1～12号（8，9号合併）発行11回

42巻総頁数 676頁

(内訳)	編	頁	41巻総頁数
原著	3	32	730頁
短報	2	7	
業績表題		122	
口演演題		204	
抄録		81	
会報，その他(総目次・索引含)		152	
広告		78	

表4．JJP昭和55年度決算および56年度予算

	55年度 予算額	決算額(見込)	摘要	56年度 予算額	摘要
製作費	9,400,000円	10,224,000円	978頁	11,246,000	972頁，10%up
審査・英文校閲料	1,380,000	1,547,700		1,630,000	5%
旅費・会議費	900,000	399,900		810,000	

通信・消耗品費	1,150,000	1,150,000		1,323,000	15%
人件費	1,750,000	1,750,000		1,925,000	10%
雑事務費	700,000	700,000		770,000	10%
送料(外国)	4,140,000	3,711,960		3,600,000	
送料(国内)	2,000,000	1,789,500		1,968,000	10%
支出合計	**21,420,000**	**21,273,060**		**23,272,000**	
国内会員	3,900,000	4,162,080	754名 @6,000 8%未収	5,320,000	760名 @7,000 (実収)
国内機関	1,950,000	1,800,000	120名 @15,000	1,800,000	120名 @15,000
外国購読	9,200,000	8,248,800	491名 80ドル @210	8,000,000	500名 80ドル @200
別刷バックナンバー	1,350,000	1,710,000		2,565,000	50%up
文部省助成	5,020,000	5,360,000		5,360,000	
繰り越し金	467,580	467,580		475,400	
収入合計	**21,887,580**	**21,748,460**		**23,520,400**	
差引繰り越し		475,400			

表5．JJP刊行状況 (Vol. 30, No. 6) 刊行部数1,450部

個人購読	754	883	外国購読	480	491
団体購読	120		外国会員その他	11	
国内寄贈	9				

表6．JJP論文投稿状況 (昭和56年3月14日現在)

昭和55年3月末日原稿手持ち数													56 a)
	4月	5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月	
受理数	9 (3)	11 (2)	10 (2)	8 (3)	12 (2)	14 (4)	13 (3)	10 (1)	8 (2)	7 (0)	15 (6)	4 (1)	121 b)
掲載数	15 (6)		14 (1)		14 (3)		14 (5)		13 (2)		11 (2)		81 c) (19)
返却数		6 (3)				6 (1)	1	6 (4)		3 (0)			22 d) (9)

( ) 内はその中に含まれる Short Comn. の数

昭和56年3月14日現在手持ち数：(a+b)−(c+d)=74

内訳 { 掲載可 (Vol. 31, No. 2, 3, 4)：32
　　 審査訂正中　　：42

表7．新常任幹事 (29名)

(任期56年～59年改選時)

北海道	広重　力	加藤　正道	中部	竹内　昭	古河　太郎
東北	田崎　京二	鈴木　泰三		入沢　宏	内薗　耕二
関東	本間　三郎	高木　貞敬		御手洗玄洋	永坂　鉄夫
	新島　旭	本郷　利憲	近畿	岩間　吉也	中馬　一郎
東京	伊藤　正男	星　猛		藤本　守	久野　宗
	島津　浩	酒井　敏夫	中国四国	中山　沃	及川　俊彦
	真島　英信	塚田　裕三	九州	後藤　昌義	大村　裕
				纐纈　教三	

表 8．新専任幹事・各委員長名簿

庶務幹事：伊藤正男
会計幹事：星　猛
編集幹事：酒井敏夫
会計監事：真島英信，島津　浩
会則委員長：島津　浩
教育委員長：菊地鐐二
評議員選考委員長：高木貞敬
研究費委員長：御手洗玄洋
生理学用語委員長：酒井敏夫
選挙管理委員長：島津　浩
JJP 編集委員長：入沢　宏
日本生理学教室史編集委員長：酒井敏夫

表 9．日本生理学会昭和56年度予算

（自　昭和56年1月1日
至　昭和56年12月31日）

収　入

①	前年度繰越金	4,946,352円	
②	昭和56年度収入	21,980,000	
	（内訳）		備考
	会費	16,550,000	（会費　6,000円×3,065×0.9）
	購読料	1,840,000	（準会費　8,000円×256×0.9）
	論文掲載料	1,500,000	
	広告料	1,200,000	
	会誌分刷売	20,000	
	預金利子	120,000	（第一勧業銀行）
	日本医学会奨励金	100,000	
	印税	250,000	（生理学実習書，用語集）
	大会費立替返却	300,000	
	雑収入	50,000	
①＋②	合計	**26,926,352**	

