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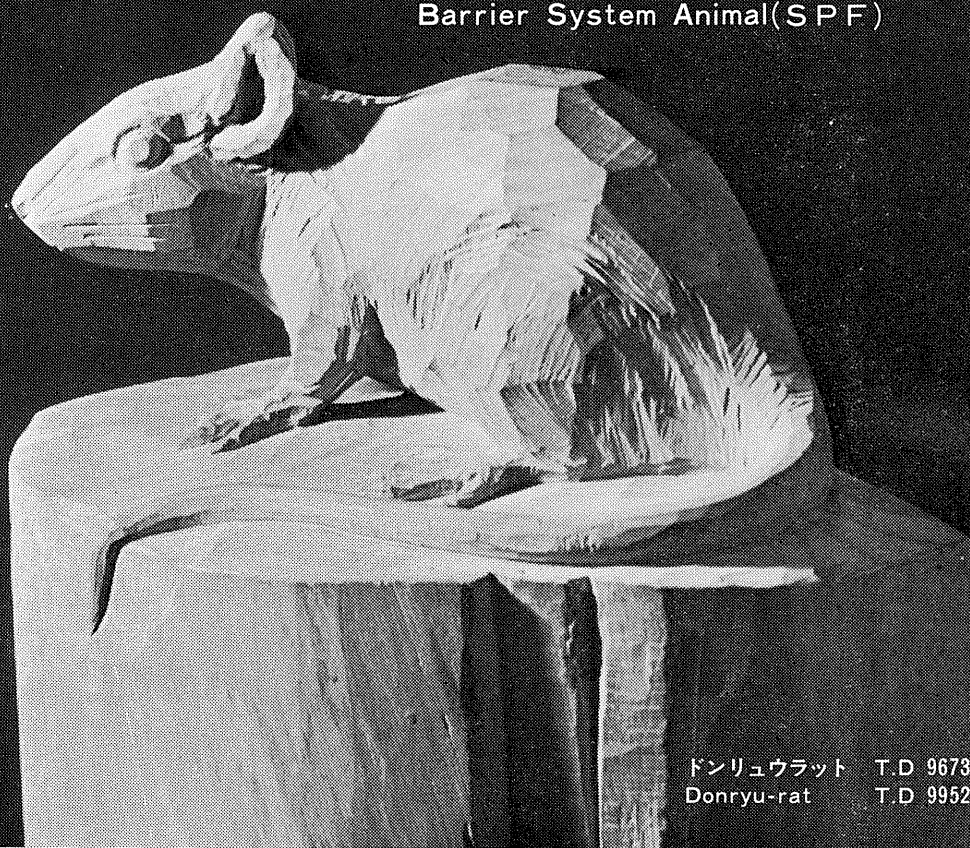
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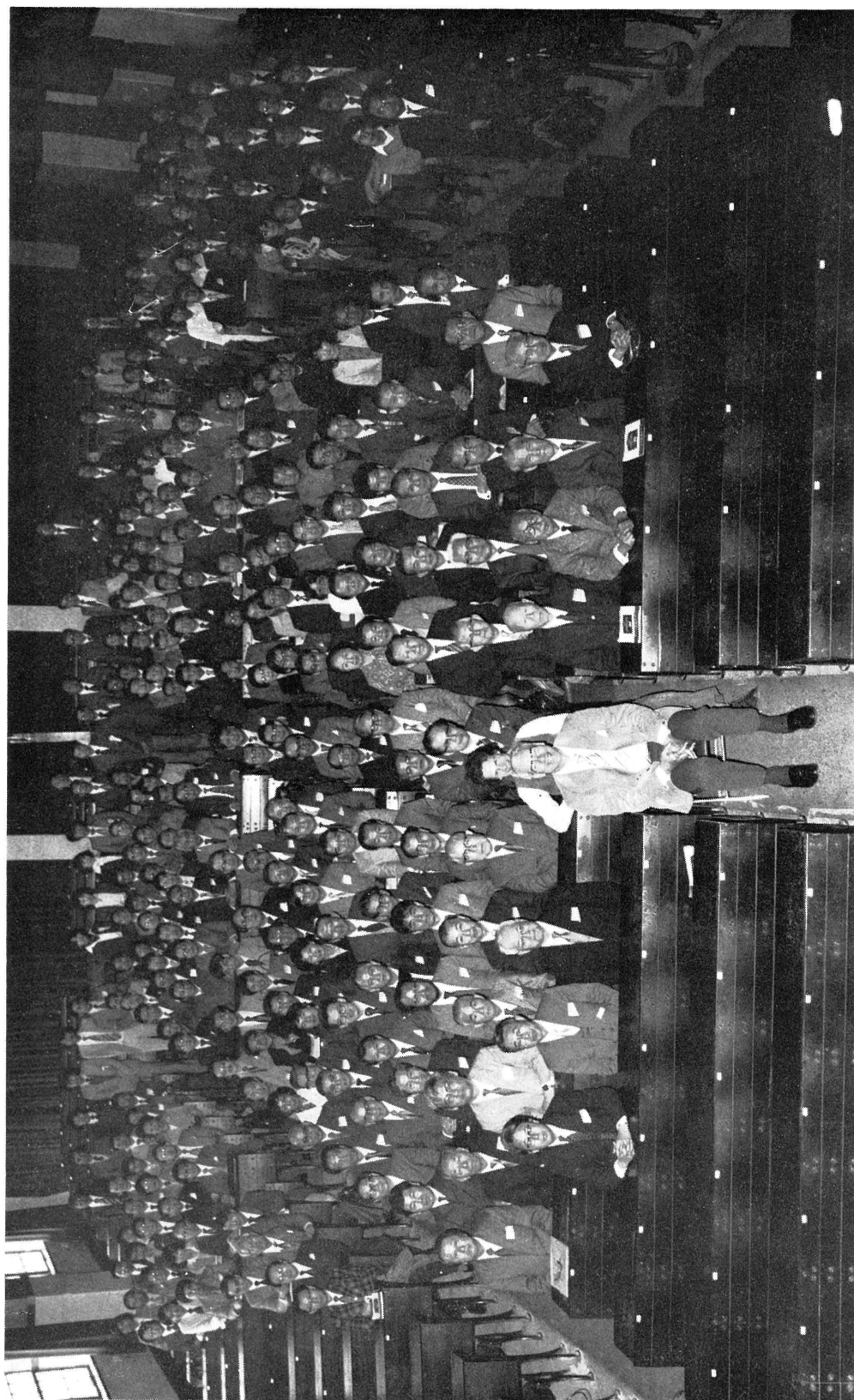
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第56回日本生理学会大会：於東京慈恵会医科大学

第56回日本生理学会大会を顧みて

第56回日本生理学会当番幹事

増 田 允・酒 井 敏 夫

このたび、第56回日本生理学会大会を東京慈恵会医科大学で開催いたしましたところ、1,393名(予約受付1,212名、当日受付181名)もの会員の方々の御参加をいただき、格別な支障もなく当番幹事の責務を果たすことが出来ました。これは偏に、会員の皆様方のご協力の賜物と厚く御礼申し上げる次第でございます。

この大会の準備に際しましては、常任幹事の方々のご支援はもちろん、前回当番幹事の方々からのご懇篤な学会資料のご提供をいただき、円滑な運営の基礎を得られましたことは、誠に有難く存じます。

大会開催の時期につきましては、医学会総会につながるよう、また会場には本学の施設を利用しようと考え、学内活動等とちか合わないようにするため、4月4、5、6日の3日間を会期と致しました。

一般演題については、できる限り討論時間を持てるように、また限られたスペース、時間などを考慮し、ポスターセッションの大幅な拡大をいたしました。その結果1研究単位につき、口演、ポスターセッション各1題ずつという募集制限をいたしました。その結果は、口演演題287、ポスターセッション173題、計460題となりました。また一般口演を午前中に打ち切りシンポジウムを午後に組んだため、口演7会場、ポスターセッション4会場が必要となりました。口演会場は学内のほとんどの講堂、集会室を使用せざるを得なくなり、会場によっては狭く換気も悪い上、連日超満員となり、多大の御迷惑をおかけ致したと思います。

また新しい試みとして、シンポジウムを企画いたしました。生理学会はすべて会員は平等を旨とし、特別講演やシンポジウムを持つ慣習は例外を除きありませんでした。しかし研究分野は近年ますます多岐に専門化され、自らの専門分野をはなれて、他分野の研究ははなはだ理解しにくい状態

になりつつあると考えられます。そこで、私共は会員の相互理解の一助とすべく、また学会の伝統を重視しながら、一般口演の延長としてのシンポジウムを5題設定いたしました。座長は当番幹事が選定し、次いでその座長の方々に、それぞれ4～5題の演題を一般演題中から選んで頂く手順を取りました。また、シンポジウムの当初、シンポジウム表題についてのわかりやすい解説を座長の方をお願いいたしました。座長の方々ははじめシンポジスト各位には一方ならぬ御迷惑をおかけしたと存じますが、お蔭様で先生方の多大な御理解、御協力により、先ずは成功裡に終了できたことと信じております。改めて快く座長ならびにシンポジストをお引き受け下さった方々には心から御礼申し上げます。

また今回からは、日生誌大会号の抄録はすべて、英文タイプ写真版印刷と致しました。この件に関して日生誌編集委員会に御提案申し上げましたところ、皆様の御賛成を得、今回その実現を見た次第です。今後の学会の国際化への大きな一助になることと確信いたしております。

学会運営費は、参加費5,000円で696万円のほかに広告料、慈大生理同窓会からの後援費等でしたが、経費の削減につとめ、ほぼ収支を相償うことが出来ました。

以上、第56回大会を顧みて、概要のご報告をいたしました。従来に比べ、会場数が多かったため、談話室等のスペースが十分とれず、会員各位には多大の御迷惑をおかけしたと存じます。シンポジウム、ポスターセッションのありかたなど新しい試みを行ってみましたが、今後の学会運営のための試金石になれば幸甚と考えます。故浦本政三郎先生当番幹事による昭和9年大会以来、45年ぶりの本学での大会開催でしたが一応大過なくその任を終えることができましたことは、会員の皆様のご協力の賜物と、重ねて厚く御礼申し上げます。

THE 56th ANNUAL MEETING
OF
THE PHYSIOLOGICAL SOCIETY OF JAPAN

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The Jikei University School of Medicine, Tokyo

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IMPROVED METHOD FOR ORGAN PERFUSION CULTURE. S. KASAI, Y. AMAGAI, S. NIHEI, H. KODAMA, M. IIJIMA. Dep. of Physiol., Tohoku Dental Univ., Koriyama Fukushima.

Rat's head was perfused applying the improved system for organ perfusion culture by the way of cannulation of carotid artery and jugular vein. The improved points were 1) application of fine pressure regulating valve, 2) installing of a large-sized motor for pumping whose vibration was fully insulated, 3) application of an artificial kidney, to modified Miller-Brauer's system. Upper half of the artificial kidney was used as an artificial lung and lower half was used as it was. Change of composition in the circulation medium, which consisted of packed RBC and α -MEM pepped up with glucose and supplemented with 8% BSA, was slowed down by outer fluid in the artificial kidney. EEGs were recorded from the rat's brain throughout the perfusion. The results showed the longest survival of spontaneous activity for 11 hours and a quarter. In this experiment, large waves were observed in response to the injection of Metrazole (known as CNS stimulant). In another trial, the dramatic revival of spontaneous brain waves was observed after long silent state extended for 2 hours 47 min., and the waves lasted for 6 hours.

2

ENZYME KINETICS STUDY BY STEADY-STATE DIALYSIS METHOD. M. HASHIMOTO*, T. HIGASHI*, M. UOZUMI*, A. OKUMURA**, (*) Dep. of Physico-chemical Physiology, Medical School, Osaka Univ., 4-3-57 Nakanoshima, Kita-ku, Osaka. (**) Central Research Lab., Hyogo College of Medicine, Mukogawa Nishinomiya, Hyogo.

The model reactor, which comprises the encapsulated enzyme in a semi-permeable membrane and the counter flow of the substrate solution on the out side surface of the semi-permeable membrane, in which the substrate reacts with the enzyme through the semi-permeable membrane, is designed. The concentration of the substrate in the enzyme solution is postulated to be homogeneous in the assumed model and are measured for the experimental proof. Xanthine oxidase and its substrate(xanthine) are employed, the rate of substrate decomposition is examined in the steady-state of the whole system.

From the experimental results and theoretical assumption, substrate clearance $(f(s_0-s)/s_0)$ in a simple cell model is interpreted in a simple expression:
 $1 / \text{clearance} = s_0 / f(s_0 - s) = (s_0 + K_m) / V_m V_i + 1 / 2f + 1 / 2k_A$
 s_0 and s : influent and effluent substrate concentration, K_m is Michaelis Constant, $V_m V_i$: total activity of the encapsulated enzyme, f : flow rate of the substrate solution, K and $2A$: permeability and area of the semi-permeable membrane.

3

SPECTRAL PROPERTIES OF FLAVINS AND FLAVOPROTEINS (K. Shiga, Y. Nishina K. Horiike*, T. Kitagawa**, H. Watari, National Institute for Physiological Sciences, Okazaki, Institute for Protein Research, Osaka University, Suita** and Dep. of Biochemistry, Medical School, Osaka University, Osaka*.)

The absorption, CD, MCD and Raman spectra of flavins and flavoproteins were observed. The MCD spectra showed two Faraday B-terms, but the A-term could not be observed, suggesting that there was no degeneracy in the excited state (310-600nm). The CD spectra reflected the environment around isoalloxazine more sensitively than the MCD spectra did. The vibronic structure of flavin was modified differently by each flavin-protein interaction. Further, to understand the electronic structure of roseoflavin and 8-amino-riboflavin, molecular orbital calculation for 8-amino-7-demethyl-isoalloxazine was performed (Pariser-Parr-Pople approximation). The transition energies (eV) and oscillator strength with parenthesis were 2.8507(0.7849), 3.5074(0.0347), 3.9359(0.0171), 4.0962(0.0986), 4.3829(0.6936), 4.7226(0.1411), 5.1429(0.5926). The results gave good agreement with the observed transition energies of two flavins above mentioned.

4

ON THE BINDING OF LIPIDS WITH SERUM ALBUMIN. T. KAWAGUCHI
H. MATSUSHITA. Dep. of Physiol., Wakayama Medical College, Wakayama

Serum albumins mixed with phosphatidyl inositol, phosphatidyl inositol monophosphate and phosphatidyl inositol diphosphate (PIP₂) were electrophoresed on urea-free cellulose acetate membrane in barbiturate buffer at pH 8.9 and pH 8.2. Electrophoretic mobilities of these albumins differed apparently with that of ligand-free or fatty acid bound albumin. Mobility was highest in PIP₂. The binding of the ligands with albumin were not damaged in 4.3 M urea during polyacrylamide gel electrophoresis (17hr), and differences of electrophoretic mobilities between these ligandbound albumins were the same as in urea-free membrane.

Several kinds of fatty acid derivatives, hexadecane, hexadecanol, cetyl bromide, 3-hexadecanone, palmitic acid, palmitic acid methyl ester, palmitic acid myristyl ester, palmitoyl chloride, palmityl acetate, heptanoyl chloride, heptanoic acid ethylester, were tested of these binding properties to albumin molecule.

5

ISOLATION AND PROPERTIES OF SIKI DEER MYOGLOBIN (Mb). A. NAKATANI,
Y. ENOKI, Y. IKAWA, M. KAWASE. 2nd Dep. of Physiol., Nara Med. Univ.,
Kashihara, Nara

Mb isolated from skeletal muscle of Sika deer (*Cervus nippon nippon*) was homogeneous by electrophoretic and sedimentation analysis. The molecular weight by sedimentation equilibrium was essentially identical with those by the iron analysis and the amino acid composition. The spectral properties of the various derivatives were determined. pK' of acid-alkaline transition of the met-Mb was 8.81(25°). Complete absence of such allosteric properties as heme-heme interaction, anion effect and the Bohr effect was noticed. Oxygen tension for half-oxygenation was 0.49 torr (20°) and its temperature-dependent change gave the ΔH° of -15.5 kcal/mol.

6

Na^+ INTERACTING WITH GRAMICIDIN D. A NUCLEAR MAGNETIC RESONANCE STUDY. H. MONOI AND H. UEDAIRA*. Dep. of Physiology, Tohoku Univ. Sch. of Medicine, Sendai, and *Res. Inst. for Polymers and Textiles, Yokohama.

^{23}Na nuclei in a milk-white emulsion composed of nonionic surfactant and higher alcohol in saline were characterized by single values of T_1 and T_2 and a single Larmor frequency. In the presence of small amounts of gramicidin D, the relaxations of ^{23}Na were greatly accelerated, and the transverse relaxation was the sum of two decaying exponentials. But only a single T_1 was observed; it was roughly equal to the slow T_2 . The slow T_2 accounted for about 40% of the total resonance intensity. The relaxation rates increased linearly with the increase of the gramicidin concentration. The absorption signal consisted of a narrow and a broad line, both centered at the same frequency. The present results suggest that nuclear magnetic resonance spectroscopy is a useful tool for studying the nature of ion-permeable channels of biological membranes, even when the channel has no ionizable groups. [Biophys. J. 25, 535 (1979)].

7

TIME-RESOLVED FLUOROPOLARIMETRIC STUDIES ON REDUCED PROTEIN-SODIUM DODECYL SULFATE COMPLEXES. M. SOGAMI, S. NAGAOKA, H. ASHIDA*, H. INOUE AND S. ERA, Dept. of Physiology, Sch. of Med., Gifu Univ., Gifu and *Dept. of Physiology, Defence Med. Col., Tokorozawa

Reynolds and Tanford (J. Biol. Chem. 245, 5161 (1970)) and Shirahama, Tsuji and Takagi (J. Biochem. 75, 309 (1974)) have proposed a rod-like model and a necklace model, respectively for reduced protein-sodium dodecyl sulfate (SDS) complex. Differences between these two models were re-examined by Wright et al (1975) and Rowe et al (1976) using the transient electric birefringence. One thiol of bovine plasma albumin (BPA) was labeled with N-dansylaziridine (DNS-AZ). Rotational freedom (rotational relaxation time (ρ)) and fluorescence lifetime of reduced DNS-AZ-BPA SDS complex were studied using time-resolved pulse fluorometric method (Abstract Paper of Int. Summer Sch. of Biophys. P 141-144 (1978)). ρ Values of reduced DNS-AZ-BPA SDS complex at binding level of 0.4g and 1.4g of SDS per g of BPA were 80 and 45 nsec, respectively. On the other hand, ρ values of nonreduced DNS-AZ-BPA in 0.10 M KCl, 8 M urea and 6 M GdCl were 110, 55 and 30 nsec, respectively. Our result might suggest the presence of domains, possessing rotational freedom, in reduced DNS-AZ-BPA SDS complex (1.4g SDS/BPA) and might support the necklace model.

8

QUANTITATIVE IMMUNOELECTRON MICROSCOPIC STUDIES OF THE MEMBRANE PROTEINS ON RAT LIVER MICROSOMAL VESICLES. YUTAKA TASHIRO, SHIRO MATSUURA & KAZUO AOI, Kansai Medical University, Dept. of Physiol., Fumizono-cho, Moriguchi-shi, Osaka 570.

Specific antibodies to rat hepatic microsomal cytochrome P-450 and NADPH-cytochrome c reductase were prepared by affinity chromatography and the approximately equimolar ferritin-antibody conjugates were prepared by Gel filtration. Rat liver microsomes were incubated with various amounts of ferritin- ^{125}I -labeled antibody conjugates and the maximum number of the antibodies which can bind to the microsomes was calculated. This number was in good agreement with the average number of ferritin particles which was determined by electron microscopic observation of the microsomal vesicles previously incubated with the conjugates at the saturation level. The present method makes it possible to estimate the amount of the microsomal enzymes (proteins) at an electron microscopic level.

9

EFFECT OF MEMBRANE CHOLESTEROL ON THE OXYGEN EGRESS FROM RED CELLS. K. KON, N. MAEDA, T. SUDA, and T. SHIGA. Dept. of Physiol., Sch. of Med., Ehime Univ., Ehime.

When the cholesterol contents in the human red cell membrane were artificially enriched, the retardation of the oxygen egress from red cells and other rheological impairments were observed.

To express the "oxygen diffusion barrier", a parameter, r , has been defined as $r = [\text{velocity of oxygen egress from red cells}] / [\text{velocity of oxygen dissociation from hemoglobin in the cells}]$, as previously reported. When the membrane cholesterol was enriched by the method of Cooper et al. (1978), the r -value decreased from 0.8 (for normal cells) to 0.6: i.e., the oxygen diffusion barrier increased. The deoxygenation rate of intracellular hemoglobin (k_c), determined by the stopped flow method, also decreased in the cholesterol-loaded cells.

Further, (i) the decreased membrane fluidity, as detected by the immobilized motion of the stearate spin label, (ii) the decreased deformability, and (iii) the slightly increased suspension viscosity were observed in the cholesterol-loaded cells.

These functional and rheological impairments could be explained by the condensing effect of cholesterol on the lipid organization.