支　出

（内訳）		備考
会誌印刷代	9,914,000円	（42巻12号～43巻11号）
会誌発送代	2,720,000	（同上）
編集会議費	80,000	（日本生理学雑誌）
校正料	250,000	（同上）
原稿査読料	30,000	（同上）
事務室使用料	732,000	（12ヶ月）
通信費	800,000	（会費外通信）
振替手数料	140,000	
事務費	850,000	（印刷物，封筒，コピー代）
備品	80,000	
会合費	300,000	（常任幹事会，委員会）
旅費	1,200,000	（同上）
人件費	2,500,000	（アルバイト含む）
職員社会保険	95,000	
職員退職金積立	100,000	
国際交流基金	250,000	
雑費	100,000	
予備費	6,785,352	
合計	**26,926,352**	

表10. 日本生理学会新評議員（1981年度）

計57名（五十音順）

氏名	所属，現職
阿相　皓晃	東邦大，医，生理，助手
赤石　隆夫	新潟大，医，生理，助手
赤須　　崇	久留米大，医，生理，講師
井上　慎一	三菱化成，生命研，脳，副主任；慶応大，工，生命化学，講師
尾島　光栄	日本歯大，生理，助教授
太田　　勲	札幌医大，生理，講師
大橋　俊夫	信州大，医，生理，助教授
片桐　康雄	東京女医大，生理，助手
金井　浩三	信州大，医，生理，助手
北田　泰之	岡山大，歯，生理，助教授
熊田　　衛	筑波大，基礎医学系，教授
黒田洋一郎	都神経科学総研，主任研究員
玄番　央恵	京大，医，脳研，助手
小杉　忠誠	宮崎医大，生理，助手
小林　孝和	帝京大，医，生理，助手
佐脇　敬子	三菱化成，生命研，脳神経生理，特別研究員
佐久間康夫	群馬大，医，行動生理，助教授
佐々木成人	筑波大，基礎医学系，講師
坂口　正雄	長野高専，講師
須美　洋行	宮崎医大，生理，助手
鈴木　季直	帝京大，医，生理，講師
鈴木　直人	京府医大，生理，講師
鈴木　雄士	日本歯大，歯，生理，教授
田中　秀洋	帝京大，医，生理，講師
高橋　徳之	金沢医大，生理，助教授
竹田　俊明	自治医大，医，生理，助手
為安　　司	帝京大，医，生理，講師
土屋　禎三	帝京大，医，生理，助教授
寺沢　　崇	東北歯大，生理，講師
寺西　泰弘	広島大，医，生理，助手
照井　直人	筑波大，基礎医学系，講師
戸田　一雄	東医歯大，歯，生理，助手
中尾　召三	鳥取大，医，生理，講師
難波　経篤	名保衛大，医，生理，助手
難波　啓泰	神奈川歯大，生理，講師
浜村みつ子	自治医大，生理，助手，講師；看護学校
林　　実	信州大，医，生理，助手
福島　菊郎	北大，医，生理，助手
福嶋　孝義	信州大，医，心研，講師
丸井　隆之	鹿児島大，歯，生理，助教授
三重野政広	長崎大，医，原研，助手
三宅　彰英	岐阜大，医，反射研，助手
水村　和枝	名大，医，生理，助手
宮村　実晴	名大，体育センター，助教授
宮本　孝甫	埼玉県立衛生短大，助教授
森　　憲作	群馬大，医，生理，講師
山口　峻司	筑波大，基礎医学系，講師
山里　晃弘	岡山大，医，生理，講師
山路　兼生	岐阜大，医，反射研，非常勤講師
山下　雄平	東京女医大，生理，助手
山田　和生	名大，環医研，教授
山田　妙子	日本女大，一般教育，助教授
山本　毅征	九大，歯，生理，助教授
山本　典子	岐阜大，医，生理，講師
横山　元昭	日本歯大，生理，助教授
吉井　光信	日本医大，生理，講師
吉田　　薫	筑波大，基礎医学系，講師

〔生理学教育のシンポジウム〕

生理学会教育委員会年次報告

大　村　　裕

教育委員会はこれまで年2回委員会を開催し，委員会の活動について討議を行ってきている．昭和55年度における本委員会の活動状況をみると次のようである．

1) 国際生理学会との対応

日本生理学会編生理学実習書の内容を全世界に紹介するため，各テーマの要旨の英訳を各委員分担で行った．各実習項目には問答形式を取り入れ実習書としての機能を果していることが本実習書の特徴であるが，項目の要旨の英訳だけではそれが理解しにくいので，そのうち次の3テーマについては全訳した（カッコ内は全訳者）．

体液調節（星　　猛）
筋　　肉（杉　晴夫）
心筋活動（後藤昌義）

これらをまとめて印刷し一冊子とした．これをアメリカ (Brookhoart), イギリス (Hutter), インド (Manchanda), ドイツ（高野）の主な教室に配布した．その配布教授名の名簿はカッコ内の教授に作成してもらった．またこれを1980年7月ブタペストで開催された国際生理科学会において展示すると同時に教育シンポジウムにおいて本間三郎教授が紹介した．

さらに科学研究費（本間委員，研究代表者）によって各実習テーマに沿って各委員が作成したビデオテープが完成したので，そのうち次のテープを国際生理学会において展示するため持参した．

心房機能(林　秀生)，心室機能(畠山一平)
呼吸運動(酒井敏夫)，腱 反 射(本間三郎)
大脳皮質誘発電位（大村　裕）

しかし，ビデオデッキを期間中借用できず，教育シンポジウムにおいて大村委員長が実習におけるビデオの必要性について話すと同時に誘発電位のビデオテープを上映し紹介した．

各委員の作成テープは日本生理学会におさめてあり，本会に申込めばそのリストおよび一巻18,000円で入手できる．これらのうち一部は1980年および1981年の日本生理学会で供覧している．

2) 国内との対応

本実習書は発売して以来4年間で1万部売れ，印税として日本生理学会に1981年7月までに合計1,046,005円納入している．現在1,500部の在庫があり，4月からの新学期に各大学で使用していただくことを希望している．これにより更に，日本生理学会に約286,000納入可能である．

本実習書は中国において9名の学者によって翻訳され，12,000部すでに出版されていることが判明した．本実習書が中国生理学の教育および研究に貢献していることは多とすべきであろう．

本実習書を改訂し，実習指導をより有機的とするため大村・酒井両委員が編集者となって準備をすすめている．昭和57年度に出版予定である．

〔お知らせ〕

1980 World Directory of Physiologists

IUPS で作製した世界中の生理学者の名簿の1980年版が出来上りました．総頁431に及び，わが国については日本生理学会評議員全員のお名前とアドレスが掲載されております．値段は個別にお求めになると6.5ドルですが生理学会で一括して購入すると5ドルに送料を加えたものとなり割安です．見本は各地区の常任幹事がお持ちです．個別の申込先は見本の表紙裏に示してあります．一括購入を希望される方は事務所迄御連絡下さい．

日本生理学会事務所

〔編集後記〕

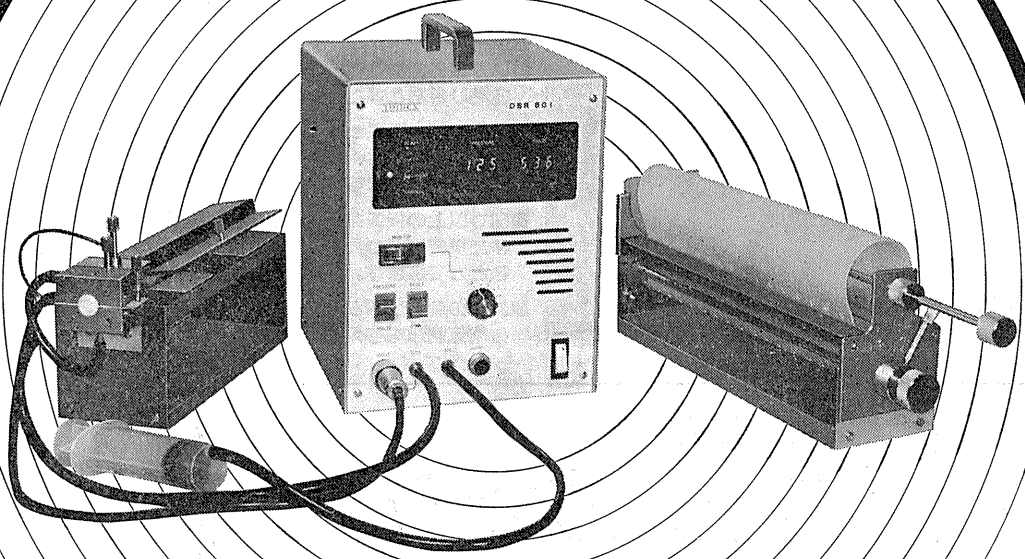
日生誌8・9合併号は恒例の生理学会大会号です．今回は全演題の英文抄録化を果して3年目にあたり，この方式による編集作業も軌道に乗ってきたことおよび大会主催者であった徳島大学の方々また印刷関係者の御尽力と相俟って，編集委員会の仕事は大分楽になった様で感謝しております．楽になると少しは本誌について考える機会も出来るようになりました．この欄を借りて大会号に関する事共を記しておきます．