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POSTNATAL CHANGES OF FETAL HEMOGLOBIN (Hb F) SYNTHESIS. II. G_γ/A_γ RATIO AND THE OXYGEN EQUILIBRIUM. Y. IKAWA, Y. ENOKI, S. TOMITA, K. NAGAI. 2nd Dep. of Physiol., Nara Med. Univ., Kashihara, Nara

In an attempt to pursue the postnatal process of qualitative and quantitative changes of Hb F, a method of high yield was developed for isolation of Hb F from infant and adult blood. Hb F, constituting 83 % of total hemoglobin in cord blood, maintained the level for 20 days post partum and thereafter declined rapidly to reach the adult value of 0.5 %.

In newborns 70 % of γ chains of Hb F were G_γ , the rest being A_γ , and G_γ continued to decrease, inversely A_γ increasing, in the postnatal growth to reach the final adult level of 30 %. Oxygenation properties of adult Hb F were identical with those of cord Hb F.

11

INTERACTION OF BILIRUBIN WITH PLASMA ALBUMIN STUDIED BY FLUORESCENCE QUENCHING METHOD. S. NAGAOKA, H. INOUE, S. ERA, M. SOGAMI. Dept. of Physiology, Sch. of Med., Gifu Univ., Gifu

The interaction of bilirubin and bovine plasma albumin was examined by static fluorescence quenching. The albumin was first labelled by dansyl chloride which was adsorbed on celite. The fluorescence from the two dansyl groups in the albumin was found to be effectively quenched by addition of bilirubin at concentration as low as 10^{-7} M when a same order of the concentration of the albumin was used. However, the polarization of the dansyl fluorescence kept constant ($P=0.257$) over the quenched states. These results suggested that the mechanism of the quenching was due to an excited state energy transfer (Forster's mechanism) with high transfer efficiency from dansyl residue to bilirubin which was associated with the albumin molecule. The typical Stern-Volmer equation was found to be unsuitable to analyze this system because of the difficulty to know the fraction of free quencher concentration, and then modified method was introduced to obtain equilibrium parameters. The method enabled to calculate the association constant of bilirubin with the albumin at very low concentration region. By our method the association constant was calculated to be $3.5 \times 10^{-7} \text{ M}^{-1}$ which gave good agreement with those obtained by other methods.

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SWELLING-SHRINKAGE RESPONSE AND CONFORMATIONAL CHANGE OF MITOCHONDRIAL MEMBRANE
H.FUJIMURA, Y.NAKASE & T.TSUJIMOTO. Dept. of Physiol., Wakayama Med. Coll., Wakayama.

As a clue to elucidate the mechanism of energy conservation in mitochondria, conformational change linked with the metabolic state transition was pursued by spin-labeled ESR with maleimide N-oxyl (Syva No.110) or stearate N-oxyl probe [I(12,3), I(5,10), I(1,14)]. Because the probes effectively inhibited (No.110) or uncoupled (stearate probe) the oxidative phosphorylation and inhibited the structural change, it was introduced into mitochondria after fixation with glutaraldehyde (abbr. as GA) by a sucrose density gradient method. The fixation of mitochondria drastically altered the spectra of No.110: weakly immobilized signal decreased, while strongly immobilized one increased; τ (empirical motion parameter) increased from 1.9×10^9 in un-treated prep. to 3.8×10^9 s in prep. treated with 1.25 % GA; and indicated a decrease of the mobility of bound probe. Parallel study with electron microscope showed a transition of structural state (from energized to non-energized) in samples un-treated with GA. Stearate probe barely reported small change in τ by GA fixation, however, disappearance of polar third high field line was noticed. Break point in Arrhenius plot ($\log \tau : 1/T$) appeared at $\sim 13^\circ\text{C}$ with No.110 probe, while those with stearate appeared at 20 to 24°C . In summary, coincidence of the changes shown in conformation, structure and oxidative phosphorylation with GA suggested an involvement of conformational change in phosphorylation process.

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CELLULAR REDOX STATE AND RESPIRATORY CONTROL IN PERFUSED RAT-LIVER.
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KIMURA, S. & OGATA, E. Dept. of Intern. Med., Univ. of Tsukuba, Ibaraki

To elucidate the relation between intracellular redox state and respiratory control, we used perfused livers isolated from fed rats. Changes in the redox state were observed utilizing two kinds of surface photometric methods; scanning spectrophotometry for the mitochondrial electron carriers and fluorometry for both the mitochondrial and cytosolic NAD. O_2 uptake was monitored with a Clark electrode inserted to the effluent tube. Infusion of ethanol caused complete reduction of the cytosolic NAD which amounted to 52.6% compared to 100% reduction with nitrogen anoxia. Therefore, the mitochondrial NAD participates 47.4% of the total. Glucagon stimulated respiration and induced reduction of the cytochromes as well as reduction of the total NAD. The cytochromes b , $c+c_1$, and $a(a_3)$ were reduced in parallel with the increase in respiration rate, whereas reduction level of the total NAD remained unchanged. This discrepancy was analyzed by calculations to separate cytosolic NAD from mitochondrial NAD. Then, 12% oxidation was calculated for 46% reduction of cytochrome a and 10% reduction of the total NAD. This result accorded with decrease in lactate/pyruvate ratio of the effluent and signifies the onset of gluconeogenesis.

14

EFFECT OF CARBON MONOXIDE ON THE TISSUE RESPIRATION IN SITU. TAKEHITO TAKANO. Dept. of Hygiene, Tokyo Med. Dent. Univ., 1-5-45 Yushima Bunkyo-ku Tokyo

The effect of carbon monoxide (CO) on the intracellular oxidation-reduction (redox) state was studied in the renal cortex of rabbits in situ. The animals were divided into two groups; one consisted of blood circulating animals, and another consisted of animals which prepared by exchange transfusion with perfluorochemical (PFC) emulsion that maintained O_2 delivery to the tissue.

Pyridine nucleotide (PN) fluorescence was detected with a light pipe fluorometer. Arterial and venous gases, CO-Hb%, tissue PO_2 , O_2 concentration in the inspired gas, and renal blood flow were measured with a gas analyzer, NDIR, O_2 electrodes, an O_2 analyzer, and an electromagnetic flowmeter, respectively.

Even when considering Haldane's effect, CO hypoxia caused increase in fluorescence response at milder hypoxidoses than that by hypoxic hypoxia, though redox state was not independent of blood flow.

However, in PFC animals which had little Hb (Ht: <1%), CO hypoxia caused more increase of the amount of reduced PN than nitrogen hypoxia, significantly. This suggested that CO had direct effect on the respiratory chain in situ.

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RELATIONSHIP BETWEEN THE INDUCTION OF DNA SYNTHESIS AND CHANGES IN THE CONCENTRATION OF INTRACELLULAR Na^+ IN THE LIVER OF INTACT RATS. K. HASEGAWA and M. KOGA, Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi.

Changes in the concentration of intracellular sodium ion ($[\text{Na}^+]_i$) were examined in rat liver stimulated to proliferate. Liver DNA synthesis was induced by partial hepatectomy (P.H.) or by chemical manipulations. The latter included injections of physiological saline or isoproterenol in combination with the injection of glucagon. $[\text{Na}^+]_i$ began to increase at 30 min after P.H., reached a maximum at 4 h and remained nearly the same level thereafter. The maximum $[\text{Na}^+]_i$ was 2.7-fold over that of non-treated rat liver. Laparotomy did not increase $[\text{Na}^+]_i$ significantly. In contrast to $[\text{Na}^+]_i$, relative $[\text{K}^+]_i$ did not change after partial hepatectomy. In the liver stimulated to proliferate by the injections of isoproterenol followed by glucagon, $[\text{Na}^+]_i$ began to increase at 2 h after the first injection, reached a maximum of 2.3-fold increase at 9 h and decreased gradually to the normal level by 20 h. In the case of physiological saline followed by glucagon injection, $[\text{Na}^+]_i$ began to increase at 2 h and reached a maximum of 1.7-fold increase at 9 h, then decreased to the normal level by 20 h. In all cases examined, $[\text{Na}^+]_i$ in the liver stimulated to proliferate showed 1.5- to 2.7-fold increases over the normal level for several hours (6 to 12 h). These results suggest the possibility that Na^+ is involved in one or more processes in the induction of DNA synthesis in the liver.

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EFFECTS OF METHYLMERCURIC CHLORIDE ON THE TISSUE RESPIRATION AND CHANGES IN THE NET MOVEMENT OF MERCURY, POTASSIUM AND CALCIUM IONS.

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In the present experiment were investigated the effects of methylmercuric chloride (hereinafter abbreviated as MMC) on the tissue respiration and the movement of cations in rabbit cerebral cortex, kidney cortex and liver slices. Concerning the influence of MMC on the tissue respiration of cerebral cortex, oxygen consumption was decreased by 10^{-4} mol MMC, but was slightly increased by 10^{-5} mol MMC. Oxygen consumption of kidney cortex was slightly decreased by each concentrations of MMC. Oxygen consumption of liver was decreased by 10^{-4} mol MMC. Concerning the changes in the movement of mercury, potassium and calcium ions, mercury ions of several tissues were taken in proportion to each concentrations of MMC. The outflow of potassium ions in cerebral cortex was decreased by 10^{-5} mol MMC. The influx of calcium ions was shown in several tissues.

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ON THE SIGNIFICANCE OF INTRACELLULAR ATP LEVEL OF L CELLS. YAMAGUCHI, H., S. ISHIGURO, T. YONEZU, S. TANABE, Y. OKA. Dep. of Physiol., Sch. of Med., Univ. of Tokushima, Tokushima

The significance of cellular ATP level 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 the glucose analogue 2-deoxy-D-glucose (2-DG), the respiratory uncoupler carbonyl cyanide chlorophenylhydrazone (CCCP) and the glycolysis inhibitor iodoacetate (IAA). Cellular ATP level in G_1 phase was only slightly decreased in the absence of exogenous glucose ($<5 \mu\text{M}$). Furthermore, neither 2-DG nor CCCP were very effective (70-80% of control) inhibitors of cellular ATP level when used individually. However, these inhibitors were highly effective (20-30% of control) in cellular ATP level to a much extent in the absence of exogenous glucose. In addition, strongly effects (10% of control) were observed when these inhibitors were combined, such as CCCP plus IAA or 2-DG plus IAA in the absence of glucose. Also, it was found that the application of 2-DG plus IAA induced a significant difference of cellular ATP level between G_1 (10-20% of control) and non-synchronous (50-60% of control) cells at the presence or absence of exogenous glucose. Taken together, these results indicate that cellular ATP level in G_1 is reflected an energy-dependent process which can be supported by IAA-sensitive glycolytic energy pathways.

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ELECTROPHYSIOLOGICAL STUDIES ON MACROPHAGE CELLS OF GUINEA PIG AND MOUSE
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School of Dentistry, Kasumi 1 Chome, Hiroshima 734

Electrophysiological profiles of the guinea pig and mouse macrophage cells cultured in vitro were investigated using microelectrode technique.

The membrane potentials were about -20mV and spontaneously increased up to -30mV temporary and these slow hyperpolarizing responses were also evoked with a concomitant decrease of the input resistance by mechanical and electrical stimulation. No excitation and rectification were observed in certain range of membrane potentials with current injection.

The wide variety of electrical communication (low resistance coupling) were observed in attached cells.

These findings were similar to L cells in culture and seemed to be categorized in same cell membrane in electrophysiological characteristics.

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STUDY ON DIFFERENTIATION OF T-LYMPHOCYTE POPULATION BY THYMUS HUMORAL FACTOR. KINOSHITA, Y., KIMURA, S., KIMURA, E., UEDA, K.* AND SAKO, H.* Dept. of Physiol. and Gynecol.*, Osaka City Univ. Med. Sch. Abeno-ku, Osaka.

Thymus humoral factor (THF) secreted by reticulo-epithelial (RE) cells are capable of inducing differentiation of precursor-T-cells (PTC) into T-cells. However, a detailed mechanism of the factor in the differentiation pathway remains unclear. Owing to study on the question, we tried to extract THF from calf thymuses. The active factor, possibly polypeptide, possessed following properties; (a) conferring surface-differentiation-antigen upon PTC in nude mouse spleen cells, (b) enhancement of responding capacity of human blood lymphocytes to concanavalin-A stimulation, (c) conferring the receptor for heat stable factor of foetal calf serum on PTC in rat thymus. Since a constitutive ratio of RE cells in thymus is only about 1%, it is uneasy to extract THF in purified form. And other active factors than our THF might be lost in the extracting procedure. Theoretically, one of the way to solve this problem would be to make higher a percentage of RE cells in the material for extraction. Accordingly, the authors attempt to culture the cells in monolayer and to make an apparatus to harvest much amount of THF from the cultured cells.

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ROLE OF LIGHT IN THE CIRCADIAN RHYTHM IN MOTILITY IN PARAMECIUM MULTIMICRONUCLEATUM.
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Characteristics of the circadian rhythm in motility in heterotrophic ciliate, Paramecium multimicronucleatum were demonstrated under various conditions of light. From experiments in which light conditions were transferred from 12 h-light and 12 h-darkness (LD; 12:12, 1000 lx) to various LD's (L 3+α:D 21-α; α=0, 3, 6, 12 h, 1000 lx), it could be concluded that the effect of transition from L to D is dominant compared with that from D to L for cells to adjust their oscillations to new LD cycles; they shift their oscillation to recur the subsequent peaks at around 4 hours after the transition from L to D. When the conditions were transferred to DL (D 21-α:L 3+α; α=0, 3, 9 h), adjustment to new DL cycles was accomplished, e. g., after several cycles in the case of DL (12:12). During the time course of the adjustment, transient peaks were observed, of which appearance could be interpreted with "the coupled translation-membrane model". The rhythm can be synchronized to shorter periods of LD cycles than 24 h (e. g., LD (6:6)). Phase response curve which was obtained with 2 h-light pulse given at various phase of the motility curve suggests the looser coupling with light in the system associated with the motility rhythm than in those associated with the various rhythms in various photoautotrophic unicellular organisms.

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EFFECTS OF γ -AMINO- β -HYDROXYBUTYRIC ACID (GABOB) SALTS ON THE EXCITABILITY OF AN IDENTIFIABLE GIANT NEURONE OF THE AFRICAN GIANT SNAIL (*ACHATINA FULICA FERUSSAC*). *I.YOKOI, *A. MORI, **M. KURONO & **S. MIYAMOTO. *Dept. of Neurochem., Inst. for Neurobiol., Okayama Univ. Med. Sch., Okayama. **Research Inst., Ono Pharmaceutical Co., Ltd., Shimamoto Cho, Mishima Gun, Osaka.

The intracellular membrane potentials were recorded from the TAN (tonically autoactive neurone, inhibited by GABA at 100 μ M). The effects of the stereoisomers (d-, l- and dl-form) of GABOB and its 14 salts were examined (bath application) on the TAN excitability at 1mM (d- and l-form) or 2mM (dl-form).

l-GABOB, one of the GABA agonists, had the inhibitory (hyperpolarizing) effects on the TAN at 1mM. d-GABOB had the very weak effect at 1mM. dl-GABOB at 2mM (total) had almost the same intensity of effect as that of the l-form, i.e. d(1mM) << l(1mM) = dl(total 2mM).

The relationships between stereoisomerism and the intensity of effect of the following salts of GABOB were similar to those of GABOB (d < l = dl); hydrochloric acid, m-xylene-sulfonic acid, methanesulfonic acid, p-toluenesulfonic acid, m-nitrobenzenesulfonic acid, 2,5-dichlorobenzenesulfonic acid, L-(+)-tartaric acid, fumaric acid, lithium and sodium. The relationships mentioned above of the following salts were different from those of GABOB; p-chlorobenzenesulfonic acid and β -naphthylsulfonic acid (d = dl < l), benzenesulfonic acid (d = l < dl) and maleic acid (d < l < dl).

22

DISTRIBUTION OF ELECTROLYTES IN EXOCRINE GLAND CELLS DETERMINED BY ELECTRON PROBE X-RAY MICROANALYSIS.

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Electron probe X-ray microanalysis of freshly frozen ultrathin sections of dog submandibular glands, frog lingual glands and posterior silk glands was performed and the distribution of electrolytes in the gland cells and/or organelles was determined. On above three kind of glands, the higher concentration of K and P was found in the cytoplasm of the gland cells. It was found that the secretory granules of the gland cells contained calcium. On pilocarpin stimulation, there was a rise in the concentration of Na and Cl in the cytoplasm as well as the secretory granule of dog submandibular gland cells. The quantitative electron probe X-ray microanalysis was also attempted.

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NONDESTRUCTIVE MEASUREMENT OF TRIGLYCERIDES IN MUSCLE BY ^1H NMR. WATARI, H.*, YOSHIZAKI, K., NISHIKAWA, H., YAMADA, S., and MORIMOTO, T. Dept. Mol. Physiol., Natl. Inst. Physiol. Sci., Okazaki*, Dept. Physiol., Kyoto Pref. Univ. Med., Kyoto

^31P NMR has been shown to be a potent tool for the study of the metabolism in living cells and organs. On the other hand, ^1H NMR studies on the living cells and organs are limited even though ^1H NMR has a great advantage that the sensitivity is much better than ^31P or ^{13}C NMR, and also that ^1H nuclei exist virtually in all biologically significant molecules. On muscle only spin-echo studies of water have been performed and the high resolution spectrum have not been reported. One of the major problems is the fact that water gives rise to an enormous resonance which swamps the spectrum. This water component uses up the available computer space and reduces the number of scans possible as well as cutting down the efficiency of digitization of the free induction decay of sample resonances. With selective saturation technique using Fourier transform NMR, it becomes possible to suppress the water resonance and to obtain the ^1H NMR (JEOL PFT-100, ^1H : 99.54 MHz) spectra of intact muscles of rat and bullfrog. The spectra consisted of a broad component (linewidth: approximately 5 ppm) and the high resolution portion, the latter was related to triglycerides and other compounds. The content of triglycerides was much higher in rat muscle than in bullfrog muscle.

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CYCLIC NUCLEOTIDE METABOLISM IN NEURONAL AND GLIAL CELL FRACTIONS SEPARATED FROM RAT BRAINS

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Intracellular levels of cyclic nucleotides (cAMP and cGMP) as well as their synthesizing and hydrolysing enzyme activities were studied on neuronal perikaryal and glial cell fractions separated in bulk from rat brains.

- 1), Larger amounts of both cAMP and cGMP were found in glial cell fraction than in neuronal fraction.
- 2), Adenylate cyclase activity was higher in glial cells than in neuronal fraction, while guanylate cyclase activity was detected in both brain cell fractions, and these cyclase activities were mainly derived from particulate fractions from these two types of brain cells.
- 3), Phosphodiesterase activities for both cAMP and cGMP were observed in both particulate and soluble fractions separated from these brain cells.
- 4), Effects of azide, fluoride and several neurohormones such as catecholamines and amino acids on these cyclase activities and cyclic nucleotide levels in neuronal and glial cell fractions were examined.

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OSMOTIC FRAGILITY CHANGE OF HUMAN ERYTHROCYTES INDUCED BY THE MIXTURE OF ELECTROLYTE AND SACCHARIDE SOLUTION: V. EFFECT OF Ca^{2+} . N. UYESAKA, Y. SHINAGAWA, Y. SHINAGAWA AND H. SHIO* Dept. of Physiol. and Geriatrics*, Fac. of Med., Kyoto Univ., Sakyo-ku, Kyoto

Osmotic fragility of human erythrocytes was tested by a coil plane centrifuge method and the conventional method. The mixture of NaCl and saccharide solution was produced by isosmotic replacement. The mixture of D-aldoses causes a striking increase in osmotic fragility of human erythrocytes, on the other hand, L-aldoses, ketoses, sugar alcohol and disaccharides cause decrease in it. Mutual inhibition of saccharide is observed. Phloretin inhibits the increase in osmotic fragility induced by the mixture. These results suggest that osmotic fragility change induced by the mixture depends mainly upon sugar transport across erythrocyte membranes, and isosmotic pressure in physical meaning does not affect isosmotically on erythrocytes. The plot of osmotic fragility changes vs. D-glucose concentration shows a biphasic curve which has maximum value. Addition of 0.05-0.5 mM Ca^{2+} to the hemolyzing solution results in remarkable decrease in osmotic fragility. The effect of Ca^{2+} upon osmotic fragility is large in the range of lower concentration of D-glucose, but is small in the range of higher concentration of it. The plot mentioned above shows monotonous curve in the presence of Ca^{2+} , and the maximum point is no longer observed. These results suggest that there exists at least two different mechanism of glucose transport in erythrocytes.

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EFFECT OF Ca ION TUBULIN STRUCTURE K.AIZAWA S.SAKAI & S.O'HATA., Dep. of Physiol., Tokyo Medical College., Shinjuku-ku Tokyo

Tubulin were prepared from developing chicks brain, by the method of SHELANSKI et al. 1973, and stored at -80°C in MES reassembly buffer pH6.8. Fluorescence of tubulin were measured in the thermostatted chamber of a HITACHI MPF-4 Fluorescence Spectrometer with excitation at 295nm. Absorption spectra of tubulin at U.V. region were measured by the Photoacoustic Spectrometer (PRINCETON APPLIED RESEARCH) in a sample cell which should be designed so as to maximized the s/n ratio of the microphone preamplifier. Fluorescence of tubulin have an emission maximum at 333nm and shoulder at 350nm. These emission intensity were in direct proportion to the protein quantity. But these intensity of the same quantity of protein could be changed under different condition. The decrease of the 333nm intensity at 37°C incubation corresponded to the polymerization of tubulin. K.AIZAWA et al.1977. After 60 min. incubation at 37°C , the 333nm intensity of tubulin was till 80% of the early intensity. By the addition of CaCl_2 (final 2mM), the 333nm intensity recovered to 95%. The 350nm intensity derived from GTP decreased about 15% by the addition of CaCl_2 . The 250nm absorption of tubulin bound GTP decreased by the addition of CaCl_2 . These decrease of emission and absorption of tubulin bound GTP induced the depolymerization of tubulin polymer by the CaCl_2 .