英文抄録化の原動力は奈辺にあったのでしょうか．委員の末席に加えられたのが昨年4月の新参者故詳しいことは知りませんが，古参の方々の言葉の節々より察するところ，学会発表の国際化にあったようです．英文抄録採用の発端は32巻大会号（1970）に始まっていますが，実情は希望者の便宜を図るというものであり，結果は和文英文の共存となり，この状態が40巻(1978) まで続きました．この混合方式による編集・校正にあたる人達の労苦は計り知れぬものがあり，その負担の軽減と併せて国際化の実を上げるために，41巻より全抄録の英文化とこれにともなうオフセット化の導入が図られ，見事に編集の簡略化の実をあげたと云えましょう．新方式への移行時の事情については馬詰委員が41巻大会号の編集後記で触れております．

では国際化の実はこれで上がった，と果して明言できるでしょうか．真の国際化とは，日本人以外の研究者達が身近に手に触れて利用できることです．抄録の英文化はその大事な第一歩でしたし，解決されたものと云えましょう．しかし，本当に国際化を考えるのなら，更に第二歩，すなわちこの抄録集を外国人研究者達の身辺に近づけることへと踏み出さざるを得ないでしょう．私見では，この問題は既に日生誌編集委員会のレベルを超えているのではないかと，案じております．本年43巻5号「日本生理学雑誌編集と現状分析」において酒井編集幹事が既に触れているように，委員会では“……せっかく大会抄録号を英文にしたからにはこれをＪＪＰ移管としたらどうであろうかという議論まで出され”ました．実はこの意見は1970年頃既に出されております．この問題は更に日生誌の今後のあり方，をも含んでいるのです．したがって，生理学会総体として考えてゆかねばならぬ問題でしょう．

現在，酒井編集幹事を中心として，日生誌の再編成への努力が進んでおります（前出43巻5号酒井報告，43巻6号中村編集後記参照）．この中には会員の意見コーナーのような欄も予定されている筈です．これを活用するためにも，生理学会諸兄姉の上述の問題に関する御意見を頂ければ，今後の日生誌の発展のためにも有難いと願っております．　（田中励作）

無加温式ラット用血圧計



DSR-801（手動式）
DSR-801A（自動式）

- 無加温で測定ＯＫ。しかも非観血。
- 操作は簡単。測定時間も５分以内。
- 最高血圧値、脈拍数は一目でわかるデジタル表示式。
- ラットのサイズに関係なく一個の保定具で使用可能。
- 価格もお手頃。

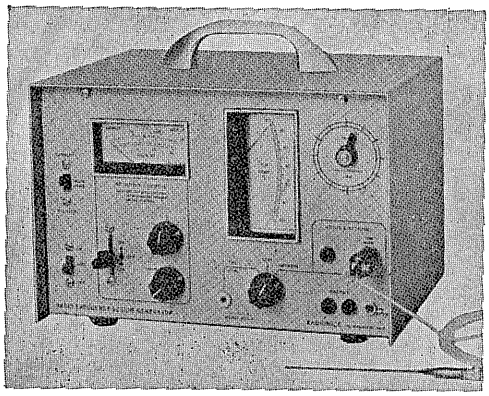
※カタログは当社に直接ご請求下さい。

株式会社トーイデン
〒150 東京都渋谷区南平台町15番地1号 ライオンズマンション南平台502号 ☎03-496-2234

0.7㎜のリージョンから脳浮腫までを
均一なサイズ、すばらしい再現性をもって作成する!

RADIONICS社

動物用 高周波 RF リージョン ジェネレータ



主な特徴

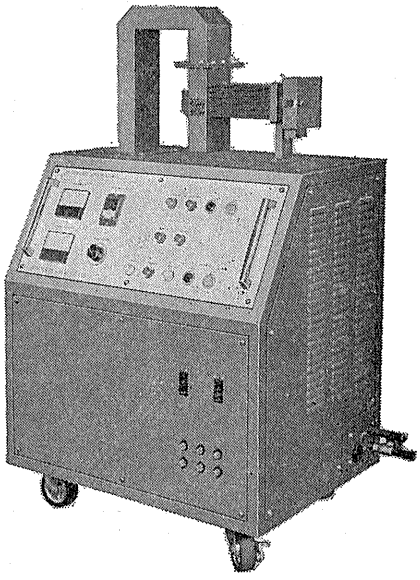
- Lesion Generatorによる損傷は、小動物の脳組織の損傷に適しており、また手技が極めて簡単です。
- いかなる損傷条件(損傷温度、損傷時間)でも生体組織に出血をひきおこすことはありません。
- 熱センサーによって損傷組織の温度を正確にコントロールすることができ、再現性、均一性に優れた損傷巣を作製することができます。
- 50℃以上の損傷条件では、損傷温度が高ければ高いほど、また損傷時間が長ければ長いほど大きな損傷巣を作製することができます。
- 外部の刺激装置と本体を接続することにより、同一電極から電気刺激を与えることもできます。