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EFFECTS OF THIOL REAGENTS ON PHOSPHOLIPID SYNTHETIC ACTIVITY OF LYMPHOCYTES. K. KAGEYAMA, Y. KINOSHITA, Y. KOMANO, E. KIMURA. Dep. of Physiol. Osaka City University Medical School. Abeno-ku Osaka

Effects of thiol reagents on phospholipid synthetic activity of lymphocytes were examined by the rapid method following Florisil column chromatography (Experientia 34, 1311, 1978). Moreover, RNA synthetic activities of the lymphocytes were observed.

Rat lymphocytes obtained from lymph nodes were incubated with a thiol reagent for 1h. Incorporation of (^{14} C) oleic acid into phospholipid in lymphocytes was reduced to 17.5 % of its control value in 20 μ M methyl mercury chloride, 18.5 % in 40 μ M N-ethylmaleimide, 18.4 % in 200 μ M hydroquinone and 47.1 % in 200 μ M α -chloroacetophenone. However, iodoacetamide did not show remarkable impairment of phospholipid synthetic activity in lymphocytes up to the concentration of 200 μ M. Similar results were also obtained in uptake of (^{14} C) acetate. The RNA syntheses of lymphocytes were tested by incorporation of (^{3} H) uridine. Effects of thiol reagents on RNA synthetic activity in lymphocytes coincided with those against phospholipid synthesis except only α -chloroacetophenone.

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A STUDY ON RESPIRATORY METABOLISM OF TISSUE CELLS. II. REGULATION OF GLYCOMETABOLISM AND MOVEMENT OF K IONS. K. YAMAGAMI, S. NISHIMURA. Dep. Physiol., Fac. Med., Kagoshima Univ., Kagoshima

In the present experiments were investigated the effects of monoiodoacetic acid (MIA) and cAMP on the cerebral cortex, liver, ascites tumor cells and subcutaneous tumor tissue by the measurement of the tissue respiration, glucose consumption and movement of K ions. On the cerebral cortex, the higher the concentration of MIA, the larger were inhibited the tissue respiration, glucose consumption and outflow of K ions. On the liver, effects of MIA were not shown. The tissue respiration on the ascites tumor cells was increased with 49 % by 10^{-4} mol MIA, and with 13 % by 10^{-3} mol MIA. The tissue respiration on the subcutaneous tumor tissue was decreased with each concentration of MIA. However, the higher the concentration of MIA, the larger were inhibited the glucose consumption and influx of K ions on the ascites tumor cells and subcutaneous tumor tissue. On the liver, the higher the concentration of cAMP, the larger was the tissue respiration. But the effects of cAMP were not shown on the cerebral cortex, ascites tumor cells and subcutaneous tumor tissue. The outflow of K ions on the cerebral cortex was decreased with each concentration of cAMP. The higher the concentration of cAMP, the smaller was the influx of K ions on the ascites tumor cells.

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STUDIES OF ENERGY METABOLISM IN MOUSE LIVER CELL NUCLEI. S. SAKAI, K. AIZAWA, S. O'HATA and M. YAMAO*. Dept. of Physiol., Tokyo Med. Col. Shinjuku-ku, Tokyo. *Dept. of Biol., O'tsuma Women's Univ. Chiyoda-ku, Tokyo.

Many reactions in nuclei including the synthesis of proteins, RNA and DNA require energy in the form of ATP. In order to examine nuclear energy metabolism, we have measured ATP levels in isolated nuclei from mouse liver and chick brain by an ATP photometer. Under anaerobic condition, ATP levels in both nuclei fall rapidly. Maximum ATP level in chick brain nuclei is obtained with glucose addition to the incubation medium under aerobic condition. The ATP synthesis in nuclear suspension is a very rapid reaction. The ATP synthesis is depend on the amount of nuclear protein and on the glucose concentration added to the medium. Iodoacetic acid which is an inhibitor of glycolytic enzyme, triphosphate dehydrogenase, decreases ATP levels in nuclei at a concentration of 10^{-3} M. Glycolysis seems to be involved in ATP synthesis in the isolated nuclei. The ATP level in chick nuclei is higher than that in mouse. The ATP level in chick nuclei decreases in the presence of Na ion in the incubation medium.

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EFFECT OF SERUM COMPONENTS ON THE GROWTH OF HeLa S3 CELLS CULTURED IN THE LOW K^+ AND HIGH Rb^+ MEDIUM

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HeLa cells grow in the chemical defined medium (CDM) described by Higuchi as well as in Eagle's MEM for four days. Rb^+ was reported to act as an analogue for K^+ in ion transport across cell membrane. Cellular K^+ was gradually exchanged with Rb^+ by replacement of extracellular K^+ with Rb^+ . When more than 90% of K^+ in CDM was replaced with Rb^+ , cell proliferation, especially protein synthesis was strongly repressed. But non-dialyzable component of calf serum which had been added to the Rb^+ -replaced CDM by 5 to 20%, diminished the inhibition, whereas intracellular K^+ or Rb^+ concentration was not influenced. Boiled serum did not have the recovery effect. Therefore some active component to decrease the inhibitory effect caused by low K^+ and high Rb^+ condition, must be protein or protein-like substances. Precipitation occurred between 40-50% addition of saturated ammonium sulfate was more effective than others. It was again separated by gel column chromatography. Effect of the fractions was compared. Range of molecular weight of the effective substance was higher than 65,000.

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CHANGES IN ACTIVITIES OF CELL PROLIFERATION REGULATORS IN RAT LIVER CYTOPLASM INDUCED BY PARTIAL HEPATECTOMY.

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In the regeneration mechanism of rat liver induced by partial hepatectomy, the changes in humoral informations modulate the hepatocytic factors; the changes in the concentration of cyclic nucleotides and activities of their regulatory enzymes and other phenomena have been reported. But the presence and roles of macromolecular regulatory factors in the hepatic cytoplasm have not been investigated thoroughly. We have communicated the co-existence of inhibitory and stimulatory protein factors for cell proliferation in rat liver cytosol. In the present communication we report the presence of two cell proliferation inhibitors in rat liver cytosol and their partial purification. One is arginase and the other is a protein factor that inhibits protein synthesis in L-cells and chick embryo cells. The factor is insensitive to the treatment by heat, trypsin, and RNase, and it is not dialysable through visking tube. The responding mechanism of cytosol factors against the changes in humoral informations induced by partial hepatectomy is to be investigated.

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INDUCTION OF DNA SYNTHESIS IN PRIMARY MONOLAYER CULTURES OF ADULT RAT HEPATOCYTES (IV)—EFFECT OF CARBOHYDRATES ON SURVIVAL AND DNA SYNTHESIS. K. NAMAI, K. HASEGAWA AND M. KOGA, Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi.

Although glucose is known to be essential for growth of cells in culture, many other carbohydrates have been found to substitute for glucose. Glucose metabolism in liver, however, is different from that in other tissues. Therefore, we examined the effect of carbohydrates on the survival and DNA synthesis of adult rat hepatocytes in primary monolayer culture. Among the carbohydrates examined, pyruvate was found to be most effective in survival and DNA synthesis of hepatocytes. The amount of ^3H -thymidine incorporated into DNA increased as the pyruvate concentration in the medium was increased from 50 to 200 mg/dl. Glucose, galactose, fructose, sorbitol, xylitol, succinate and lactate were less effective; they did not permit the survival of hepatocytes when substituted for pyruvate in our culture system. The addition of these carbohydrates (100 mg/dl) in the pyruvate medium did not change the degree of DNA synthesis. By contrast, pyruvate alone did not support growth of the rat liver cell line, Hepro, and a small amount of glucose in addition to pyruvate was necessary. Also, the rat hepatoma cell line, AH66F, required glucose at relatively high levels for growth.

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DEPOLARIZING AND HYPERPOLARIZING EFFECTS OF NORADRENALINE ON GUINEA-PIG LIVER CELLS. K. EGASHIRA and T. TOMITA. Dept. of Physiol., Sch. of Med., Fukuoka Univ., Nishi-ku, Fukuoka

It has been reported that noradrenaline (NA) hyperpolarizes the membrane and decreases the membrane resistance in the guinea-pig liver cells (Haylett & Jenkinson, 1972). This effect is mediated through α -receptors and has been explained by an increase in K conductance. However, in the present experiments, a biphasic response, depolarization followed by hyperpolarization, was observed. In the cells having lower membrane potentials the hyperpolarization was larger, while in those having higher membrane potentials the depolarization tended to be larger. The depolarizing component was dependent on both Na and Cl, suggesting an increase in conductance to these ions. On the other hand, the hyperpolarizing component was inversely dependent on external K. When external Ca was removed, the hyperpolarizing component was gradually abolished. Readmission of Ca in the presence of NA produced a similar response to NA in normal solution. It is speculated that NA facilitates inward transport of Ca and that Ca acts on the inner surface of membrane to increase the K conductance.

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Mg-ATP-INDUCED DEPOLARIZATION OF GRANULE MEMBRANE POTENTIAL AND RELEASE OF EPINEPHRINE IN ISOLATED CHROMAFFIN GRANULES. M. OGAWA Dept. of Physiol., Kochi Med. School

The effects of ATP, Mg, and various agents on membrane potential and epinephrine release across membrane of chromaffin granules, isolated from bovine adrenal medullae, have been investigated. The fluorescence of diS-C₃-(5) was used to estimate the membrane potential of granules. Addition of 0.2mM ATP and 1.0mM Mg induced depolarization of granule membrane potentials, -45mV (intragranule side negative) to +27mV, and release of epinephrine. The magnitude of depolarization (ΔE_m) was a saturable function of ATP and Mg. In proportion to ΔE_m , the rate of amine release ($\dot{Q}$) increased. The time courses of ΔE_m and amine release (Q) were different; ΔE_m was rapid and established within a minute, while Q was approximately linear for more than 15 minutes with constant $\dot{Q}$. These evidence suggests that a charged species must be involved in the amine release mechanism. DCCD, an inhibitor of H⁺-ATPase in mitochondria, reduced competitively ΔE_m . Replacement of Cl⁻ with impermeant anion SO₄²⁻ also reduced ΔE_m . Using valinomycin, a K⁺ ionophore, the K⁺ equilibrium potential was monitored at the process of ATP-induced depolarization. It was shown that Mg-ATP brings about release of intragranular K⁺. These results suggested that Mg-ATP-induced depolarization promotes the transport of K⁺, H⁺, and Cl⁻ across the granule membrane and which is preconditions for epinephrine release.

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K⁺ ACTIVITY IN THE DOG SUBMANDIBULAR ACINAR CELL USING K⁺ SENSITIVE MICROELECTRODES. H.MORI, M.MURAKAMI, T.GOTO, Y.IMAI. (Dep. of Physiol., Osaka Med.Col., Takatsuki, Osaka)

When dog submandibular acinar cell was stimulated by Ach, it evoked a change in membrane potential (M.P) with K release from cell to blood and saliva. These results have been already reported in cat and dog submandibular gland in perfused experiments. Double barreled Ion-selective microelectrodes were applied to measure intracellular K⁺ activity, M.P and their changes during Ach-stimulation in vitro. Resting membrane potential and A_Kⁱ ranged widely from -20 to -65mV with mean -36.8mV and 35 to 110mM mean 77.9mM (n= 172), respectively. And slight correlativity (γ=0.54) was observed between M.P and A_Kⁱ in resting cells. By addition of small dose of Ach (10⁻⁴M) directly to tissue bath, hyperpolarization and A_Kⁱ decrement of acinar cell was observed. A_Kⁱ decrement delayed slightly. Average value of A_Kⁱ changes was 8.25±4.8mM (n=6) among various A_Kⁱ levels. These observations may be explained as the result of increment of P_K on the acinar cell during stimulation which induced hyperpolarization of membrane potential and K⁺ release from the cell in the initial phase.

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A MODIFIED METHOD FOR ISOLATING INTESTINAL BRUSH BORDER MEMBRANE VESICLES AND MEMBRANE CHARACTERISTICS OF HIGHLY PURIFIED VESICLES. K. OHSAWA, A. KANO, K. KAWAHARA, and T. HOSHI. Dept of Physiol., Faculty of Med., Univ. of Tokyo, Bunkyo, Tokyo.

A simpler and more rapid method for isolating brush border membrane vesicles was developed. The new method includes two major steps; filtration of the homogenate of epithelial cells and fine-porous-glass-beads column chromatography (size-separation procedure). Any step of ultracentrifugation was omitted in the new method. Ca⁺⁺-precipitation step was also eliminated because extensive comparative studies revealed that Ca⁺⁺ had no important role in vesicular formation and preservation of permeability characteristics or transport functions. The presence of EDTA or EGTA had no effect on Na-dependent overshooting uptake of D-glucose. Availability of very homogenous vesicular preparations enabled us to estimate the zeta-potential for the brush border membrane vesicles. It was found that the zeta-potential was -10.1 mV in a medium containing 0.15 M NaCl and 0.05 M mannitol at 20°C and pH 7.4, and that the polarity was reversed at pH 4.3. The electrophoretic mobility of the vesicles decreased rapidly with increase in the ionic strength of the medium from 0.01 to 0.1 but it decreased only slightly with increase from 0.1 to 0.2. High concentrations of divalent cations caused the reversal of the polarity of membrane surface charge, e.g. CaCl₂ caused the reversal at 0.14 M.

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EFFECTS OF ANIONS ON WATER TRANSPORT ACROSS THE INTESTINE OF SEAWATER EELS. ANDO, M. Physiol. Lab., Fac. of Integrated Arts and Sci., Hiroshima Univ., Hiroshima

In seawater eel intestine, both water and Cl⁻ transports are higher than fresh-water eel's. The present investigation was performed to clarify the relationship between Cl⁻ transport and water transport across the seawater eel intestine. The electrical potential difference (PD) and net water flux were measured simultaneously with a stripped preparation after changing Cl⁻ concentration in bathing solution. The Cl⁻ concentration was altered by replacing Cl⁻ with NO₃⁻, C₂H₅COO⁻, CH₃COO⁻, CH₃SO₄⁻ or SO₄²⁻. When the mucosal Cl⁻ was replaced with SO₄²⁻, the net water flux was reduced to zero in 10 min, while the serosal replacement of Cl⁻ by SO₄²⁻ had no effect on the net water flux. This shows that the net water flux is dependent only on mucosal Cl⁻ concentration. With the diminution of mucosal Cl⁻ concentration, from normal (128.3) to 0 Eq/l, the net water flux progressively fell to zero and the PD of serosa-negativity was also progressively decreased to serosa positive at 0 Cl⁻. When NO₃⁻ was substituted completely for Cl⁻, however, 50 % of the normal water flux still remained and PD was near zero. When these net water fluxes were plotted against their corresponding PD values, a linear relationship was obtained between them in both middle and posterior parts of the intestine. The correlation between the PD and the net water flux indicates that the water transport closely depends on the Cl⁻ transport.

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CHARACTERISTICS OF PAH UPTAKE IN Na-FREE MEDIUM BY RAT KIDNEY CORTEX SLICE.

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Two sets of experiment were designed to study the effect of Na-free PAH uptake in rat kidney cortex slice. (1) Effect of competitive inhibitor and anoxia on PAH uptake in Na-free medium: Simultaneous presence of hippurate, competitive inhibitor of organic acid, resulted in a significant decrease in PAH uptake. Anoxia caused a significant increase in PAH uptake and in ECF(PEG) space, and a significant decrease in the intracellular K concentration. (2) Effect of medium K concentration on PAH uptake: K has an augmenting effect on PAH uptake even in the absence of Na. When tissue water content was controlled at 72% with elevating medium osmolarity by an addition of mannitol, the augmenting effect was seen even when K was elevated up to 145meq/l, and PAH uptake was linearly proportional to the decrease in the difference between the logarithms of extra- and intracellular K concentrations. In the presence of Na at a fixed concentration, an graded increase of K concentration resulted in the increase of PAH uptake in almost parallel to that caused by K in the absence of Na. The data show that Na-dependent and K-dependent uptake are simply additive and K stimulates only the uptake mediated by PAH-carrier complex through the decrease in $\log [K]_o/[K]_i$, namely the depolarization of the peritubular membrane.

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INFLUENCE OF PHENAZINE METHOSULFATE AND VITAMINE C ON THE MEMBRANE SODIUM AND POTASSIUM ADENOSINE TRIPHOSPHATASE.

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It has been reported that sodium ion dependent amino acid transport was increased by the addition of phenazine methosulphate (PMS) and vitamine C (VC). Then the influence of PMS+VC was investigated on the Na, K-ATPase and K-Phosphatase activities in the NaI treated membrane preparation. The enzyme activities were inhibited by PMS 10^{-5} M+VC 5 mM which are known inhibitory on amino acid transport. The effect of PMS+VC was demonstrated in the enzyme preparation from kidney, brain and heart of guinea pigs. Similar inhibitory action was found by using PMS+NADH, but PMS+NAD was not effective. The inhibitory action of PMS+VC or PMS+NADH was decreased by chelating agent such as EDTA, EGTA and O-phenanthroline. These inhibitions on Na, K-ATPase and K-dependent phosphatase activities were decreased also by NaCN and antimycin A. Therefore the inhibition of Na, K-ATPase may be resulted from the reductive inactivation of the membrane preparation by PMS+VC and PMS+NADH. This process involves heavy metal ion probably Fe^{3+} , because Fe^{2+} alone inhibited enzyme and Fe^{3+} intensified the effect of PMS+VC. The forementioned phenomenon might relate to a regulation of Na-pump ATPase by energy supply from respiratory chain in the cell membrane.

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RELATION BETWEEN ELECTROLYTES CONCENTRATION IN SALIVA AND Na^+-K^+ ATPase ACTIVITY. T.UEHA, T.KIDA, K.HOSOI. Dept. of Oral Physiol., Josai Dent. Univ. Saitama

Twenty male SD rats were divided into 4 groups of 5 each (non-treated, ADEX, ADEX+DOCA, ADEX+Na⁺-loading). Concentrations of Na⁺ and K⁺ in the submandibular saliva were significantly increased and slightly decreased respectively by ADEX. Whereas, Na⁺-K⁺ATPase activity in the gland was significantly decreased by ADEX and it was recovered to control by DOCA but not by Na⁺-loading, although Na⁺ and K⁺ in the saliva from the latter group were recovered to control. Similar results were observed histochemically using P-NPP as substrate. Duct system showed much higher ATPase activity than acinus and there was no difference between ADEX and Na⁺-loading. On the other hand, the rate of salivary flow and size of acinus in the gland were significantly reduced by Na⁺-loading. Therefore it seems likely that Na⁺-loading affect the acinus but not the ATPase activity in duct system. These results suggest that mineralcorticoids regulates the ATPase activity in duct system, affecting Na⁺ reabsorption and K⁺ secretion from this portion; Na⁺-loading, however, may affect the acinus cells and suppress the secretion of water from these cells.

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DISTRIBUTION OF GLUCOCORTICOID RECEPTORS IN RAT KIDNEY CORTICAL TUBULES ENRICHED IN PROXIMAL AND DISTAL SEGMENTS.

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The intrarenal site of action of glucocorticoid hormone was investigated using a new technical approach. Sedimentation at $1 \times g$ through a discontinuous Ficoll gradient was used to segregate proximal and distal segments of rat kidney cortex obtained by collagenase treatment. Fraction A was enriched in distal segments which represent 50% of the protein and 70% of the DNA. Fraction B was enriched in proximal segments which represent 90% of the protein and 75% of the DNA. Consistent with difference in morphology, there were significant difference in biochemical properties (protein/DNA, activities of hexokinase, alkaline phosphatase, and adenylate cyclase). Under this method, specific cytoplasmic binding of [^3H]-triamcinolone indicated more number of site of triamcinolone (N_{max}) in fraction B (5.0×10^{-13} mol/mg of protein) than in fraction A (3.0×10^{-13} mol/mg of proteins), and no significant difference in dissociation constant (Kd. at $25^\circ C$, 1.1×10^{-8} M). These data suggest a predominantly proximal distribution of glucocorticoid receptors in rat kidney cortex.

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DEVELOPMENT OF PUMP ELECTROGENESIS IN HYPOKALEMIC RAT SOLEUS MUSCLE.

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In hypokalemic rats maintained on a potassium deficient diets for 10-50 days, the isolated 'Na-loaded' and 'K-depleted' ('Na-rich') muscle fibers were depolarized from -115 mV in 'fresh' muscles of normal rats in K-free Krebs solution. Upon adding 5 mM K to the K-free medium bathing 'Na-rich' soleus muscles, the current generated by Na-pump was observed as K-sensitive hyperpolarization. The hyperpolarization was depend on the amount of intracellular Na concentration ($[Na]_i$) accumulated during the potassium deficiency. The electrogenic Na-pump was activated by an increase of $[Na]_i$ of less than 5 mM and further enhanced with increasing $[Na]_i$. The magnitude of pump electrogenesis is expressed as a linear function of $\log [Na]_i$.