新発売

実験動物脳内酵素不活性化装置

東芝マイクロウェーブ アプリケータ

TMW-6402A型(改良型)



実験動物の脳内物質の測定に先立ち、測定物質に関連する諸酵素を不活性化する方法として凍結法があります。しかしながら凍結法では生体内酵素を不活性化させるまでにかなりの時間を必要とし、この間に測定物質が変化するおそれがあります。

最近この解決方法としてマイクロウェーブの瞬時照射により諸酵素を不活性化する方法が用いられるようになりました。とくに照射後は凍結法で行われる低温処理の必要もなく室温にて処理ができ、安定した測定値が得られます。アセチルコリン、サイクリックAMP、サイクリックGMP、GABA、DOPA、5-HTP、セロトニン、カテコールアミンとその代謝産物、エンドルフィンなどの正確な測定の前処理装置として薬理学、生化学、生理学、内科学など広い分野にご活用いただけます。

主な特長

1. 均一な照射が得られ、更に従来組織破壊の見られた視床下部もきれいに残ります
2. アプリケータ内のラットの脳波を記録することができます。
3. サイズの異なる実験動物を使用する場合、ホルダーを交換するだけで済むので手間がかかりません。
4. マイクロ波エネルギーは0~5,000Wまで連続可変、照射時間は0.1~9.9秒まで0.1秒単位で設定できます。
5. 電源部・アプリケータ部・出力部が1つにまとまっているので設置に要するスペースが少なくて済みます。

日本総代理店

室町機械株式会社

〒103 東京都中央区日本橋室町4－3(大辻ビル)
電話 (03)241-2444(代表)

フロッピーディスクによる

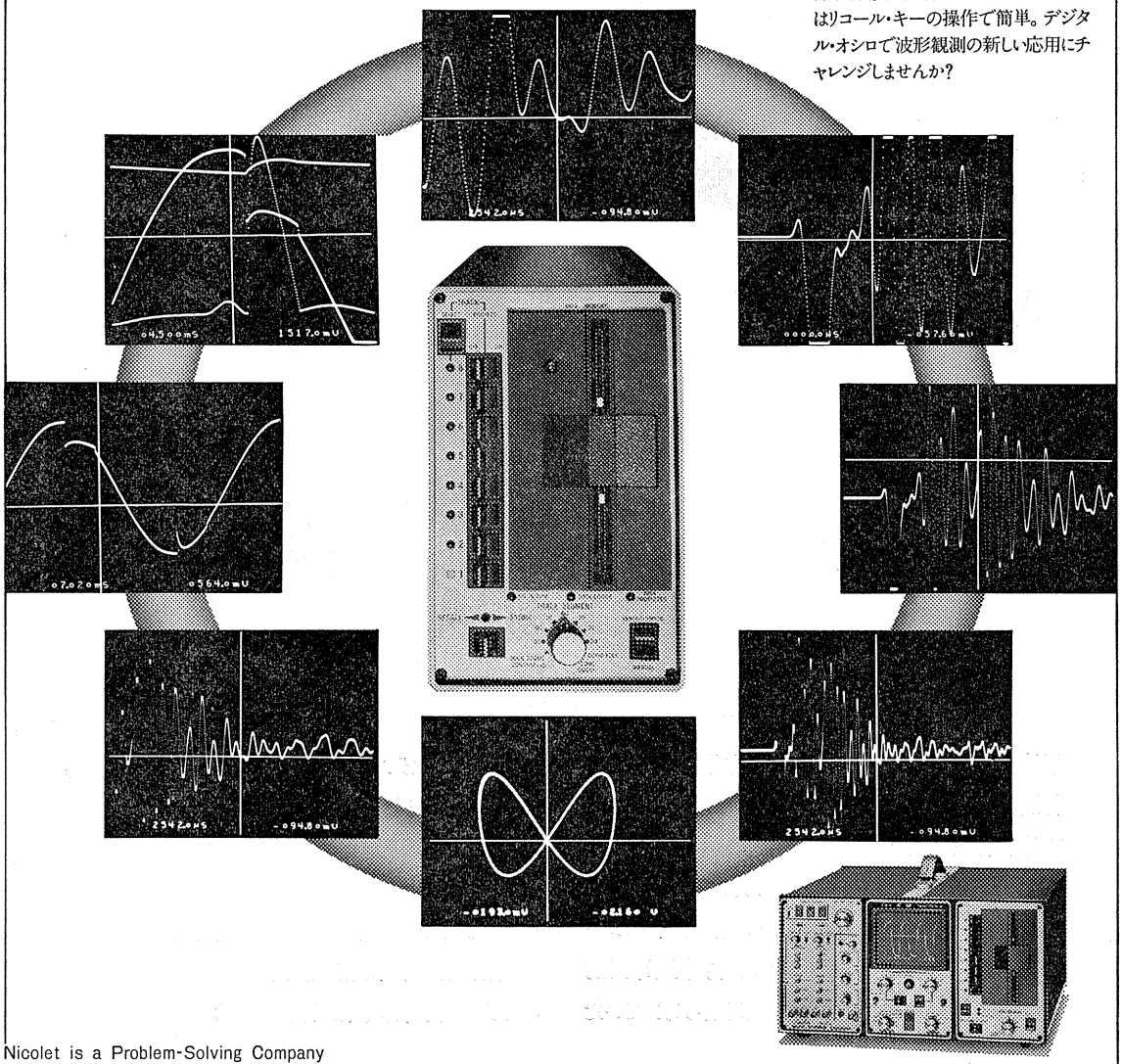
大容量波形記憶 32kワード。

デジタルオシロスコープ

model 2090 シリーズ

■主な性能 ●分解能：12ビット(2090-1/201、206プラグ・イン)、8ビット(204プラグ・イン) ●サンプリング・タイム：200kHz(201)、1MHz(2090-1)、2MHz(206)、20MHz(204) ●メモリ容量：4kワード ●プリトリガ機能 ●デジタル拡大：×2～×64水平・垂直共 (2^nステップ) ●デジタル読み取り ●外部記憶：ミニ・フロッピー・ディスク32kワード(オプション) ●CRT：8×10cm

model 2090シリーズのミニ・フロッピー・ディスクは1シートで32kワードの記憶容量。デジタル・オシロ本体で捕捉した4kワードの波形を8トラックまで記憶。さらに本体のメモリー分割を1kワードにすれば32枚の波形記憶が可能です。ユニークなオート・サイクル機能は、例えばいつ発生するかわからないノイズの様なトランジェント波形の捕捉・記憶・トリガ待ちを自動的に繰返します。しかも再生はリコール・キーの操作で簡単。デジタル・オシロで波形観測の新しい応用にチャレンジしませんか?