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ON THE ANALYSIS OF THE STRUCTURE AND FUNCTION OF AMINO ACID OF TUBULIN
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In order to estimate the relation between structure and function of the complicated tubulin, we started first to research tetragastrin because of its simple structure and function. As we have reported in several times, the division ratio ($\sqrt{\pi}/2 : 0.886$) of the mass was used, and the matrix of Trp, Met, Asp, Phe(NH₂) which are composed of tetragastrin were estimated. The numbers of possibility of the matrix of Trp, Met, Asp, were 6 cases, but in reality 4 cases were excluded, and the results of the calculation of 2×2 matrix represented that the matrix of Trp, Met, Asp, Phe(NH₂) and the arrangement of Trp, Asp, Met, Phe(NH₂) were rational, because these structures have the negative feedback mechanism with HCl. And, this conclusion exactly coincident with the results of the observation of physiology.

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INHIBITION OF PROTON ELECTROGENIC PUMP

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Orthovanadate, a contaminant found in Sigma "Sigma Grade" ATP, is a powerful inhibitor of the (Na, K)ATPase of animal cells and the dynein ATPase from cilia and flagella.

The inhibitor brought about the reversible depolarization of the membrane potential of *Neurospora crassa*. The depolarization was observed only in phosphate-starved cells, in which a high-affinity phosphate-transport system (P_{II}) should be derepressed. This result indicates that vanadate may be taken up by P_{II} and may act from the inside of the cell. The vanadate effect was also tested on eight P_{II} -mutants: two were deficient and six were partially constitutive. These results are consistent with the above-mentioned hypothesis.

Moreover, the difference in the current-voltage curve between before and after the addition of vanadate suggests that vanadate may inhibit the proton-electrogenic pump of the membrane. Bowman et. al. have shown that the plasma membrane ATPase of *N. crassa*, which is postulated to be involved in the H^+ pump, is inhibited by vanadate. This observation supports the above-mentioned possibility.

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EXCITATION AND PHOSPHORUS METABOLISM OF CRAYFISH NERVE CORDS MEASURED BY ^{31}P -NMR.

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^{31}P -NMR was used as a non-destructive method for the detection of phosphorus compounds in tissue. Ventral nerve cords of crayfish were maintained at living state with perfusion technique and electrical stimulation was given before or during the measurements. ^{31}P -NMR spectrum showed the resonance lines of sugar phosphates, P_i , Phospho-arginine, ATP, and NAD^+ at 24°C. The effect of perfusion at 0°C was observed as changes in signal intensity or chemical shift of P_i signal. When nerve cords were stimulated with the electrodes in NMR tube, the spectrum showed only the resonance line of phosphoarginine due to the external electrical noise on the receiver coil of NMR probe. When ^{31}P -NMR measurements were carried out at 0 to -5°C after continuous electrical stimulation at 24°C, the signal intensities of phosphoarginine were 6.0 without stimulation, 6.5 with 200,000 pulses (50Hz), 8.1 with 100,000 pulses (100Hz), 4.3 with 2 000 00 pulses (100Hz), 8.9 with 2 000 00 pulses (200Hz) and 4.2 with 8 000 00 pulses (200Hz). Chemical shifts of P_i and the resonance lines of sugar phosphates showed almost no change.

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EFFECTS OF DIAZOXIDE ON SODIUM TRANSPORT AND WATER PERMEABILITY OF THE FROG BLADDER
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Effects of diazoxide (DZ), strong anti-hypertensive drug, on the sodium transport and water permeability of frog, *Rana cutesbiana*, were studied comparing to that of hydrochlorothiazide (HT). Na transport was estimated by the short-circuit current (SCC) with the method of Ussing and Zerahn. Water permeability was measured as osmotic water flow. Na, K-dependent ATPase activity was measured by the method of Fiske-Subbrow, and adenylate cyclase activity by the method of White et al.

DZ inhibited SCC by addition to the serosal chamber while HT did it by the mucosal side. DZ enhanced the effect of vasopressin on the osmotic water flow while HT showed no effect. However, DZ did not affect the water permeability induced by cyclic AMP. Both DZ and HT inhibited Na, K-ATPase activity of the frog kidney microsomal fraction. DZ activated the adenylate cyclase activity of the 2,500xg fraction of rat renal medulla although HT could not affect the enzyme activity.

These results suggest that DZ enhances the activating effect of vasopressin on the water permeability by activation of adenylate cyclase activity, and that DZ inhibits Na transport across the membrane by suppressing Na, K-ATPase activity.

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MODE OF ACTION OF FUROSEMIDE ON Cl-DEPENDENT SHORT-CIRCUIT CURRENT ACROSS THE TOAD CILIARY BODY. Y. SAITO, *T. WATANABE, Dept. of Physiol. and *Dept. of Ophthalmol., Tohoku Univ. Sch. Med., Sendai

Our previous studies on the toad ciliary epithelium showed that short-circuit current across the epithelium was dependent on Cl and explained by active Cl transport from the stromal to the aqueous side. In the present study the effects of furosemide (Fu) on the Cl-dependent short-circuit current (SCC) across the toad ciliary epithelium were examined. Under control conditions, the SCC obeyed Michaelis-Menten kinetics against medium Cl concentration, the K_m for Cl being 90mM whereas the V_{max} 128 μ A/cm². Fu added to the aqueous side of the epithelium rapidly reduced the SCC profoundly. The effect from the stromal side was much smaller and slower than that from the aqueous side. The dose-dependent range of Fu action was from 0.1 μ M to 1mM and 50% inhibition was seen at about 5 μ M. Lineweaver-Burk plot of the SCC against the Cl concentration showed that Fu decreased the value of V_{max} without affecting K_m , the inhibition being of non-competitive type. Probenecid, reduced the effects of Fu significantly when added simultaneously. These findings suggest that Fu added to the aqueous side is taken up by the epithelial cells via organic acid transport system located at the aqueous facing membrane and then inhibits the active Cl transport at the step of aqueous facing membrane from the intracellular side.

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ACTION OF UNCOUPLER OF OXIDATIVE PHOSPHORYLATION ON MEMBRANE POTENTIAL AND INTRACELLULAR K^+ IN RENAL PROXIMAL TUBULES. M. HONDA, K. NAITO, T. KUBOTA, M. FUJIMOTO. Dept. of Physiol., Osaka Medical College, Takatsuki City, Osaka.

Time course of changes in membrane potential (E_m) and intracellular K^+ (a_{K_i}) after administration of metabolic inhibitors were observed with double-barreled K^+ -microelectrodes in renal proximal tubule of bullfrog. Luminal administration of DNP (dinitrophenol) or PCP (pentachlorophenol) caused a biphasic response: an early increase in E_m and a_{K_i} within 3 minutes and a late decrease, whereas the peritubular DNP or OLI (oligomycin) decreased both uniformly. The change of chemical potential (ΔE_K) after DNP was initially greater than that of E_m (ΔE_m), but ΔE_K became half as much as ΔE_m later. Although the effects depended on the dosages, bilateral administration of DNP, PCP or OLI caused a decreased E_m more severely than E_K . The similar change was also observed in late period (more than 3 min.) after unilateral perfusion of any of the inhibitors. The early unilateral effect would be resulted from a single effect on the membrane affected, while the late unilateral or bilateral effect from derangement of common source of energy. Thus, the uncoupling of the oxidative phosphorylation may have a more profound effect on the electrogenesis of the membrane than the effect predicted from the change of cellular K^+ .

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Ca DEPENDENCE OF POTASSIUM TRANSPORT AND PROTEIN SECRETION IN RAT AND MOUSE SALIVARY GLANDS IN VITRO. K. KATOH, M. SAKAI and M. NAKASATO. Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata City, Yamagata

The outputs of K and protein in response to stimulation with acetylcholine (ACh), phenylephrine and isoproterenol were investigated in superfused segments of rat and mouse salivary glands. ACh or phenylephrine stimulation for 5 min caused a rise in protein or amylase output and a short lasting K release which was enhanced by an addition of ouabain. These responses were considerably suppressed by an omission of Ca from the solution. Isoproterenol stimulation induced a large amount of amylase output and a K uptake, which was blocked by an addition of ouabain. These responses were not affected by an omission of Ca. From these results and Petersen's and our electrophysiological studies (1)(2) on salivary glands, we concluded that in cholinergic or α -adrenergic receptor activation extracellular and membrane bound Ca are important for protein secretion and increase in membrane permeability to K and Na ions resulting in a activation of Na-K exchange pump, and in β -adrenergic receptor activation some other than Ca may be involved in ion transport and protein secretion.

References

- (1) Roberts, M.R., Iwatsuki, N. & Petersen, O.H. (1978) Pflügers Arch. 376, 159-167.
- (2) Katoh, K., Nishiyama, A., & Wakui, M. (1977) J. Physiol. Soc. Jpn. 39, 223 (In Jpn.)

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Immunofluorescent anti-tubulin staining of tubulin in the perfused squid giant axon. HORIE, H., TAKENAKA, T., INOMATA, K., INOUE, H., and YOSHIOKA, T. (Dept of Physiol., Yokohama City Univ. Sch. of Med., Yokohama)

The existence of tubulin near the inner surface of the squid giant axon is rather difficult to visualize with phase contrast or differential interference microscopy. To overcome this difficulty we tried indirect immunofluorescent staining on fixed specimens to visualize tubulin both in its structured and unstructured form. The present experiments were undertaken to characterize the response of axonal microtubule (ortubulin) to the effects of colchicine and cytochalasin B¹. After KF perfusion, the axon was fixed by 3% formalin for 6 minutes at 20°C, followed by introducing tubulin antiserum prepared against sea urchin egg. Then FITC-IgG was perfused intracellularly. In the case of short period KF perfusion, the inner surface displayed a multitude of very thick separate fluorescent fibers in the axoplasm. When the axoplasm removed thoroughly, the fluorescent fibers were disappeared. The axons incubated in a 10⁻⁵M of colchicine containing artificial sea water (ASW) showed only small fluorescent spot (d=30μ), while the axon treated by 10⁻⁵M cytochalasin B displayed fine spots (d=8μ) on the surface of axolemma.

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THE RESISTANCE AND CAPACITANCE OF THE LIVING BODY AT ZERO TRANSIENT POTENTIAL BY HALF SINE CURRENT, T. SAITO, Dep. of Physiol., Nippon Dental University Tokyo, Chiyodaku Tokyo

When a half sine current, basic unit of the alternartig current, is applied to a living body, its resistance and capacitance can be determined from the ensuing transitional phenomena.

Formerly those values were obtained when the transient potential was maximal. This time they are determined when it is zero by following equations.

$$\frac{\sin(\omega\tau + \phi_0) \cos\phi + \cos(\omega\tau + \phi_0) \sin\phi}{\tan\phi (\cos\phi_0 \cos\phi - \sin\phi_0 \sin\phi)} = \varepsilon^{-\omega\tau x}$$

$$K = \frac{\omega R E_m}{R+r} \cos^2\phi (\cos\omega\tau - x \sin\omega\tau + x^2 \varepsilon^{-\omega\tau x})$$

half sine current: $E_m \sin(\omega t + \phi_0)$

$$x = \tan\phi = \frac{1}{\omega(R+r)c}$$

τ : time when transitional potential is zero,

R is an input resistance of a meter. $K = \left(\frac{di}{dt}\right)_{t=\tau}$

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TTX-RESISTANT AND Co-SENSITIVE Na SPIKES IN INSECT LARVAL MUSCLE FIBERS. WASHIO, H. AND YAMAMOTO, D. Lab. of Neurophysiol., Mitsubishi-Kasei Institute of Life Sciences, Machida, Tokyo.

The ionic mechanism of the action potential produced in ventral muscle fibers of mealworm larva, *Tenebrio molitor*, was investigated by means of intracellular electrodes. The peak potential of the regenerative activity depended on the external calcium concentrations between 5 to 50mM regardless of presence or absence of Na ions in the medium. In Ca-free saline, the muscle fibers could produce all-or-none action potentials provided a higher concentration of Na than 117mM was present in the medium. The overshoot potential increased with a slope of about 40mV per ten-fold elevation of the external Na concentration. The action potential was resistant to TTX (up to 3.3μM), but reversibly suppressed by Co ions. It was concluded that the Ca channels alone are responsible for the action potential and Na ions pass through the same channels in the muscle fiber membrane of mealworm larvae.

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MEMBRANE CURRENTS OF Ca CHANNEL MUTANTS IN PARAMECIUM. YOUKO SATOW. Lab. of Molecular Biology, Univ. of Wisconsin, Madison, Wisconsin U.S.A.

Membrane currents were recorded with a voltage clamp from the wild type and the "pawn" mutants of the pwA, pwB and pwC groups in P. tetraurelia. A typical pawn of the pwA group, pwA₅₀₀, has no Ca transient upon step depolarizations but is normal in its resting and various rectifying conductances. It is chosen as the null control to analyze the G_{Ca} of other mutants. A leaky mutant of the pwA group, pwA₁₃₂, has 45% residual G_{Ca} . Except for its smaller size, the residual I_{Ca} of pwA₁₃₂ is normal in its time course, its voltage sensitivity and its discrimination between Ca^{++} and Ba^{++} . Thus, mutations at the pwA locus appear to reduce the total number of functional Ca channels without any changes in the channel characteristics. Similar studies of the pwB group show that a typical mutant pwB₉₅ has no measurable G_{Ca} but a leaky mutant, pwB₅₅₁, has 60% residual G_{Ca} . The time course of Ca channel activation in the presence of Ba^{++} in the test solution is faster in pwB₅₅₁. The pwB mutations also cause larger non- K^{+} currents in both outward- and inward-going directions. Preliminary results on a mutant of the third group, pwC₁₃₁, has 50% residual G_{Ca} . The simplest interpretation of these results is that the three genes affect the synthesis, assembly or maintenance of the Ca channels and do not code for the channel proteins themselves. Supported by NSF grant BNS77-20440 to C. Kung.

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PRESYNAPTIC Ca CURRENTS IN THE SENSORY EPITHELIUM OF PLOTOSUS ELECTRORECEPTOR. SUGAWARA, Y. and OBARA, S., Dept. Physiol., Teikyo Univ., Sch. Med., Itabashi-ku, Tokyo

Trans-epithelial voltage-clamp on isolated receptor units of Plotosus electroreceptor revealed a complex inward current pattern with distinct early and late peaks, which was attributed to two successive Ca-current components both arising in the basal membrane of receptor cells. The presynaptic role of the epithelial currents in the afferent transmission was demonstrated by the corresponding time course of the PSP's externally recorded in the afferent terminals. Possibilities of an outward transient involved in the current pattern were further examined. The equilibrium potential estimated by the instantaneous V-I relation remained unchanged at various phases of the current pattern, suggesting involvement of a single ionic battery throughout. An outward transient due to K activation in the basal membrane was excluded, since addition of 3-aminopyridine (2 mM) or CsCl (1 mM) to the bath did not change the current pattern. A possibility of transient activation of an electrogenic pump in the basal membrane was also excluded, since Ouabain (1 mM) or KCN (1 mM) only induced a gradual decline in the epithelial DC potential with little change in the current pattern. The linear V-I relation in the negative quadrant in Plotosus receptor furthermore excluded a possibility of activity in the apical membrane causing an outward transient such as shown in skate receptor.

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MEMBRANE CONDUCTANCE OF SQUID GIANT AXONS UNDER SIMPLIFIED IONIC CONDITIONS. WATANABE, A., NAGANO, M., SAKAI, T. Dept. Physiol. Tokyo Med. Dent. Univ. Yushima, Bunkyo-ku, Tokyo.

Squid giant axons were intracellularly and extracellularly perfused and the membrane current was measured with the voltage clamp technique. On application of the depolarizing voltage pulse an inwardly directed current was observed when extracellular and intracellular media contained the same kind of alkali cations at the same concentration (the external medium contained Ca also). The time course of the current was slower than that of the initial transient current observed under the natural conditions. The slope conductance of the membrane at the peak of the slow membrane current followed the order of $g(K) > g(Na) > g(Rb) > g(Cs)$, where $g(A)$ indicates the membrane conductance of an axon perfused extracellularly and intracellularly with solutions containing an alkali cation A. The conductance increased when external cation concentration increased, but remained practically constant when internal cation concentration was changed between 10 and 100 mM. When the external and internal cation species were changed the conductance of the membrane was changed in a way as if the conductances of the external and internal layers of the membrane changed more or less independently. The result is consistent with a membrane model in which the external layer prefers Na to Cs but the internal layer prefers Cs to Na.

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CHANGES IN MEMBRANE PROPERTIES OF CHICK CORTICAL NEURONS DEVELOPING IN CULTURE. J. MORI, E. MARU, H. ASHIDA, J. TATSUNO, Dep. of physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama

Cortical neurons from 7-9 days chick embryos were explanted on collagen-coated dishes. The neuronal tissues during 5-28 days in culture were supplied to study changes in membrane properties during development. Resting membrane potentials were low at 5 days in culture and increased very slowly except large change during 5-7 days as growing of neurons. At earlier stages, neurons showing small input resistance and time constant were seen more frequently than in later stages (after 2 weeks). Though action potentials were induced by applying stimulating pulse to neurons after 10 days in culture, anode break excitation by hyperpolarizing pulse were observed in most cases. On the other hand, action potentials by depolarizing pulse were incomplete. Amplitude and rate of rise of action potentials intended to increase during development. Such potentials were sensitive to tetrodotoxin (10^{-6} mg/ml). These results suggest that sodium inactivation mechanisms in membrane might be involved in changes of membrane properties during development in culture.

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EFFECTS OF ANIONS ON THE LINKAGE BETWEEN THE INTRACELLULAR RELEASE OF Ca^{2+} AND K^{+} PERMEABILITY OF THE MEMBRANE IN SYMPATHETIC GANGLION CELLS. MORITA, K., KUBA, K. and KOKETSU, K. (Dept. of Physiol., Kurume Univ. Sch. Med., Kurume)

Transient or rhythmic slow hyperpolarizations were recorded from the bullfrog sympathetic ganglion cell in Ringer, when an intracellular electrode filled with 1M K_3 -citrate instead of 3M KCl was used. These hyperpolarizations were increased or decreased in amplitude in a low or high K^{+} solution, respectively, abolished or increased in their interval by dantrolene-Na or decreasing external Ca^{2+} , and potentiated or triggered by caffeine or lowering temperature. Thus, as in the case of caffeine hyperpolarizations (Kuba & Nishi, J. Neurophysiol. 39, 547, 1976), they seem to be generated by transient or rhythmic rises in P_K of the membrane as a result of increases in intracellular free Ca^{2+} due to release of Ca^{2+} in the cell. The order of anions in the electrode favourable to induce slow hyperpolarizations with or without caffeine were citrate, acetate or sulphate, and Cl. It is unknown whether citrate is inert and hyperpolarizations occur physiologically, or citrate has an ability to release Ca^{2+} from intracellular reservoir sites as caffeine does.

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INITIATION OF THE Ca INDUCED SPIKE IN INTRACELLULARLY PERFUSED SQUID GIANT AXONS

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The effect of intracellular Ca ions on the resting membrane was studied in squid giant axons internally perfused with Ca containing solutions. The axon immersed in artificial sea water was initially perfused with 25mM KCl or KF solution. When the K-salt solution was replaced with a Ca containing solutions at the concentration ranging 0.1mM and 30mM, a sudden large depolarization or a spike production occurred without any electrical stimulations. In some conditions, the size of the spike was almost similar to that of the action potential. This intracellular Ca induced spike was Na_o dependent and was also TTX sensitive. Therefore, this spike production is considered to be a chemically stimulated action potential triggered by intracellular Ca ion to the internal surface of the cell membrane.

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SERUM PROTEIN-INDUCED HYPERPOLARIZING RESPONSE IN CULTURED FIBROBLAST. W. TSUCHIYA, Y. OKADA, H. YAWO, T. YADA AND J. YANO* Dept. of Physiol., and Dept. of Gynecol. Obstet.*, Fac. of Med., Kyoto Univ., Sakyo-ku Kyoto

Cultured fibroblast (L cell) not only exhibits spontaneous repetitive hyperpolarizations, but is known to respond to an electrical or a mechanical stimulus with a transient hyperpolarization. We report here that the cell responds to a new kind of stimulus, i.e. serum protein. The addition of bovine serum elicited a rapid and prolonged hyperpolarizing response (HR). Amongst the serum proteins, β -lipoprotein (LDL) and complement were found to be most effective in the HR generation. The amplitude of the HR was dependent on $[K^+]_o$ and the presence of external Ca^{++} was indispensable for the HR generation. Cooling of the cells or application of metabolic inhibitors completely blocked the HR. Thus, the mechanism for the generation of the protein-induced HR seems to be identical to that of spontaneous HR (ref. Abstract of foregoing meeting). It was also suggested that sulphhydryl groups and phospholipids on the cell membrane are essential for the HR, because treatment with phospholipase C or SH-blocking agents (PCMB and NEM) abolished the HR. Since the application of LDL or complement was followed by vigorous membrane ruffling and pinocytic vesicle formation, we suppose that the HR might be related to the membrane movement associated with endocytosis.