Nicolet is a Problem-Solving Company

NICOLET JAPAN CORPORATION

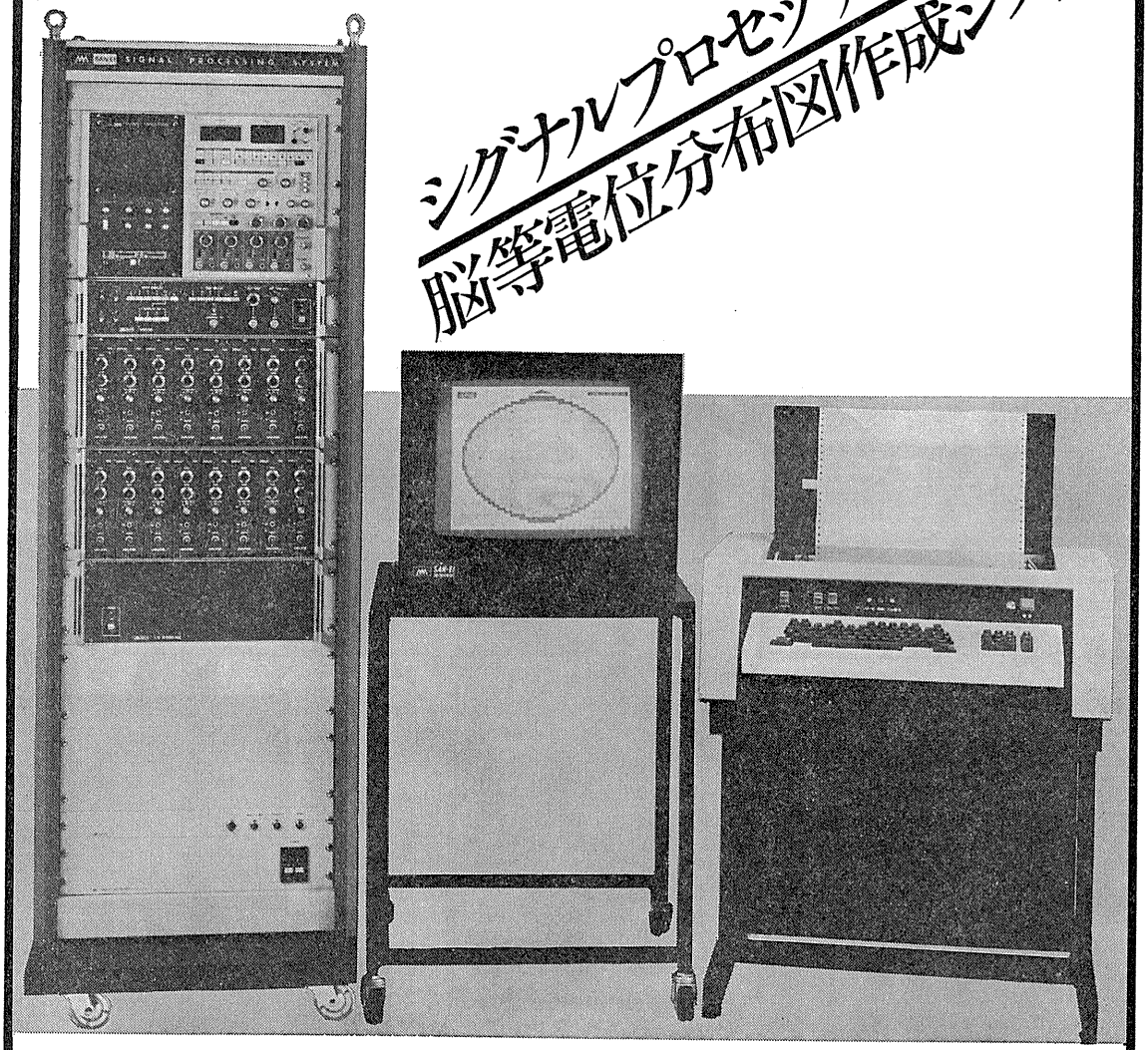
ニコレージャパン株式会社

東京都目黒区東山1丁目1番2号(東山ビル) 〒153 TEL 03(715)2551(代)
大阪市淀川区西中島6丁目7番8号(大昭ビル) 〒532 TEL 06(305)2150(代)
名古屋市千種区内山3丁目10番17号(今池ビル) 〒464 TEL052(741)2150(代)

詳しい資料を請求ください

明日の健康と福祉を守る
San-ei 三栄測器
東京都新宿区大久保1-12-1 〒160 ☎03(209)0811(代)

シグナルプロセッサによる脳等電位分布図作成システム



脳波計で導出した12または16chの脳波を解析して、各周波数帯域における脳等電位分布や、あるいはある潜時上における誘発反応電位振幅を求め、詳細な頭皮上の等電位分布図(二次元表示)を作成してカラーブラウン管に表示し、かつ超高速キーボードプリンタで印字記録するシステムです。従来、脳波を判読して、頭の中で空間的分布を作りあげていたものが、本システムにより、短時間で客観的、定量的にマッピング可能となりました。

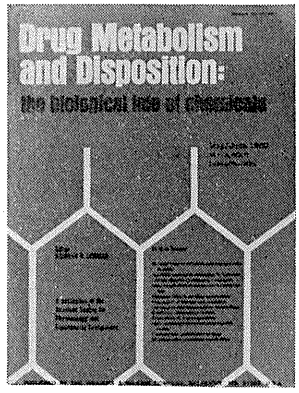
- ●周波数分析と誘発反応のマッピングが可能
- ●FFT方式による高速演算処理
- ●データ取込み時間を自由に設定可能
- ●周波数分析帯域は6帯域
- ●カラー表示、印字は11段階表示

トポグラフィシステム500

薬物代謝と生体処理

DRUG METABOLISM AND DISPOSITION

the Biological Fate of Chemicals



年6回発行

図書館・法人	￥21,300／年
個人	￥15,000／年
学生	￥11,500／年

本誌のテーマは、薬物、毒物、あるいは環境又は工業的化学物質等のin vitroおよびin vivoにおける運命についてであります。
特に興味あるのは、異物の吸収、拡散、代謝、排泄にかかわる経路とメカニズム、物質の化学的・物理的性状とその代謝処理との関係、これらのパラメーターの生物学的・薬理学的制御とその研究方法等であります。