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CONTROL OF FERTILIZATION BY MEMBRANE POTENTIAL OF AN OOCYTE

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Sperm entry into the starfish oocyte was blocked when the membrane potential of the oocyte was held more positive than $-10 \sim -5$ mV, whereas multiple sperm entries occurred when the potential was kept more negative. Based on this potential-dependent fertilization block mechanism, it was demonstrated that an activation potential (AVP) which is induced immediately after the attachment of the first sperm to the egg surface plays the role of a fast polyspermy block. There is a great difference in the susceptibility to polyspermy at various maturation stages of the oocyte. AVPs of mature oocytes exceeded -5 mV (the critical potential level for fertilization block) within 1 sec and the potential stayed at $+12$ mV even after the formation of the fertilization membrane. Thus, the entry of a second sperm is blocked. In contrast, AVPs of overripe oocytes took about 15 sec to attain -5 mV, or they did not exceed -5 mV. Consequently, overripe oocytes become polyspermic and hence they undergo abnormal development after fertilization. In overripe oocytes "step depolarizations" were seen in the rising phase of the AVPs before the formation of the fertilization membrane. Each step is probably associated with an additional sperm entry.

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THE ASYMMETRICAL CAPACITANCE CURRENT IN CRAYFISH GIANT AXONS. K. MURAYAMA, H. KITASATO, K. NISHIO, S. SATO. Dept. of Physiol., Shiga Univ. of Med. Sci., Ohtsu

In order to clarify the gating mechanism of ionic channels, the relation between membrane potential and the asymmetrical capacitance current (I_s) was investigated. I_s 's were analyzed from tail currents obtained from voltage clamped crayfish giant axons bathed in 54 mM K + 100 mM Cs van Harreveld's solution in response to repolarization (V2) to various levels after the first depolarization to 0 mV from the holding potential (-100 mV), by suppressing ionic components by Cs ions and further subtracting the surge of capacity current. I_s 's thus obtained were all inward in their flow to repolarizing V2. Semilogarithmic plotting of the magnitude of I_s against time revealed that I_s consisted of two components, both of which showed a fairly good linear relation. By extrapolating the fast component of the straight lines to the beginning of V2, the initial magnitude of I_s [$(I_s)_0$] considered as being responsible for gating was estimated. From its slope, time constant (τ_m) was also obtained. $(I_s)_0$ gradually increased in magnitude and per contra τ_m shortened as the membrane potential during V2 became more negative; both of them became saturated attaining to the steady values below -100 mV. Changing temperature from 6°C to 12°C increased $(I_s)_0$ and decreased τ_m . The magnitude of the displaced charges responsible for $(I_s)_0$ was also calculated from the relation, $(I_s)_0 \cdot \tau_m$.

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DIFFERENCE OF EFFECTS OF SOLUTION VISCOSITY ON THE EXCITATION FROM THE INSIDE AND THE OUTSIDE OF SQUID GIANT AXONS

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When intracellularly perfused squid giant axons were used, the solution viscosities in the internal and in the external solutions could be changed independently without any change of ionic concentrations or ionic activities. The neutral molecules in the inside and the outside of the axon affected the time course of the action potential and the membrane currents in the different manner. The membrane current from the side of the glucose or sucrose solution to that of the glycerol solution was reduced more largely than expected from the additive effect of the viscosities of the internal and of the external solutions and the membrane current in the reverse direction changed in proportion to the mean of the viscosities of the internal and the external solutions. The amplitude and the time course of the membrane currents and the time course of the action potential were determined by the mean of the viscosities of the internal and the external solutions and species of neutral molecules which were used to increase the viscosity.

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TETRODOTOXIN-RESISTANT POTENTIALS IN THE CRUSTACEAN CARDIAC GANGLION.

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Tetrodotoxin(TTX)-resistant potentials were studied in large cells of crustacean cardiac ganglion. When all impulse activity has been inhibited by 3×10^{-7} M TTX, depolarizing current passed into one of the somata leads to active responses which are independent of pacemaker potential and spiking mechanisms. Such responses have been termed 'driver potentials' because they represent the normal source of current for generation of impulse bursts. Since the cells are electrically coupled, initiation of the driver potential response in one results in highly synchronized responses in all others. Driver potentials are initiated in an anterior large cell of the ganglion after its isolation by ligaturing. Thus, they are endogenous to each neuron. In ganglia treated with 4 mM Mn-saline which inhibits driver potentials, no evidence of bursting is seen, but regular trains of spikes are recorded. Driver potentials, coordinated primarily through electrotonic spread, appear to underlie the organization of impulse firing into rhythmically recurring bursts in each of the neurons in the normally functioning ganglion.

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BURSTING ACTIVITY AND INTRACELLULAR CALCIUM MOVEMENT IN A SNAIL NEURON STUDIED BY CCEP-XMA. M. Onozuka, T. Iwata, K. Yamada, T. Kobori & E. Sugaya. Dept. of Physiol., Kanagawa Dent. Coll., Yokosuka, Kanagawa.

Combined study of computer controlled electron probe X-ray microanalyser(CCEP-XMA), ion shower milling and flameless atomic analyser was performed to clarify the mechanism of bursting activity(BA) induced by pentylene tetrazole(PTZ) in snail neurons. Freeze-dried specimens of single isolated neuron of *Euhadra peliomphala* were used.

- 1) During BA, the intracellular calcium concentration decreased and that near the cell membrane increased.
- 2) The content of calcium in lysosome-like granule(LLG) decreased remarkably during BA, and dense type LLG changed into lamella type one.
- 3) The released calcium from LLG moved probably to inner surface of cell membrane.
- 4) By the examination of chemical shift using CCEP-XMA, the calcium binding state changed by PTZ induced BA.

Above findings suggest that the intracellular calcium movement toward the cell membrane is a essential step to induce BA.

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THE CHANGES OF MEMBRANE EXCITABILITY BY ACTIVATION OF THE EGG OF A CERTAIN TUNICATE. M. KOZUKA, K. TAKAHASHI. Dept. of Neurophysiol., Inst. of Brain Res., Tokyo Univ., Sch. of Med., Bunkyo-ku, Tokyo.

The activation of the egg is an important concomitant of the fertilization, initiating the embryonic development. It is induced not only by a sperm but also by various physical or chemical agents including Ca ionophore. Recently it was reported in the egg cell membrane of the tunicate that there is electrical excitability; the existence of Na, Ca, delayed K and anomalous K channels, which have essentially the same properties as those found in other excitable membranes. In the present study we examined the changes of membrane excitability during activation of the tunicate egg, using the voltage-clamp technique and Ca ionophore A23187 as an activating agent. Immediately after the egg activation started, the resting membrane conductance was enhanced transiently. At the same time the current through Na channels similarly increased while the current through Ca channels decreased reciprocally. All these changes associated with the egg activation were consistently suppressed by the preceding injection of Ca chelating substance, EGTA, into the egg, and were triggered by intracellular perfusion of Ca-buffered solution with concentration more than 10^{-6} M Ca ions. It was suggested that these changes were caused by the increase of intracellular Ca ion concentration in the egg.

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DIVALENT CATION (Ca, Sr, Ba) DEPENDENT RESPONSES IN DORSAL ROOT GANGLION CELLS OF THE ADULT MOUSE. MATSUDA, Y. and YOSHIDA, S. Dep. of Physiol., Med. Col. of Shiga, Otsu and Dep. of Physiol., Inst. for Brain Res., Fac. of Med., Kyoto Univ., Kyoto

Part of the dorsal root ganglion cells of adult mice can generate a Ca spike (Yoshida et al., J. Neurophysiol. 41:1096-, 1978). In the present study, it was proved that, even in the neurons showing no Ca spikes, regenerative responses were elicited when Ba or Sr ions were substituted for Ca ions or when TEA was applied under Na-free conditions. A propagating Ba spike was observed in a small neuron with an unmyelinated axon. Ionic sequence of easiness to elicit divalent action potentials was $Ba > Sr > Ca$. In Ba solution, some neurons produced a depolarisation plateau spontaneously or on stimulation, and an abolition of Ba action potentials was detected in a few cells often followed by a spontaneous rising of membrane potential and a spike. The plateau was interrupted for a moment by a hyperpolarizing current with concomitant changes in membrane conductance. The conductance changed in two ways during hyperpolarizing responses.

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CHARACTERIZATION OF 5-HT RECEPTORS ON VAGAL AFFERENT NEURONS IN RABBITS. HIGASHI, H. & NISHI, S. Dept. Physiol., Kurume Univ. Sch. Med., Kurume

The somata of visceral sensory neurons protruding a non-myelinated axon (type C neurons) are sensitive to the depolarizing action of serotonin (5-HT). Applied by iontophoresis or by superfusion 5-HT induced in type C neurons a rapid depolarization, 20-40 mV in amplitude, which was followed by a hyperpolarization (after-hyperpolarization) of approximately 5 mV. Analysis of the 5-HT response in various ionic media showed that the depolarizing component was induced by a simultaneous increase in sodium and potassium conductance, while that the after-hyperpolarization was produced by a selective increase in potassium conductance (G_K). The latter G_K increase seems to be triggered by the entry of sodium and calcium ions, since the deprivation of sodium or calcium from the superfusing medium markedly depressed or eliminated the afterhyperpolarization.

Study of the kinetics of 5-HT receptor activation on the dose-response curves obtained from voltage clamped neurons showed the Hill coefficient of 2.8 on the average. This would suggest cooperativity in the drug action caused by several receptor subunits per channel. 5-HT response was reversibly and dose-dependently blocked by d-tubocurarine, but it was not affected by LSD-25, methysergide, acetylcholine, nicotine, hexamethonium or atropine. The depressant action of d-tubocurarine appeared to be competitive.

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EFFECTS OF ERGOT ALKALOIDS ON THE EXCITABILITY OF AN IDENTIFIABLE MOLLUSCAN GIANT NEURONE. MIYAMOTO, M., YOKOI, I., SAKAI, A. & TAKEUCHI, H. Dept. of Neurochem., Inst. for Neurobiol., Okayama Univ. Med. Sch., Okayama.

Effects of ergot alkaloids and their related substances have been examined on the excitability of a giant neurone (PON, periodically oscillating neurone) identified in the suboesophageal ganglia of the African giant snail. Of the substances examined, the following six alkaloids (the critical concentrations of bath application, in parentheses) showed an excitatory effect: ergometrine (5×10^{-6} kg/l), methylergometrine (5×10^{-6} kg/l), D-lysergic acid (3×10^{-5}), D-lysergic acid amide (3×10^{-5}), D-lysergic acid 3-hydroxypiperidinamide (3×10^{-5}) and D-lysergic acid 4-hydroxypiperidinamide (10^{-4}). However, nicrogoline, metergoline, methysergide, ergotamine, bromocriptine etc. had no effect on PON at 10^{-4} kg/l.

The microdrop application of the two substances having the marked excitatory effect, ergometrine and methylergometrine, was performed, and it was concluded that the two substances act directly to the membrane of the neurone examined.

The slow oscillations of PON membrane potential were exaggerated by application of ergometrine or methylergometrine in the physiological state. However, the oscillations disappeared when Na^+ in the medium was replaced with Li^+ , indicating that Na^+ is indispensable to produce the membrane potential oscillations.

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Double polarized excitable system of the nerve fiber and its action potential. Masao MATUMOTO (Department of Physiology, School of Dentistry, Showa University, Tokyo, Japan)

Matumoto, M. experimentally found that the equivalent circuit of the nerve fiber in resting state was constituted of two layer, the one inner layer polarized E_m and the other, outer layer polarized E_o due E_m and that the equivalent circuit in excited state was the one, in which the inner polarized layer disappeared effectively due to reduce of resistance of the inner layer to zero.

The excitable system constituted of double polarized layers as mentioned above is called double polarized excitable system. In this system, cell potential E_c (potential difference between outside and inside of the system, resting potential) is represented with equation; $E_c = E_m - E_o$. On this relation origin of the overshoot of action potential is clearly accounted for ~~that~~ merely quick decrease of E_m from resting value to zero according to reduce of resistance of inner layer (membrane resistance) nearly to zero.

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The role of histidine residues in the excitable membrane of the squid giant axon. HORIE, H., TAKENAKA, T. INOUE, H. INOMATA, K. and YOSHIOKA, T (Dept of Physiol., Yokohama City Univ. Sch. of Med., Yokohama)

By modifying imidazole group through the exposure of the interior of squid axons to potent photooxidizing agents, the excitability of the membrane was studied. The giant axon of squid, *Doryteuthis bleekeri*, were intracellularly perfused with KF solution and voltage-clamped with an axial wire system. After $1 \mu\text{M}$ rose bengal was introduced into a perfusion solution, the axon was illuminated with a 100 quartz iodine lamp. The resting potential was depolarized 4–6 mV, but the excitability was completely maintained. Then the rose bengal was washed out with the dye free perfusion solution before conducting a voltage-clamp experiment. The potassium current were strongly depressed after photooxidation, while the sodium current had been little affected. Radio-labelled iodosulfanilic acid was used as a membrane labelling agent. Membrane materials were analyzed by the SDS gel electrophoresis. During the photooxidation, the radioactivity was increased. These results indicate that the histidine residue is associated with the membrane components involved in control of potassium conductance.

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FAST AND SLOW COMPONENTS OF OUTWARD CURRENT IN MOUSE NEUROBLASTOMA DEVELOPING *IN VITRO*.
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Machida, Tokyo 194

In mouse neuroblastoma cells (clone N-18), the inward current of their action potentials (A.P.s) is carried by both Na^+ and Ca^{2+} at an intermediate developmental stage *in vitro*¹⁾. These A.P.s were followed by a marked after-hyperpolarization (A.H., 10–25 mV in strength and 0.5–3 sec in duration). Two components (fast and slow ones) were detected in the falling phase of these A.P.s, suggesting that two kinds of an outward current were activated during the A.P.s. The fast component was suppressed by the external application of tetraethylammonium (TEA) with a half-blocking dose of approximately 1 mM. On the other hand, the slow one was unaffected by the TEA treatment (up to 100 mM). The A.H. was not inhibited by the TEA treatment and markedly dependent to $[\text{K}^+]_o$. The slow outward current and the A.H. were always preceded by the activation of a Ca-spike, i.e. by the influx of Ca^{2+} . A set of the results obtained suggests that the fast outward current is the "delayed K-current" and the slow one is the "Ca-activated K-current", and that the slow K-current mainly contributes to the A.H. in the developing N-18 cells.

1) Miyake, M., Brain Res. 143(1978)349–354

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OPTICAL RECORDING OF SPONTANEOUS ELECTRICAL ACTIVITY FROM VERY EARLY EMBRYONIC CHICK HEART. S. FUJII, A. HIROTA, K. KAMINO, Dept. of Physiol.,
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In the embryonic heart cells at very early developmental stages, the use of micro-electrodes to follow the membrane potential changes is either impossible or inconvenient, because of cell size, frailty and topological localization.

Using an optical method for measuring membrane potential, we have been able to monitor spontaneous electrical activity in the very early embryonic chick heart. Changes in light absorption of the embryonic heart stained with a merocyanine-oxazolone dye were used to monitor the activity *in situ*. We detected the spontaneous activity optically from region of ventricle of the embryonic chick heart at the developmental stage of 7–9 somites, which had not begun spontaneous beating. When the heart was stained with voltage insensitive dye, no signal was observed. These records demonstrated the evidence for the spontaneous electrical activity in the very early embryonic heart cells before the generation of mechanical contraction. The activity in the ventricular region was largest. In the region of primordia of atrium, significant signals were occasionally detected. In addition, the results indicated that one detector recorded the signals from two different cells, and that there were 2–3 active cells per about 0.0078 mm^2 of the ventricular region in 8 somite embryonic heart.

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CHANGES IN LIGHT ABSORPTION DURING THE EXCITATION OF DYE-STAINED MAMMALIAN NERVES. A. WARASHINA. Dept. of Physiol., Niigata Univ. School of Medicine, Niigata City

Changes in light absorption during nerve excitation (absorption responses) were measured with vagal nerves of rats and rabbits stained with merocyanine-rhodanine dyes. The wavelength dependences of the absorption responses from these mammalian C fibers with some of the dyes were largely different from those commonly seen in invertebrate nerves. In order to interpret the observed difference, a possible mechanism of the response production was proposed. In the mechanism two distinct sites, N and R, were assumed in the membrane matrix. The dye molecules are bound to site N with the orientation in the normal direction to the membrane, while they exist in the random orientation in site R. The partition coefficient of dye distribution in the sites is altered during the nerve excitation through the interaction between the membrane potential and the electric dipole moment of the dye. The difference in physico-chemical nature of site R between the two classes of nerves were suggested in an analysis based on the proposed mechanism.

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TETRODOTOXIN RESISTANT Na AND Ca SPIKE COMPONENTS IN MAMMALIAN NERVE CELLS DURING NEURITE OUTGROWTH IN TISSUE CULTURE.

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Nerve cells were dissociated from dorsal root ganglia (Th-12 to L-5) of adult guinea pigs (250 to 350 gr body weight) by collagenase treatment. These cells were incubated at 37 °C in a tissue culture medium under sterile air containing 5 % CO₂. In a few days of incubation, the nerve cells extended several neurites on a collagen-coated dish. We could continue the culture for more than 2 months. With this tissue culture preparation, spike generation mechanisms were studied.

Intracellular recording with a glass microelectrode revealed that the nerve cells generated not only ordinary TTX-sensitive Na but also TTX-resistant Na and Ca spike components. The two Na spike components were differentiated by inhibiting the Ca spike component with Co⁺⁺. The Ca spikes were elicited in a Na-free medium. Comparison of the maximum rate of rise of these spike components suggests that inward currents carried by TTX-sensitive Na channels, TTX-resistant Na channels and Ca channels are of ratio of 10: 6: 1 to 2.

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TRIGGERING AND BLOCKING ACTIONS OF VARIOUS ONIUMS ON THE DIFFERENT TYPE OF ACh-RECEPTOR ACTIVITIES OBSERVED IN APLYSIA GANGLION CELLS.

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The abdominal and pleural ganglia of *Aplysia* include various types of acetylcholine receptors. They may be classified into three types according to each ionic specificity involved in their activities. Na^+ -dependent activity is called DNa -type since the response is depolarization(D), though other ions are partially involved. Similarly, Cl^- - or K^+ -dependent response is called HCl - or HK -type since the response is hyperpolarization(H) produced by an exclusive increase in permeability toward Cl^- or K^+ . ACh-induced responses were evaluated by an increase in membrane conductance.

Ammonium and hexamethonium selectively block the response of DNa -type but no effect on either HCl - or HK -type. Choline and tetramethylammonium can activate the responses of either DNa - or HCl -type but not HK -type. Tetraethylammonium blocks the responses of both DNa - and HK -types but not HCl -type. Decamethonium can activate the response of HCl -type but not HK -type. In contrast, it acts as an inhibitor to the receptor of DNa -type.

The active sites of each onium compound were discussed with respect to the structural specificity of each acetylcholine receptor and ionic channel.

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NEUROTROPHIC REGULATION OF ACETYLCHOLINE RECEPTORS IN CULTURED CHICK MUSCLE CELLS. M. KANO, N. SUZUKI, S. YAMAZAKI, H. OJIMA, M. YAMAMOTO.

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The effect of chick nerve extract and chick spinal cord explant on acetylcholine receptor site density and distribution was studied using ^{125}I - α -bungarotoxin on chick myotubes developing in vitro. In control myotubes, receptor site density was about 90 sites/ μm^2 at 4 days in culture and remained almost constant during the period examined (up to 14 days in culture). The addition of brain extract resulted in an increase in the site density during 7-14 days in culture (from about 100 sites/ μm^2 during 4-7 days to about 180 sites/ μm^2 at 14 days in culture). In this context, acetylcholine sensitivity measured electrophysiologically for 14-day-old myotubes was twice as much in cultures grown in the presence of brain extract compared with control cultures. The formation of high-density patches of receptors was also enhanced between 8 and 14 days in culture by the addition of brain extract. Chick spinal cord fragments put onto the cultures had the similar effects to the brain extract in the site density and patch-formation. These results suggest that a diffusible substance originating from the nervous tissues was responsible for these changes.

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NON-CHOLINERGIC GANGLIONIC TRANSMISSION AND PEPTIDES. S. NISHI, J. NAKAMURA & Y. KATAYAMA. Dept. of Physiol., Kurume Univ. Sch. of Med., Kurume

In search for the chemical substance that mediates the non-cholinergic excitatory transmission in sympathetic ganglia, the possibility of a catecholamine or a peptide playing such a role has been investigated electrophysiologically on bullfrog paravertebral ganglia. Catecholamines which appear histochemically in the intraganglionic chromaffin-like cells did not exert on the principal ganglion cells a depolarizing effect comparable to that of the non-cholinergic transmitter producing the late slow EPSP. Among eight different neuropeptides examined, substance P (sP) which has recently been shown to exist in various sympathetic ganglia appeared to be characteristic in producing the responses essentially similar to the late slow EPSP. Physalaemin and eledoisin which are in common with sP having the same amino acid sequence (-glycine-leucine-methionine) in their terminals showed a similar but weaker depolarizing effect to that of sP. The depolarizing action of sP was also found in the ganglion chronically and presynaptically denervated. The results suggest that sP is a promising candidate for the non-cholinergic excitatory transmitter in the sympathetic ganglion.