薬理学の臨床関係者、内分泌学、消化器学等の専門医の方々に是非ご購読をおすすめします。

〈注〉学生価格は、3年間に限って適用されるので、ご注文の際には、学校名と専攻分野をお知らせ下さい。

■詳細なカタログご希望の方はご一報下さい。
■ご注文は最寄りの洋書取扱店又は、弊社にて承ります。
■予告なく出版元にて価格変更がなされる場合もあります。

Williams & Wilkins

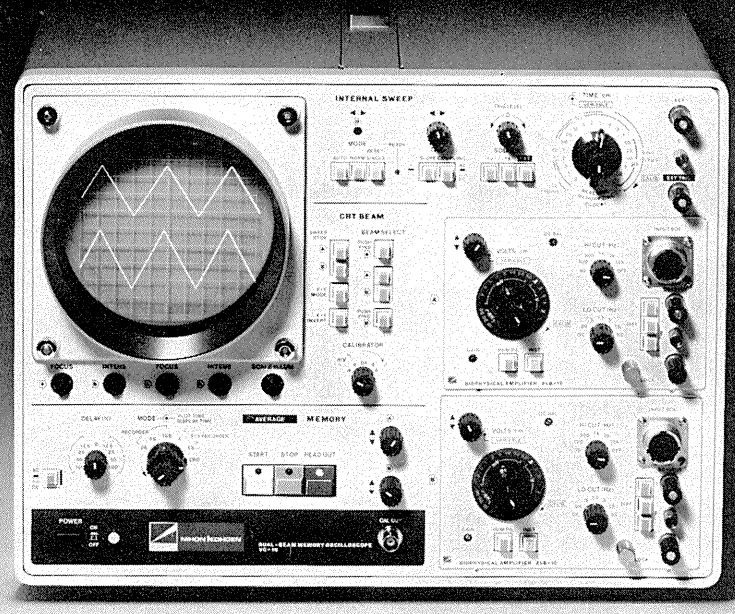
日本総代理店

USACO SCIENCE & TECHNOLOGY INFORMATION SERVICE

株式会社ユー・エス・エシアテックカンパニー

■本　社 〒105 東京都港区新橋1丁目13番12号 堤ビル ☎東　京(03)502-6471(代表)
■大　阪 〒530 大阪市北区堂島1丁目2番2号 日昭ビル ☎大　阪(06)344-6624(代表)
■名古屋 〒461 名古屋市東区橦木町3丁目63番地 ☎名古屋(052)931-2601(代表)
■筑　波 〒300 土浦市富士崎1丁目7番21号 和光ビル ☎土　浦(0298)23-1773(代表)

グレードアップして新登場!!



2-4現象 メモリオシロスコープ VC-10

DUAL-BEAM MEMORY OSCILLOSCOPE

2chメモリ内蔵。

記憶内容を静止波形として表示できます。リアルタイム波形と記憶波形の同時表示も行えます。また、記憶内容（X・Y）のリサージ表示も可能です。

トリガ点前の記憶も可能。

刺激後の誘発反応だけでなく、刺激前の現象を観察することもできます。±100%までのディレイ設定が行えます。

アベレージャ(別売)の追加可能。

誘発反応加算装置を追加することにより、2チャネルアベレージングが行えます。

専用モニタを用意。

4現象モニタVC-MA-10は、今までと違い1ガンチョッパ方式としたため、経済的な価格でお求めになれます。

さらに性能アップしたプリアンプ群。

(VC-9シリーズも使用可能)

①チョッパ増幅器（AVM-10）を使用した時も、両チャネルの信号出力（1V/cm）が得られます。

②AVH-10は、DC～10μV/cmの感度（入力インピーダンス10MΩ）とLO. CUT, HI. CUTフィルタの追加によりさらに使い易くなりました。

③AVB-10は、入力換算雑音5μV以下、入力インピーダンス180MΩ以上となり、バッファ・アンプ付入力箱により性能がアップしています。

エレクトロニクスで病魔に挑戦する

NIHON KOHDEN

日本光電

〒161 東京都新宿区西落合1-31-4

☎03(953)1181

販売推進部宣伝課

日本生理誌・第43巻8・9号・昭和56年9月1日発行（毎月1日発行）
〔昭和27年5月6日　第3種郵便物認可〕

昭和五十六年八月二十日印刷
編集兼発行人　酒井敏夫　東京都文京区本郷三―三〇―一〇　布施ビル（四階）　日本生理学会
印刷者　三浦経夫　山形県鶴岡市山王町一四―二四　鶴岡印刷株式会社
発行所　日本生理学会　〒一一三　東京都文京区本郷三―三〇―一〇　布施ビル（四階）
電話　八一五―一六二四
振替　東京三―八六四三〇
定価　三千円