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EFFECTS OF CHEMICAL MODIFICATION ON FROG NEUROMUSCULAR JUNCTION
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The molecular structure of ACh receptor in the frog neuromuscular junction was analyzed by means of chemical modification. (1) Groups related to AChE: When the histidine residue, serine residue and amino group were modified with methylene blue, diisopropyl fluorophosphate (DFP) and trinitrobenzene sulfonic acid, respectively, epp amplitude decreased in the absence of AChE whereas only DFP effect was suppressed by curare. (2) Groups unrelated to AChE: When carboxyl groups were modified with para-nitrothiophenol, epp amplitude decreased. The rate of decrease approximately coincided with the decrease of I_{Na} . After modification of phosphate in phospholipid with ammonium molybdate, epp amplitude decreased at first and then reached the plateau. It is suggested that the serine residue and phosphate bind with ACh at carbonyl group and nitrogen sites, respectively. And thus the conformational change of membrane molecular structure causes Na transport through the carboxyl group. On the other hand, histidine residue and amino group may be related to the stabilization of the serine residue.

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DISTRIBUTION OF GLUTAMATE RECEPTORS ON THE CRAYFISH MUSCLE. A. TAKEUCHI, K. ONODERA.
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Synaptic region on the opener muscle of the walking leg in the crayfish was visually identified using Nomarski optics (40× water immersion) and the glutamate sensitivity was tested by ionophoretic application. The nerve branches were likely to be terminated with boutons which lie on the muscle surface or embedded in the cleft. Ionophoretic application of L-glutamate showed that the highest sensitivity was found at the edge of the bouton and it sharply decreased to less than 3 % at 2 μ m from the edge, but a small glutamate sensitivity was detected up to about 20 - 30 μ m from the bouton. When the tip of the glutamate pipette was critically placed at the bouton, the resulting glutamate potential showed the time course almost the same as that of spontaneous e.p.s.p. The glutamate potential was produced within 0.3 msec after the glutamate application at 18°C. This value is smaller than the synaptic delay of the nerve-evoked e.p.s.p. (0.5 msec at 23°C). When kainic acid was applied ionophoretically or in bath, the glutamate potential produced at the bouton was competitively inhibited, whereas the glutamate potential produced at about 5-30 μ m from the bouton was augmented by kainate. It is suggested that the properties of the glutamate receptor at the synapse are different from those at the extrasynaptic region.

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FACILITATION AND PRESYNAPTIC INCREASE OF CYCLIC AMP BY ADENOSINE IN MAMMALIAN BRAIN. Y. KURODA, K. KOBAYASHI, Dept. of Neurochemistry, Tokyo Metropolitan Institute for Neurosciences, Fuchu-shi, Tokyo 183.

It has been reported that cyclic AMP analogs facilitate the release of transmitter in peripheral systems. Dibutyl-AMP (DBcAMP; 100 μ M) potentiated the EPSP evoked by LOT stimulation in olfactory cortex slices of guinea pig. Incubation with DBcAMP increased the Ca^{2+} uptake into crude synaptosomes. [^3H]-DBcAMP in the medium was easily accumulated in the synaptosomes. These results suggest that the potentiation in the EPSP is mediated by the presynaptic increase of cyclic AMP and resulted increase of Ca^{2+} influx. Adenosine derivatives are released, together with transmitter (glutamate) from the olfactory cortex slices by LOT stimulation. Adenosine increased the cyclic AMP level in synaptosomes from the slices. Furthermore, adenosine-treated olfactory slices often showed potentiation in the EPSP just after the removal of adenosine which itself had an inhibitory action on the EPSP when stimulated at low frequency. A hypothesis is proposed that repetitive stimulation accumulates adenosine in the synaptic cleft; the adenosine increases the presynaptic cyclic AMP and the following biochemical changes facilitate the release of transmitter.

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DOES CYCLIC AMP MEDIATE THE SLOW IPSP IN SYMPATHETIC GANGLIA ? HARUO KOBAYASHI,
NAKAKO S. USHIYAMA & TOSHIO HASHIGUCHI. Dept. Physiol., Tokyo Med. College, Tokyo.

The slow inhibitory postsynaptic potential (s-IPSP) in the rabbit superior cervical ganglion is known to be a response to intraganglionically released dopamine (DA) (Libet & Tosaka, 1970). All three catecholamines can directly produce hyperpolarizing responses in the ganglion. The relative potencies between these amines to produce such responses were found to be in the order of adrenaline > noradrenaline > dopamine. On the contrary, the order appears to be reverse for the stimulation of cyclic AMP accumulation by these amines. Theophylline, one of the phosphodiesterase (PDE) inhibitors, can actually augment both the s-IPSP and DA-induced hyperpolarization. The other potent PDE inhibitor RO-20-1724, however, has no such augmentative effect. Intracellularly injected cyclic AMP failed to produce any hyperpolarization, whereas it did produce the characteristic long-lasting enhancement of the slow excitatory postsynaptic (s-EPSP) responses. The above findings may cast some doubt on the hypothesis that cyclic AMP is the mediator for the s-IPSP. A different possible role of cyclic AMP in the regulation of ganglionic transmission has been postulated. (RO-20-1724 was kindly supplied by Nippon Roche K.K.).

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ON THE ROLE OF Ca IN THE REGULATORY MECHANISMS OF TRANSMITTER RELEASE FROM GUINEA-PIG VAS DEFERENS. ITO, Y., TAJIMA, K., KURIYAMA, H. Dept. of Pharmacol. Fac. Med. Kyushu Univ. Fukuoka 812, Japan.

Effects of prostaglandins, 4-aminopyridine (4-AP) or tetraethylammonium (TEA) on the neuromuscular junction of the guinea-pig vas deferens were investigated using micro-electrode and double sucrose gap methods. Prostaglandins (10^{-8} - 10^{-10} M) or 4-AP (5×10^{-4} - 5×10^{-5} M) did not alter the membrane potential, membrane resistance, amplitude and frequency of miniature excitatory junction potentials (m.e.j.p.s), although prostaglandins suppressed and 4-AP enhanced the amplitude of excitatory junction potentials (e.j.p.s). TEA possessed much the same actions with 4-AP on the neuromuscular junctions. The facilitation phenomena appeared by repetitive nerve stimulation, however, was not effected by treatment with prostaglandins, 4-AP or TEA. Prostaglandins did not affect, but 4-AP prolonged the duration of action potentials recorded from the terminal region of small sympathetic nerve by the aid of micro-electrode. The mechanisms of prostaglandins, 4-AP and TEA actions on the resting and active nerve terminal membrane in relation to the role of Ca ion were discussed.

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IONIC MECHANISM OF THE INHIBITION OF LONG DURATION IN APLYSIA SYNAPSE. M. SAWADA,
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In the abdominal ganglion of *Aplysia kurodai*, three neurons were identified which responded with the inhibition of long duration (ILD) to a single stimulation of siphon nerve or bath and iontophoretic applications of dopamine. The ILD is a long lasting hyperpolarizing potential (15-60 sec) mostly associated with a conductance increase, and only difference from that of *Onchidium* is that it is usually not inverted by hyperpolarization. Exchange of half the external chloride with acetate induced no change in the ILD. The ILD was reduced and enhanced in 0.1 K and 2 K solutions, respectively, and was progressively impaired by metabolic inhibitor. These results suggest that the ILD is composed of increases in the K^+ conductance and activity of the electrogenic Na-pump. Theophylline potentiated the ILD especially in its duration. Bath application of dibutyryl cAMP, furthermore, augmented the synaptically elicited ILD and the dopamine responses to 130% of the controls without any effect on the change in membrane conductance during long lasting hyperpolarization. Intracellularly injected cAMP also increased the ILD, but 5'-AMP showed no such an effect. These data suggest that dopamine acts in the ILD neurons by increasing the activity of K^+ conductance and electrogenic Na-pump and that cAMP might stimulate the component of electrogenic Na-pump in the ILD.

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THE TERMINAL STRUCTURE OF PHOTORECEPTOR AXONS IN BARNACLE. AN ELECTRON-MICROSCOPE AUTORADIOGRAPHIC STUDY. Kazuko Tsuda and Hiroyuki Koike, Dept. Neurophysiology, Tokyo Metropolitan Institute for Neurosciences, Fuchu City, Tokyo.

We injected [^3H]gamma-aminobutyric acid (GABA) into a photoreceptor cell body in the lateral ocellus of *Balanus eburneus*, and followed its movement inside the axon by electronmicroscope autoradiography. Injected [^3H]GABA moved down the axon at about 0.9 mm/sec, and within several hours after the injection it reached axon terminal region in the supra-esophageal ganglion. The radioactivity was only detected in a certain type of axon terminals which contained many clear synaptic vesicles of about 400Å in diameter, some dense cored vesicles of 600-1300Å, and glycogen granules. An identified photoreceptor axon terminal formed many synapses, and at each synapse it faced two postsynaptic elements with a gap distance of 160-200Å wide. The photoreceptor axon terminals took up [^3H]diaminobutyric acid selectively from the perfusate. Present results will support the notion that the transmitter substance of the photoreceptor cell of barnacle is GABA.

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IS THERE AN INHIBITORY MECHANISM ON TRANSMITTER RELEASE AT THE MOTOR NERVE TERMINAL? OHTA, Y. and KUBA, K. (Dept. of Physiol., Kurume Univ. Sch. Med., Kurume)

Liberation of the transmitter from the motor nerve terminal is known to depend on the intracellular Ca^{2+} concentration ($[\text{Ca}^{2+}]_i$) in the terminal. Indeed, in the frog neuromuscular junction, the frequency of MEPP increases, when $[\text{Ca}^{2+}]_i$ in the terminal is raised by either an increase in the extracellular Ca^{2+} , application of caffeine or tetanic nerve stimulation. These procedures, however, reduce MEPP frequency, when the preparation is pre-treated with a high K^+ solution which would also raise the level of $[\text{Ca}^{2+}]_i$. These results imply that an additional increase of $[\text{Ca}^{2+}]_i$ from a previously elevated level in the terminal results in depression of spontaneous transmitter release. There may be two possible mechanisms for the reversal of the effect of an increased $[\text{Ca}^{2+}]_i$ on MEPP frequency. First, when the $[\text{Ca}^{2+}]_i$ exceeds a certain level, a Ca^{2+} buffering system in the nerve terminal would start to operate as a sort of an inhibitory system and reduce the rate of transmitter release. Second, there may be a genuine inhibitory mechanism in the transmitter release system, which is activated at a relatively high $[\text{Ca}^{2+}]_i$.

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TETANIC RISE IN THE FREQUENCY OF MINIATURE END-PLATE POTENTIALS AT THE FROG NEUROMUSCULAR JUNCTION IN MN-, CO- AND NI-SALINE SOLUTIONS. KITA, H. & NARITA, K. Dept. of Physiol., Kawasaki Med. Sch., Kurashiki, Okayama.

Increasing the extracellular concentration of Mn, Co or Ni in the absence of Ca produced an increase in the frequency of min.e.p.p.s. In preparations depolarized with 20 mM-K the min.e.p.p. frequency was markedly increased by raising the $[\text{Mn}]_o$, $[\text{Co}]_o$ or $[\text{Ni}]_o$. Over a range from 4 to 10 mM a plot of the log(maximum min.e.p.p. frequency) as a function of the $[\text{Co}]_o$ or $[\text{Ni}]_o$ gave a straight line whose slope was 2.6 or 2.3 respectively. Tetanic stimulation of the motor nerve in solutions made with no added divalent cations but containing MgEGTA caused slight or no increases in min.e.p.p. frequency. In Mn-, Co- or Ni-saline solution stimulation of the motor nerve resulted in substantial increases in min.e.p.p. frequencies. The maximum frequency attained was a power function of (1) the duration of the tetanus, (2) the frequency of tetanus or (3) the extracellular concentration of the divalent cation. It is suggested that Mn, Co and Ni can enter the nerve terminal through a voltage-gated channel and once within the terminal they can stimulate the quantal release of ACh.

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ION CHANNELS AND RECEPTIVE SITES ON GABA SENSITIVE ONCHIDIUM NEURON

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A few onchidium neurons respond to GABA with a conductance increase and two membrane potential changes. One is early transient hyperpolarization (phase I); the second is late continuous hyperpolarization (phase II). Phase I is caused by increased Cl^- permeability; phase II by increased K^+ permeability. Phase II is suppressed by lowering temperature or exposing to NaCN. It is enhanced by decreased $[\text{Na}^+]_o$. A mechanism for these phenomena is blockage of K^+ channels by $[\text{Na}^+]_i$. Chemical modification of amino acid residues indicated that the Cl^- channels contain lysine residues with ϵ -amino groups, and the K^+ channels contain tyrosine residues with OH groups; serine and tyrosine residues are important at one part of these GABA receptors and the phosphate groups of phospholipids are important at another site. α -mannosidase suppresses both phase I and II at high GABA concentrations, but enhances at lower concentrations. These observations suggest that two abnormalities are caused by sugar chains: one is reduction of receptor stability, and the other is reduction of receptor effectiveness. Con A, which produces a drastic changes in glutamate response, has no effect on this GABA response.

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A VISCOELASTIC STUDY ON THE GIANT AXON OF THE CRAYFISH NERVE.

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A viscoelastic study was done on the giant axon of crayfishes; several constants such as Young's modulus and viscosity coefficient as well as relaxation time were estimated by rheological analysis of the stress relaxation curve obtained from the stretch of the nerve. The temperature dependences of these constants were compared with those of conduction velocities, suggesting an existence of a phase transition phenomenon at about 10°C. Some local anesthetics were also tested on the axon. The blockade of the conduction was found in high values of Young's modulus and viscosity constant, without affecting the relaxation time.

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EFFECT OF TETANUS TOXIN ON CAT SPINAL CORD IN LOCAL TETANUS. K. KANDA, *K. TAKANO.

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It has been considered that the tetanus toxin blocks the inhibitory synaptic transmission of mammalian spinal cord by reducing release of the inhibitory transmitter. However, recent works suggest the effect of the toxin is rather universal and does not depend on the nature of the transmitter. The chromatolysis also occurs in motoneurons.

In this experiment the effects on the properties of motoneuron itself as well as the excitatory and inhibitory post-synaptic potentials produced in the motoneurons by the stimulation of various peripheral nerves were investigated by means of the intracellular recording technique. Tetanus toxin (100 mouse MLD/kg) was injected into the left medial gastrocnemius (MG) muscle of the cat. And the data from MG motoneurons were analyzed. Conduction velocity of the axon, duration of the afterhyperpolarization and input resistance of motoneurons showed no or a little, if any, change throughout the period of the present observation while the synaptic transmission was impaired considerably by the toxin. The disynaptic group Ia IPSP and the IPSP component of sural PSP were almost disappeared as early as on the second day after the toxin injection, when the group Ia EPSP still remained intact. On the sixth day the Ia EPSP also became very small.

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ROLE OF SUBSTANTIA GELATINOSA NEURONS IN THE MONKEY SPINAL CORD DORSAL HORN. H. HAYASHI, D.D. PRICE* AND R. DUBNER*. Dept. Physiol., Sch. Dent. Tokyo Med. Dent. Univ. and *NIDR, NIH, USA.

Many spinothalamic (ST) neurons in dorsal horn layer I receive convergent input from A β , A δ and C primary afferents. Since many of these primary afferents terminate outside of layer I and the dendrites of layer I neurons are confined to that layer, input must be relayed to layer I ST neurons via excitatory interneurons. The present study compared the response properties of pairs of neurons whose activity was recorded successively in the same microelectrode track, and were located in layer I and layers II/III, respectively. Layer I neurons were identified as ST neurons. Data obtained from 35 pairs revealed that: 1) many layer II/III neurons received convergent input, 2) the paired neurons had overlapping receptive fields with layer II/III neurons having smaller RFs, 3) layer II/III neurons had shorter first spike latencies, 4) neurons which received only A δ and/or C nociceptive afferent input were in layer I or layer II, 5) neurons which received low-threshold mechanoreceptive afferent input were located near the layer III-IV border. These data support the hypothesis that different classes of afferents synapse on layer II excitatory interneurons. This input is relayed to layer I ST neurons where more convergence occurs.

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SPINAL INTERNEURONES WITH COMMISSURAL AXONS PROJECTING TO THE MOTOR NUCLEUS IN THE CAT.
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Spinal interneurons projecting to the contralateral hindlimb motor nucleus were identified by means of retrograde transport of HRP and by antidromic activation from the motor nucleus. The cells were located mainly in lamina VIII of L4-S1. Systematic mapping with a stimulating electrode revealed that stem axons of those cells in L5-L6 descended in the contralateral ventral funiculus and very often reached S2. In their course they sent many branches in and around motor nuclei at different lumbar segments. Synaptic inputs were studied using intracellular recording from these cells. More than 90% of cells were excited monosynaptically by stimulation of the ipsilateral Deiters' nucleus and/or MLF. Monosynaptic inputs from the two sources converged in one third of them. Small number of cells were excited by one source and inhibited by the other. Volleys in flexor reflex afferents (FRA) from both hindlimbs evoked polysynaptic excitation and/or inhibition in all cells tested. The dominant patterns were co-excitation and co-inhibition from both sides. It is suggested that these interneurons integrate information from descending and FRA paths and transmit it to various motor nuclei of the contralateral side.

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RHYTHMIC BURST DISCHARGES OF THE SPINAL CORD IN EXPERIMENTALLY PRODUCED SPONTANEOUS TREMOR IN MONKEYS. C. OHYE, S. IMAI, H. NAKAJIMA, T. SHIBAZAKI, T. HIRAI. Dep. of Neurosurg., Gunma Univ. Sch. of Med., Maebashi, Gunma.

Extracellular recordings were made from the upper spinal cord (C₁-C₂) in four awake monkeys with experimentally produced spontaneous tremor by a mesencephalic ventromedial tegmental lesion. Two types of rhythmic burst discharges time-locked with the peripheral tremor were distinguished. The one was found ipsilaterally to the tremor at the level of the dorsal column, reflecting certainly afferent impulses resulted from the peripheral tremor. The other was found also ipsilaterally in the ventral quadrant, 1.5-2.0 mm from the mid line. Time relationship analysis between the rhythmic burst in the spinal cord and corresponding tremor EMG revealed that the spinal rhythmic burst preceded the EMG. This suggested strongly that rhythmic discharges mediating the peripheral tremor came down from somewhere in the higher center. The point where the rhythmic burst discharges were recorded in the ventral quadrant was marked with the aid of Elgiloy electrode. Histological examination showed that the points thus marked by ferric chloride were located in the lateral part of the ventral horn at the level of Rexed VII and IX layers and their adjacent ventral column.

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AFFERENT PROJECTION OF NECK MUSCLES IN THE CATS.
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Afferent projection of dorsal neck muscles biventer cervicis, splenius, complexus, and occipitoscapularis upon brainstem was investigated on anesthetized cats. Neurons responding to electrical stimulation of these muscle nerves were located in external cuneate nucleus and rostral tip of main cuneate nucleus. It was found that all neurons responded to only one of these afferent nerves and none showed convergence from more than two afferents. Among 82 neurons studied, 33 responded to biventer, 31 to splenius, 16 to occipitoscapularis and 2 responded to complexus muscle nerve. Within the nuclei, neurons conveying informations of biventer muscle are located in the caudal part, and neurons responding to splenius are located in the rostral half. 39 neurons (47.5%) showed the first spike response at stimulus strength below 1.7T suggesting group I afferents are responsible for the discharges, and 42 neurons (51.2%) responded with latencies within the monosynaptic connection. With increasing stimulus strength, 35 neurons showed only one spike showing larger afferent nerves have no excitatory connections to these neurons, and the remaining 47 neurons showed multiple spike discharges and 32 of them showed increasing spike number with increasing stimulus strength showing excitatory convergence from small and larger afferents.

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INPUT - OUTPUT RELATION IN SPINAL MOTONEURONS IN THE STRETCH REFLEX. S. HOMMA,
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Random triangular stretches of a muscle can activate the spinal cord to elicit random motor unit spikes. A primary correlation kernel is revealed by cross-correlation analysis of the motor unit spikes and the muscle stretches. Integration of the primary correlation kernel was thought to indicate the rising phase of the EPSP elicited on an alpha-motoneuron by spindle primary afferent impulses from the stretched muscle. Simultaneous random triangular stretches of the test muscle and a synergistic or an antagonistic muscle increased the motor unit spikes or depressed them, respectively. Cross-correlograms of motor unit spikes with the synergistic or the antagonistic muscle stretches revealed a facilitatory primary correlation kernel or an inhibitory primary correlation trough, respectively. Integration of the kernel or trough made it possible to calculate the rising phase of the EPSP or the IPSP. That is, statistical analysis of the motor unit spikes makes it possible to calculate the time course of postsynaptic potential, i.e. the excitatory postsynaptic potential due to the proprioceptive input, the facilitatory potential due to the homonymous input from the synergist, and the inhibitory potential due to the heteronymous input from the antagonist. Thus, the coding process between input and output carried out by postsynaptic potential was statistically quantified.

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TERMINALS OF SINGLE GROUP Ia FIBERS IN THE MOTOR NUCLEUS IN THE CAT
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Single Ia fibers from hindlimb muscles were intra-axonally stained with HRP in the cat. Five to eleven stained collaterals were found to be given off from the stem axon in the dorsal funiculus. Nearly all the terminals of lamina IX were stained in 19 collaterals. The rostrocaudal spread of the terminals belonging to one collateral was confined within 100-500µm, and the terminal regions of neighbouring collaterals never overlapped, usually separated by gaps of 300-1500µm. Ia terminals of some muscles were distributed mainly within their homonymous motor nuclei, but those from others in a few heteronymous nuclei, in addition. The number of lamina IX terminals distal to a certain site of a collateral was found to be linearly related to the diameter of that site of axon. The number of terminals in lamina IX of a single collateral was found to be 150 on the average. About 20% of the terminals contacted with motoneurons on their somata and proximal dendrites. Such terminals from a single fiber terminating on one motoneuron were 1-10, 3.3 on the average, in number. The results are discussed in relation to previous physiological findings on synapses of single Ia fibers on motoneurons.

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PRIMARY AFFERENT DEPOLARIZATION IN THE BRANCH OF A SINGLE AFFERENT NERVE FIBER IN THE BULLFROG Y. WATANABE and S. HASHIMURA
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The primary afferent depolarization (PAD) of the branch of the single afferent nerve fiber was investigated in the spinal cord of the bullfrog. Either of cutaneous and muscle afferent fibers induced PAD from both of cutaneous and muscle nerve impulses in a hardly distinguishable manner. So, it was concluded that PAD in the bullfrog was not as characteristic as that in the cat in terms of the sensory modality and the receptive area. The nonspecific occurrence of PAD became more significant proportionately with the longer distance of the afferent fiber in the spinal cord, although the extent and occurrence of the PAD decreased. However, PADs in two branches of a single afferent fiber situated more than several mm apart in the spinal cord were induced in a different manner, suggesting the different presynaptic inhibition from a branch to the other. It was concluded that the branches of a single afferent nerve fiber behaved in different manner in terms of the pre-synaptic inhibition.

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ENHANCEMENT OF EXTRACELLULAR POTASSIUM ION ACTIVITY IN THE MIDBRAIN RETICULAR FORMATION DURING REM SLEEP. T. SATOH, N. MUTSUGA*, Dep. of Physiol., Sch. of Dent., Aichi-Gakuin Univ., Chikusa-ku, Nagoya and Dep. of Neurosurg., Sch. of Med., Univ. of Nagoya, Showa-ku, Nagoya*

Many neurons in the midbrain reticular formation (MRF) show an enormous increase in discharge rate during REM sleep. It is expected that potassium ion activity in the extracellular space of the MRF may be enhanced during REM sleep because of a large quantity of released K ions exceeding the capacity to remove them. Glass pipette of 3 μ m in diameter which was filled with a short column of K ion-exchanging resin, was inserted acutely into the MRF of cats carrying chronically implanted electrodes for monitoring sleep-wakefulness cycle. The reference barrel was glued to the K-sensitive electrode. The K ion activity was rather stable during wakefulness and slow wave sleep. During REM sleep it was enhanced and showed marked fluctuations. It is suggested that a number of erratic phenomena observed during REM sleep may be explained to some extent on the basis of enhanced K ion activity in the extracellular space.

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CONTROL OF EQUILIBRIUM RESPONSES BY DESCENDING INTERNEURONS IN THE CRAYFISH. M. TAKAHATA, M. HISADA. Zool. Instit., Fac. of Science, Hokkaido Univ., Sapporo

A pair of uropods in the crayfish *Procambarus clarkii* Girard show asymmetrical movements for steering in response to body rolling. When the animal is tilted so that the left side is lifted, the uropod on the left side is opened while that on the right side is closed. These movements are primarily controlled by a pair of statocysts. Each statocyst drives 4 interneurons, interneurons I₁ and I₂ in the ipsilateral and C₁ and C₂ in the contralateral commissure. I₁ and I₂ in turn excite the opener while C₁ and C₂ excite the closer motoneurons on the same side respectively. Thus each statocyst alone can produce the asymmetrical movements of bilateral uropods. However, although these interneurons can control the direction and magnitude of the uropod movement, they can not initiate it. The animal must be performing extension or flexion of the abdomen for the uropod movement to occur. Thus the uropod reflex pathway should be activated by some other elements for the emergence of actual movement. This activation process was found to occur in the 6th abdominal ganglion where the uropod motoneurons are located.

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NEURONS IN TRIGEMINAL NUCLEUS CAUDALIS INVOLVED IN INDUCTION OF TRIGEMINO-NECK REFLEX. R. SUMINO and S. Nozaki. Sect. Physiol., Inst. Stomatognathic Sci., Sch. Dent., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo.

We have previously reported that low threshold afferents from mechanoreceptors in the facial skin of cats constitute principal trigeminal inputs to induce the reflex discharges in the upper cervical nerves which innervate the dorsal neck muscles (Trigemino-Neck Reflex, TNR) and the amount of TNR depends not only on displacement but also on velocity of mechanical stimuli. TNR induced by mechanical stimulation of the facial skin was almost completely abolished by transection of the lateral one third of the brainstem at the level of the obex. Some neurons in trigeminal nucl. caudalis which were activated orthodromically by mechanical stimuli to the facial skin were also activated antidromically by localized electrical stimulation of the C₂ motoneuron pool. The antidromic spike potential was blocked by preceding mechanical stimulation. When velocity of mechanical stimulation was fixed at high speed (more than 333 mm/sec), the first spike of the identified neurons appeared with small displacement (300 μ m) and the number of spikes increased with increment of displacement. On the other hand, when displacement was fixed, spike number increased as a function of velocity. It was, therefore, inferred that some mechanically activated neurons in trigeminal nucleus caudalis projected monosynaptically to the upper cervical motoneurons and would be involved in induction of TNR.

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Nociceptive visceral responses of neurons at mesodiencephalic junction. T. Yokota, E. Carstens, M. Zimmermann. Dept. of Physiol., Med. Coll. of Shiga, Seta, Otsu and II. Physiol. Inst., Universität Heidelberg

In Nembutal anesthetized cats, units responding to electrical stimulation of the splanchnic nerve were identified in the caudal thalamus (medial geniculate body) and adjacent midbrain reticular formation, and their responses to intestinal distension were studied. The Thiry's jejunal loop was surgically prepared and was distended with a balloon catheter inserted through an opening in the abdominal wall.

Altogether 134 units were obtained. Of these 118 units responded to splanchnic as well as posterior tibial and/or superficial radial nerve stimulation, thus demonstrating viscerosomatic convergence. When the Thiry's jejunal loop was distended, 19 units showed slowly adapting responses sometimes followed by afterdischarge. These units generally had thresholds to splanchnic nerve stimulation well above threshold for the viscerointercostal reflex which is regarded as a nocifensive viscerosomatic reflex. They almost always had large cutaneous receptive fields and responded best to intense mechanical stimulation. A few also responded to noxious cutaneous heating at 50°C.

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DISTRIBUTION AND CHARACTERISTICS OF THE CELLS IN MEDIAL THALAMUS RESPONDING TO NOXIOUS STIMULI. HIROSHI RYU, M.D., KENICHI UEMURA, M.D. Dept. of Neurosurgery, Hamamatsu Univ., School of medicine. WILLIE K. DONG, Ph.D., IRVING H. WAGMAN, Ph.D. Dept. of Animal Physiology, Univ. of California, Davis

Extracellular responses of the cat medial thalamus to peripheral noxious and non-noxious stimuli were studied. 72% of the sample responded to stimulation of A δ and C-fiber groups and to other noxious mechanical stimuli. These neurons were considered to be nociceptive. Most of the noxious neurons located in Pf, Spf, and CL. None were found in CM (small celled true CM). 10% of the sample responded only to brisk tap to skin or underlying tissue, and were driven by activation of A α and β fibers. In 18% of the sample, their resting discharge were inhibited by noxious stimuli and stimulation of A δ and C-fiber groups. The results obtained from monitoring the peripherally evoked noxious response in the medial thalamus before and after selective lesions of the spinal cord suggested that bilateral spinothalamic and/or spino-reticulo-thalamic tracts play an important role in mediating A δ and C-fiber input to these cells.

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ANTERIOR AND POSTERIOR CANAL INPUT TO CAT EXTRAOCULAR MOTONEURONS. Y. UCHINO, S. SUZUKI, *T. MIYAZAWA & S. WATANABE. Dept. of Physiol., Kyorin Univ. School of Medicine 6-20-2 Shinkawa, Mitaka-shi Tokyo & *Dept. of Physiol., Nihon Univ. School of Medicine 30-1 Kamimachi Ooyaguchi, Itabashi-ku Tokyo.

In the anesthetized cat, the vestibular ampullary nerve branch of the anterior canal (ACN) and posterior canal (PCN) were stimulated by electric pulses and synaptic responses were recorded intracellularly in the three antagonistic pairs of extraocular motoneurons. Weak stimulation of the ACN evoked disynaptic EPSPs in contralateral superior rectus, inferior oblique and disynaptic IPSPs in bilateral inferior rectus and ipsilateral superior oblique motoneurons. In ipsilateral superior oblique motoneurons, the ACN stimulation evoked IPSPs and also the PCN stimulation produced IPSPs (Uchino et al. Exp. Brain Res. 32, 377-388 (1978)). The IPSPs due to the test PCN stimulation was abolished by the conditioning shock of the ACN stimulation. Weak stimulation of the PCN evoked disynaptic EPSPs in bilateral inferior rectus, contralateral superior oblique and disynaptic IPSPs in bilateral superior rectus and ipsilateral inferior oblique motoneurons. Between the ACN and PCN, plane-specific inhibition has been obtained in above extraocular motoneurons which received EPSPs following ACN stimulation and contralateral IPSPs in response to PCN stimulation, and vice versa. The contralateral inhibition may increase the reflex activity and sensitivity of the reflex.

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ROLE OF INTERNEURONS WITHIN THE ABDUCENS NUCLEUS IN NYSTAGMIC MODULATION OF MEDIAL RECTUS MOTONEURONS. S. SASAKI. Dept. of Neurophysiol., Inst. Brain Res., Sch. of Med., Tokyo Univ., Bunkyo-ku, Tokyo. S. NAKAO. Dept. of Physiol., Sch. of Med., Univ. of Tottori, Yonago.

Interneurons within the abducens nucleus were identified by antidromic activation following stimulation of the contralateral oculomotor nucleus in *encéphale isolé* cats under local anesthesia. Intracellular recording was simultaneously made from contralateral medial rectus motoneurons. Excitatory synaptic connection of each interneuron with contralateral medial rectus motoneurons was demonstrated by revealing monosynaptic unitary EPSP by means of post-spike averaging technique. The spike activity of thus identified interneurons showed nystagmic modulation in phase with contralateral medial rectus nerve discharges. The onset of synaptic excitation of motoneurons indicated by steep negative deflection of the field potential in the oculomotor nucleus was synchronous with the onset of spike burst in the interneurons. Lack of positive field potentials at the quick inhibitory phase of motoneurons suggested that the spike suppression of motoneurons was mainly due to disfacilitation caused by reduction of spike activity of interneurons. It was concluded that interneurons within the abducens nucleus were immediate excitatory premotor neurons participating in nystagmic modulation of contralateral medial rectus motoneurons.

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EFFECTS OF STIMULATION OF THE GLOSSOPHARYNGEAL NERVE ON THE FACIAL NEURONS IN CATS. T. TANAKA, T. ASAHARA, Dep. of Physiol., Mie Univ., Tsu

Evoked responses in the facial nucleus (FN) of cats were recorded with microelectrodes intracellularly on stimulation of the glossopharyngeal (IX) nerve, lingual nerve, and solitary tract nucleus (STN). EPSPs, EPSPs with succeeding IPSPs, and IPSPs were elicited in the FN neurons by stimulation of the ipsilateral IXth nerve. Of 83 FN neurons investigated, 74 neurons were evoked EPSPs and 9 neurons were produced IPSPs by stimulation of the ipsilateral IXth nerve. The latencies of the EPSPs ranged from 2.8 msec to 7.0 msec (mean 4.6 msec, N=74). Stimulation of the contralateral IXth nerve also induced EPSPs, EPSPs with succeeding IPSPs, and IPSPs in the FN neurons. The latencies of the EPSPs ranged from 4 msec to 8 msec (mean 5.4 msec, N=32). STN stimulation induced mono- and polysynaptic EPSPs in FN neurons, and the findings are strongly indicative of a disynaptic or polysynaptic connection in the afferent pathway from the IXth nerve to the FN. Lingual nerve stimulation was capable of inducing EPSPs and IPSPs in FN neurons. Of 53 FN neurons tested, 47 could be elicited EPSPs by stimulation of both the lingual and IXth nerves. Only 4 were inhibited by both nerves stimulation.

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THE DEPRESSION OF A LATE IPSP IN THE HYPOGLOSSAL MOTONEURONS. M. TAKATA, S. FUJITA, Dept. of Oral-Physiology, School of Dentistry, Tokushima Univ., 3 Kuramoto-cho, Tokushima

In intracellular recordings from the hypoglossal motoneurons in the cat it has been elucidated that IPSPs evoked by lingual nerve stimulation were the composite of an early and a late IPSP. When two shocks separated by 80 to 100 msec interval were applied to the lingual nerve, the 1st shock produced two components of IPSPs but only an early IPSP was caused by the 2nd shock. In strychninized cat the 2nd shock did not produce any IPSP. After administration of picrotoxin (7mg/kg i.v.) both the 1st and the 2nd shock produced the same size of IPSP. These results indicate that when double stimuli were applied to the lingual nerve, the 2nd shock only produces an early IPSP and a late IPSP was completely abolished. This depression was lasted for 250 msec.

In hypoglossal motoneurons stimulation of the hypoglossal nerve also produced a late, strychnine insensitive IPSP. When double shocks were applied to the hypoglossal nerve, both the 1st and the 2nd shock produced a late IPSP. This hypoglossus-induced IPSP was not depressed by stimulation of the lingual nerve as a conditioning stimulus.

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Effects of strychnine and picrotoxin upon trigeminal subnucleus caudalis neurons. Y. Nishikawa, N. Nishikawa, Y. Kaiga, S. Ohno, T. Yokota. Dept. of Physiol., Osaka Dent. Univ., Higashi-ku, Osaka and Dept. of Physiol., Med. Coll. of Shiga, Seta, Otsu

Effects of intravenous strychnine or picrotoxin upon the receptive field characteristics of trigeminal neurons within the trigeminal subnucleus caudalis and nearby bulbar lateral reticular formation were studied in urethane-chloralose anesthetized Japanese monkeys. Following strychnine (0.08 mg/kg) administration, the nociceptive receptive field of wide dynamic range neurons in the lateral part of subnucleus reticularis dorsalis was markedly expanded. In contrast, intravenous picrotoxin (1 mg/kg) virtually abolished the nociceptive surround of the receptive field of these neurons, although it expanded the center of the receptive field in which tactile stimulation was effective. Picrotoxin also expanded the size of receptive field of tactile neurons in the pars magnocellularis of trigeminal subnucleus caudalis, but strychnine had no effects upon the receptive field size of these neurons. Both strychnine and picrotoxin had no effects upon the receptive field of nociceptive neurons in the marginal layer of trigeminal subnucleus caudalis.

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FUNCTIONAL SIGNIFICANCE OF TRIGEMINAL SPINAL NUCLEUS CAUDALIS TO NOCICEPTIVE REACTION TO TOOTH PULP STIMULATION. IKEGAMI, S. and KAWAMURA, H. Lab. of Physiol. Psychol., Mitsubishi-Kasei Institute of Life Sciences, Machida-shi, Tokyo

In the cat, whose brain stem was transected at such a level that the nucleus caudalis of the spinal trigeminal complex was completely removed from the forebrain, a passive avoidance conditioning of vertical eye movements to tooth pulp stimulation was immediately established. Also, in chronic cats, threshold for jaw opening reflex by electrical stimulation of tooth pulp was studied before and after bilateral trigeminal spinal tractotomy. Threshold for jaw opening reflex increased by 30-50% after the tractotomy, but nociceptive reaction to tooth pulp stimulation was maintained. These results strongly suggest that dental pain sensation can be conducted via the trigeminal main sensory nucleus and nucleus oralis of the spinal trigeminal complex after ablation of the nucleus caudalis.

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NEURONAL ORGANIZATION OF THE MAMMILLARY BODY OF CAT. KOBAYASHI, N. Dep. of Radiological Technol., Kanazawa Univ., Sch. of paramed., Kanazawa

Effects of electrical stimulation of the fornix (FX) to the mammillary body (MB) was studied under the Nembutal anesthesia in the cat. Anterior nuclei of the thalamus (A) was also stimulated to evoke antidromic responses in MB. Population responses were recorded by concentric macro-electrodes or glass micropipettes. The latters were filled with pontamine sky blue to identify their tip positions. FX stimulation evoked mainly a positive wave with a duration of about 70 ms. It was composed of three components (wave 1, 2 and 3). Their peak latencies were about 3, 10 and 30 ms, respectively. It was shown that the wave 1 was derived from the fornix column fibers and the wave 2 and 3 were generated postsynaptically in MB. In the unit studies, FX shocks evoked single or burst discharges with the shortest latency of 5.6 ms. The burst discharges frequently occurred close to the wave 2 and/or 3. FX shocks also inhibited the spontaneous discharges for 0.1 to 0.5 s. It was shown that unit activities with burst discharges were derived from the output neuron of MB.

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MODULATION OF THE RHYTHMIC MASTICATORY MUSCLE EMG ACTIVITY BY STIMULATION TO THE CORTICAL MASTICATORY AREA AND LATERAL AMYGDALOID NUCLEUS IN THE RABBIT.
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The suppression and facilitation by stimulation to the cortical masticatory area and lateral amygdaloid nucleus for the masseter and digastric muscle EMG activity during rhythmic jaw movements which is induced by continuous electrical stimulation to the cortex and lateral amygdaloid nucleus has been determined.

- 1) It was found that the time course of the facilitation and suppression produced by cortical stimulation were almost same to that of produced for digastric and masseteric reflex.
- 2) The stimulation of the caudal portion of the cortical masticatory area induced suppression then followed the facilitation.
- 3) The stimulation to the lateral amygdaloid nucleus shows the same modulation as well as cortical stimulation for the digastric muscle. On masseter muscle, however, could not induced reciprocal relationship between digastric and masseter muscle as the cortical stimulation.
- 4) The large motor unit has been more modulated by each stimulation than smaller motor unit except for the masseter muscle by the cortical stimulation.

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CORTICAL PROJECTION TO MASTICATORY MOTONEURONS IN THE RAT.
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Mylohyoid-digastric (Myl-Dig) motoneurons (Mtnn) receive short latency (4.6 - 6.5 ms) excitatory projection from the frontal cortex (FCtx), whereas masseteric (Mass) Mttn receive short latency (about 5 ms) weak inhibition followed by slightly longer latency facilitation from FCtx, both with contralateral predominance.

Stimulation of the trigeminal motor nucleus (Mt Ncl V) produced an antidromic potential at the contralateral FCtx with a latency of about 4 ms. If the synaptic delay were assumed to be 1 ms, a monosynaptic pathway is possible in the cortical projection to Mt Ncl V.

Histological study with degeneration method revealed that degenerated fibers were present in and near the bilateral Mt Ncl V and in the ipsilateral pyramidal tract. A small number of degenerated fibers were found in a close vicinity of some Mttn. This finding may confirm possibility of monosynaptic pathway.

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FUNCTIONAL CONNECTION FROM THE SUPRACHIASMATIC NUCLEUS TO THE HYPOTHALAMUS. Y. OOMURA, H. KITA, N. SHIMIZU, T. ONO*, H. NISHINO* and K. SASAKI*. Dept. Physiol., Fac. Med., Kyushu Univ., Fukuoka, *Dept. Physiol., Fac. Med., Toyama Med. Pharm. Univ., Toyama.

Circadian rhythm of rat lateral hypothalamic area (LHA), and ventromedial nucleus (VMH) neuron activity has been reported. Circadian rhythm has also been reported in rat feeding and drinking. The suprachiasmatic nucleus (SCN) is connected directly to the hypothalamus. The facts suggest that the SCN is probably affected by optical sensory and pineal gland activity and in turn produces biorhythm in feeding through its modulation of LHA and VMH activity. Intracellular recordings from LHA neurons in anesthetized rats responded to SCN stimulation with fast or slow IPSP's (43%), or driven EPSP discharges (16%) with variable latencies for various stimulus intensities. Some neurons showed antidromic spikes, indicating bidirectional pathways. VMH neurons showed EPSP's alone (10%) or EPSP-IPSP sequences (12%) during SCN stimulation. Some neurons showed antidromic spikes. No initial inhibition was obtained. These results lead to the conclusion that the SCN mainly excites VMH activity and inhibits in the LHA.

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ACUPUNCTURE ANALGESIA AND CAUDATE NUCLEUS.

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Evoked potentials was induced by acupuncture stimulation in periaqueduct central gray (PAG), corpus callosum (CC) hippocampus and centromedian nucleus of thalamus. While it was not recorded in caudate nucleus (Nca). PAG-stimulation also caused evoked potentials in CC and hippocampus.

Electrode Insertion (0.5 mm in diameter) to PAG, CC and Nca through CC abolished acupuncture analgesia (AA) which was evaluated by tail flick test. Analgesia caused by 0.5mg/Kg morphine was also abolished by electrode insertion to CC and PAG.

Naloxone abolished the PAG stimulation-produced analgesia (PAG-SPA) which was rendered to similar grade with AA. The electrode insertion to CC and Nca through CC abolished PAG-SPA.

These datas indicate that PAG, CC and hippocampus might associated with acupuncture afferent pathway and implied that endogenous morphine like factors might be liberated from some end place of this pathway.

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CHARACTERISTICS OF GLUCOSE-SENSITIVE NEURONS IN MONKEY FEEDING CENTER. H. NISHINO, T. ONO, K. SASAKI and K. MURAMOTO. Department of Physiology, Faculty of Medicine, Toyama Medical and Pharmaceutical University, Toyama 930-01.

Chemosensitive neurons which play an important role in feeding behavior have been reported in rat and cat lateral hypothalamic area (feeding center, LHA). In this report we examined in chronic monkey LHA : chemosensitivity, response to motor cortex (MC) stimulation, response to bar press feeding behavior etc. Results were as follows: i) glucose, applied to 55 neurons, inhibited neuronal activity of 12. Thus, we regarded these 12 as glucose-sensitive neurons. Morphine and enkephalin, a morphine like peptide which is abundant in the hypothalamus also inhibited the activity of the majority of these glucose-sensitive neurons, and had no clear effect on non glucose-sensitive neurons; ii) MC stimulation produced short latency (0.5-1.5 msec) excitation followed by inhibition and second excitation in glucose-sensitive neurons; iii) of 12 glucose-sensitive neurons 5 were studied further for activity during bar press feeding. It is noteworthy that all of these glucose-sensitive neurons showed early excitation, 2.0-0.8 s prior to the bar press while no non glucose-sensitive neurons tested showed such early excitation. These results suggest that glucose-sensitive neurons in LHA which are also sensitive to endogenous morphine like peptide are crucial in motivating feeding behavior.

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MORPHOLOGICAL FEATURES OF PHYSIOLOGICALLY IDENTIFIED EXCITATORY AND INHIBITORY NEURONS OF TRIGEMINAL MOTONEURONS IN THE MEDIAL BULBAR RETICULAR FORMATION AS REVEALED BY INTRACELLULAR HRP INJECTION

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From our previous studies it has been assumed that the neurons are located in the medial bulbar reticular formation (MBRF) which are the last-order interneurons involved in orbital cortically evoked inhibition of masseter motoneurons (IM neuron) and excitation of anterior digastric motoneurons (ED neuron), respectively. This study was performed in cats under α -chloralose anesthesia with the purpose to clarify the morphological features of physiologically identified IM and ED neurons by HRP injection. The HRP-positive IM and ED neurons (7 each) were all of small to medium size; the former was smaller than the latter. Some of MBRF neurons responded with IPSPs to orbital cortical stimulation but did not respond antidromically to stimulation of trigeminal motoneuron pools. The HRP-positive such 3 neurons were all found to be giant cells.

The results suggest the functional differentiation among MBRF neurons which is correlated with the size of neurons.

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INHIBITION OF ELECTRICAL ACTIVITIES OF RAT NIGRAL NEURONS INDUCED BY STIMULATION OF PERIPHERAL SENSORY NERVE. C.T. TSAI, S. NAKAMURA AND K. IWAMA. Dept. Neurophysiol., Inst. Higher Nerv. Activ., Osaka Univ. Med. Sch., Osaka.

The effects of electrical stimulation of sciatic nerve on spontaneous discharges of neurons of pars compacta of substantia nigra (SNc) were investigated in urethane-anesthetized rats. Most of the cells (84%) were inhibited by sciatic nerve stimulation. The onset latency was 16-82 msec (mean, 38.2 msec), and the duration was 60-510 msec (mean, 204.6 msec). Natural noxious stimuli also produced the inhibition. In caudate-lesioned animals the sciatic-induced inhibition was strengthened; its duration was 100-760 msec (mean, 355.1 msec). The inhibitory effect of sciatic nerve stimulation was weakened when it was given together with caudate stimulation. After intravenous administration of haloperidol (0.1 mg/kg), the inhibition was alleviated. Conclusions: (1) The commonest effect of electrical stimulation of peripheral sensory nerve upon spontaneous discharges of SNc neurons was inhibitory. (2) Noxious stimuli were effective to induce the inhibition. (3) Caudate nucleus interfered the inhibition. (4) Dopamine may be involved in causing the inhibition.

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MEDIAL PREOPTIC NUCLEUS NEURONES: CONVERGING SYNAPTIC INPUTS AND STIMULATION-DEPENDENT CHANGES IN SYNAPTIC EFFICACY IN FEMALE RATS MITSUKO BAN and KINJI YAGI. Dept. of Physiol., Jichi Med. Sch., Tochigi-ken

In urethane-anaesthetized female rats medial preoptic nucleus (MPO) units were examined for stimulation of the amygdala (AMY), the pyriform cortex (PYR) and the surface of the median eminence (ME). Of the 41 units tested 21 same single units responded to each of AMY (and/or PYR) and ME stimulations. In 7 of the 21 units latency of the response to ME stimulation was similar to that of the response to AMY (PYR) stimulation. After 35 - 200 stimulations of the lateral AMY of PYR repeated at 0.97 Hz a transitory excitation appeared in 6 units, the excitatory response which had been observed disappeared in the other 1 unit, and duration of an inhibition prolonged and changed during stimulation in the other 2 units. Changes in synaptic efficacy were reproduced 5 minutes after termination of stimulations. These results suggest that certain MPO neurones receive converging synaptic inputs both from AMY and tubero-infundibular neurones and the pathway from lateral AMY (PYR) includes the synapse whose efficacy depends on the foregoing stimuli. These synaptic transmission appears to be associated with some memory processes.

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THE PRESENCE AND NATURE OF INHIBITION IN SMALL SLICES OF THE DORSAL LATERAL GENICULATE NUCLEUS OF RAT AND CAT INCUBATED IN VITRO.

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The nature of the inhibitory function of interneurons within the lateral geniculate nucleus was investigated by optic tract stimulation in thin slices of rat and cat LGN maintained in vitro. Intracellular recordings were made with potassium acetate- or chloride-filled micropipettes with tip resistances between 60 and 500 M Ω . In almost every cell (51 cells), the optic tract stimulation with pulses of 0.1 - 0.5 msec in duration and 1 - 100 V in intensity evoked a short-latency EPSP. In only 5 cells there was a clear hyperpolarizing IPSP. Neural elements present in most slices from both rats and cats could still evoke inhibitory phenomena. In 8 cells, in the absence of an IPSP, the spontaneous firing was seen to be interrupted by a stimulus-linked pause. In 9 cells a double shock study showed that the response evoked by the second shock was decreased significantly as the interval between the two shocks was reduced to 300 msec or less. It therefore appears that in rat and cat LGN "remote inhibition" is mediated by interneurons which lie within the nucleus.

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RELATIONS BETWEEN THE LATENCY OF THE BLINK REFLEX RESPONSE AND THE TYPE OF THE TRIGEMINAL NERVE. Y. TAMAI, M. IWAMOTO AND T. TSUJIMOTO.
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Blink reflex responses evoked by the stimulation of the cornea and the conjunctiva were examined in the anesthetized cat.

Two types of the reflex responses were observed by the stimulation of the cornea as follows. Type A, latency 6.3-9.4 msec, was observed when the stimulation of the cornea was strong. Type B, latency 14.9-34.7 msec, was evoked by weak stimulation of the cornea. Both type A and B had two successive reflex responses, early (first) and late (second) responses and were similar in other characteristics. The latency of the type A response was the same as that observed by the stimulation of the conjunctiva.

These two types of blink reflex responses may be evoked by trigeminal afferent fibers with different diameter. One of the afferent fibers which yielded the type B responses may extend as far caudally as obex.

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CROSS CORRELATION ANALYSIS OF THE IMPULSES OF PRIMARY AFFERENTS AND CUNEATE NEURONS IN CATS. M. AOKI, H. WATANABE, H. NISHIMURA. Dept. of Physiol., Asahikawa Med. Coll., Asahikawa.

Cross correlation technique was employed to estimate the synaptic convergence of afferent inputs on a cuneate neuron. Under light pentobarbital anesthesia, unit activities were recorded simultaneously from the fasciculus cuneatus and the cuneate nucleus using tungsten microelectrodes. These units responded to adequate mechanical stimuli applied to the forelimb and were classified into one of the modality types such as touch-pressure, guard hair, joint and Pacinian units. During stimulation, data consisted of 300-800 impulses of primary afferent and cuneate cell spikes were sampled for 20 seconds. Cross correlation was then computed for 500 msec with 10-ms bin width. When the units from the fasciculus cuneatus and the nucleus belonged to the same modality type and had partially overlapping receptive fields, cross correlation was higher, having its peak value of 0.2 to 0.4 at 10-20 ms and slowly decreased within a time period of 100 ms. These results were considered to reflect the time course of excitatory converging effects on cuneate neurons. In contrast, no significant correlation was obtained for the units belonging to either different modality types or having non overlapping receptive fields.

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CEREBELLAR CONTROL OF LOCOMOTION. M. UDO, K. MATSUKAWA, H. KAMEI, Dept. of Biophys. Eng., Fac. of Eng. Sci., Osaka University, Toyonaka, Osaka.

During spontaneous locomotion of high decerebrate cats that was induced on a motor-driven treadmill, a short train of electric pulses (15-40 mA) was given to the dorsum of the paw of left forelimb (LF). When the stimulation was given in the early stance phase of LF, the stance phase was shortened in LF and a shortening of the swing phase occurred in the right forelimb (RF). EMG in RF indicated that augmented activity of flexors, and subsequent augmentation of extensor activity.

Cerebellar Purkinje cells that connect with Deiters neurones were identified in the bl-microzone (Andersson and Oscarsson, 1978) of the right side. Neuronal activity of these cells during locomotion had considerable activity in the RF swing phase, and this activity was strongly augmented following the LF stimulation. It is concluded that such Purkinje cell activity is controlling RF extensor activity at an appropriate level, thus ensuring point of RF touchdown to be sufficiently forward. Possibly, the steady state activity of these cells in the RF swing phase is controlling the process of placing down the RF during locomotion.

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Reciprocal excitatory connections between nucleus interpositus and precerebellar nuclei subserving reverberation. Murakami, F*, Tsukahara, N., Ozawa, N. and Uno, M. National Inst. for Physiol. Sciences* and Dept. of Biophys. Engn., Fac. of Engn. Sci., Osaka Univ.

Intracellular recordings were performed from nucleus interpositus (IP) of the cats with chronic ablation of cerebellar cortex and from paramedian reticular nucleus (PMRN) of normal cats. IP neurons, identified by the antidromic activation from the red nucleus (RN) and nucleus reticularis tegmenti pontis (NRTP), received monosynaptic excitation from PMRN, LRN and NRTP. Some IP cells were also activated antidromically by the stimulation of PMRN. Intracellular recordings from PMRN neurons, identified by the antidromic activation from IP, indicated that IP neurons make monosynaptic excitatory connections with PMRN neurons. Stimulation of one of these precerebellar nuclei or cerebellar peduncles evoked long lasting depolarization or repetitive firings in IP neurons, which were similar to those observed in RN cells. These results indicate that mutual connections between IP and those precerebellar nuclei constitute reverberating circuit. Contribution of IP-RN-LRN-IP loop to reverberation was also suggested.

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UNGRADABILITY OF PURKINJE CELL RESPONSE IN CAT'S CEREBELLAR CORTEX. H. TAKAHIRA, Dept. of Physiol., Tokai Univ. School of Medicine, Bohseidai, Isehara, 259-11, Japan.

The response of single Purkinje cell in cat's cerebellar cortex was elicited by white matter stimulation and was recorded by capillary microelectrode. The generative process of the simple spike response was a succession of small depolarizing potentials which was ungradable by grading the white matter stimulation. This ungradability is difficult to attribute to mossy fiber - granule cell - parallel fiber pathway. The generative process of the complex spike response consisted of two phases of depolarization; the initial component and delayed long one. It was emphasized that the initial component (so-called 'CF-EPSP') was elicited in all-or-none manner (Eccles, Ito, Szentagothai, 1967), however, it is observed in the present experiment that the probability of the complex spike response was increased by grading the white matter stimulation. The gradability of response probability, prolonged generative action and variable long latencies are difficult to attribute to monosynaptic climbing fiber input. It is more likely that both types of Purkinje cell discharges are mediated through serial internuncial cortical relays.

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NEURAL ACTIVITIES OF NUCLEUS RETICULARIS TEGMENTI PONTIS (BECHTEREW) WHICH TRANSFER OPTIC SIGNALS THROUGH MOSSY FIBER AFFERENTS TO THE CEREBELLAR FLOCCULUS OF RABBITS.
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It has been reported that the horseradish peroxidase injected in the cerebellar flocculus labeled neurons in the nucleus reticularis tegmenti pontis (Nrt) on both sides. Neuronal activities in Nrt were recorded by a glass microelectrode extracellularly. Fifty-six neurons antidromically activated from either ipsi- or contra-lateral flocculus (latency: $0.6-1.8(0.94 \pm 0.31\text{SD})$ msec, $n=56$) responded also orthodromically to ipsi- and/or contra-lateral optic nerves (latency: $3.0-7.0(4.71 \pm 1.02\text{SD})$ msec, $n=76$). Sum of antidromic and orthodromic latencies for each neuron was in the range of 4.0-9.0 msec, which is compatible with latencies of mossy fiber activations of flocculus Purkinje cells from both optic nerves, when allowance is made for the transmission time from granule cells through parallel fibers to Purkinje cells. Out of fifty-six cells thus identified as prefloccular relay cells in Nrt, twenty cells were orthodromically activated from both ipsi- and contra-lateral optic nerves but none was antidromically activated from both flocculi. These neurons were later histologically confirmed to be in Nrt. Thus it is evidenced physiologically that optic signals were transferred through Nrt neurons to the flocculus via mossy fiber afferents.

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DISTRIBUTION WITHIN MONKEY PREFRONTAL CORTEX OF NEURONS ACTIVATING DURING GAZE BEHAVIOR AND THEIR VISUAL PROPERTIES. HISAO SUZUKI, MASAO AZUMA. Dept. Physiol., Hiroasaki Univ. Fac. Med. Hiroasaki

We marked the recorded sites of the prefrontal neurons which were activated during gaze at a tiny light target. We found thereby that they were located in the second, third, fifth and sixth layers of the cortex. The neurons in the second and third layers showed relatively independent properties upon the visible target, and activated only by gaze intention despite lack of visible target. On the other hand, the neurons in the fifth and sixth layers showed graded properties with respect to dependence of their activation on the visible target.

Most of the above-mentioned units were responded by the other visual stimulus than the light target to be gazed at, and flashed in a specific region of the visual field of the animal during the gazing. we found some difference in such response pattern in terms of depth of the cortex.

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PROJECTION OF THALAMIC VA NUCLEUS ONTO PREMOTOR CORTEX IN CATS. UNO, M. and OZAWA, N. Psychiatric Research Institute of Tokyo, Setagaya-ku, Tokyo.

Neuronal excitation in the premotor cortex from N.ventralis anterior (VA) of the thalamus was studied in anesthetized cats. Low frequency repetitive stimulation of the medial part of VA where pallidal afferents project produced augmenting responses in the medial part and medial wall of the precruciate gyrus. These region were anatomically indicated to correspond to the premotor area in primates. Thirty-six neurons in the premotor area were identified as pyramidal tract cells (PT cells) by antidromic activation from cerebral peduncle. Twelve cells out of them with antidromic latencies of less than 1.6 msec, recorded in the 5th layer, were excited with short latencies following repetitive VA stimulation. On the other hand, slow PT cells were excited with much longer latencies or did not show any activation by VA stimulation. Thirty-four neurons recorded mainly in the 3rd layer were activated antidromically from caudate nucleus with latencies of 3.4-33.0 msec (mean, 14.4 msec). They did not respond to VA stimulation.

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FAST IPSP AND SLOW IPSP IN THE RABBIT'S PIRIFORM CORTEX NEURONS. M. SATOU, K. MORI, S. F. TAKAGI. Dep. of Physiol., Sch. of Med., Gunma Univ., Maebashi, Gunma

Two types of inhibitory postsynaptic potentials (IPSPs) were evoked in the rabbit's piriform cortex neurons when the olfactory bulb was electrically stimulated. One type was called "fast" IPSP which had a short duration (less than 100 msec) and a small peak amplitude (about a few mV negative to the resting membrane potential). The other was called "slow" IPSP which had a long duration (from 400 msec to more than one sec) and a large peak amplitude (from 10 to 25 mV negative to the resting membrane potential). The reversal potential of the fast IPSP shifted to the depolarizing direction by an increase of the intracellular concentration of chloride ion. By contrast the slow IPSP was not affected by a change in the intracellular chloride concentration. The membrane conductance increased about 200-400 % and about 50-90 % at the peak of the fast IPSP and the slow IPSP, respectively. The amplitude of the slow IPSP decreased when a hyperpolarizing as well as a depolarizing current was injected into the cell. It was concluded that the fast IPSP was generated by a permeability increase of the postsynaptic membrane to mainly chloride ion. It was suggested that the slow IPSP was produced by a permeability increase of the postsynaptic membrane to potassium ion, and that this permeability increase was suppressed by a depolarizing current injected into the cell.

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AN ANALYSIS OF THE FUNCTIONAL CONNECTION BETWEEN THE MOTOR AND THE SOMATOSENSORY CORTEX BY MEANS OF INTRACELLULAR POTENTIAL RECORDINGS. K. ITO, T. ARAKI*, Y. SHIGENAGA** & A. MITANI. Dept. of Behav. Physiol., Fac. of Hum. Scs., Osaka Univ., Suita, Osaka, *Dept. of Physiol., Fac. of Med., Kyoto Univ., Sakyo-ku, Kyoto and ** Dept. of Oral Anat., Osaka Univ. Dent. Sch., Kita-ku, Osaka

Intracellular potentials were recorded from PT and non PT cells in the motor cortex (MC) and the somatosensory cortex (SI) of the cat by stimulation of SI and MC respectively. Short latency EPSPs were evoked in PT cells of MC by SI stimulation. Their latencies in fast PT cells were in a monosynaptic range. Monosynaptic EPSPs were observed also in non PT cells of MC by SI stimulation. Besides monosynaptic EPSPs, di- and polysynaptic late EPSPs were observed in PT cells. When combined VL and SI, or SI and VL stimulation was given with appropriate intervals, disynaptic EPSPs were frequently observed in PT cells, suggesting the existence of a common interneuron in the disynaptic pathway from VL and SI to the PT cell in MC. Occasionally, antidromic spike potentials were observed in some PT cells of MC by SI stimulation, indicating that axon collaterals of the PT cells in MC extend to SI. In addition to EPSPs, SI stimulation often produced IPSPs in PT and non PT cells. MC stimulation evoked short latency EPSPs in PT and some kinds of non PT cells in SI, the latency of which was, in some cases, in a monosynaptic range. No antidromic spike potentials were observed in PT cells of SI by MC stimulation.

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BILATERAL SEMICIRCULAR CANAL INPUTS TO THE VESTIBULAR CORTICAL NEURONS OF THE CAT. H. JIJIWA, S. WATANABE, Inst. Equilibrium Res., Gifu Univ. Sch. Med., Tsukasa-machi, Gifu

Information integration by the single cortical neurons (area 2v) of the inputs from bilateral semicircular canals was investigated in the cat under immobilized and lightly anesthetized condition. Through stimulating electrodes (200 μ m diameter copper wire insulated with enamel lacquer) inserted into each ampullae of bilateral anterior and lateral semicircular canals, single square pulses were delivered to each canal nerve. Single neurons were recorded extracellularly with glass micropipette. Of 101 cells recorded, 28% responded with initial excitation, 34% only with inhibition, and 39% no responses. Approximately 79% of responding cells showed convergence from several canals, the response being excitatory in many cases. Many cells responded in the same fashion, excitatory or inhibitory, to same canals of bilateral sides, even for the lateral canals. The inhibitory and nonresponsive type of cells located in more superficial layers and excitatory ones in deeper layers. Of 63 cells examined, 25% showed somato-vestibular convergence, 27% exclusively somatic, 27% vestibular and 21% no responses.

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EXCITATORY POSTSYNAPTIC POTENTIALS RECORDED IN VITRO FROM HIPPOCAMPAL PYRAMIDAL NEURONS. YAMAMOTO, C., KITAMURA, K., TAKAGI, M. Dept. of Physiol., Univ. of Kanazawa, Med. Sch., Kanazawa.

Thin sections (0.35 mm thick) were prepared from the hippocampus of the guinea-pig and incubated in the artificial medium. Potentiation of EPSPs generated by mossy fiber stimulation in pyramidal neurons in these sections was studied while IPSPs were blocked by bicuculline. When a pair of shocks were given at various intervals, the second response was facilitated. As shock interval was increased, the facilitation decayed exponentially with a time constant of about 120 msec. After high frequency stimulation (10 or 100 Hz) for 10 sec, EPSPs were increased in amplitude (post-tetanic potentiation, PTP). PTP increased in magnitude and in duration with an increase in calcium concentrations and decrease in magnesium concentrations. In high calcium concentrations, PTP was often followed by a long-term potentiation in which heterosynaptic potentiation was invariably observed.

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FUNCTIONAL SIGNIFICANCE OF THE DENDRITIC POTENTIAL IN HIPPOCAMPAL PYRAMIDAL CELLS OF RABBITS. Y. FUJITA, I. MATSUZAWA, M. SAKURANAGA. Dept. of Physiol., Nippon Medical School, 1-1-5, Sendagi, Bunkyo-ku, Tokyo, 113 Japan.

Chronic electrical stimulation of the hippocampus or chronic injection of 6-hydroxy-dopamine into the cisterna magna produced a pathological state in the hippocampus as evidenced by the appearance of the spontaneous EEG spike. One of the intracellular counterparts of the EEG spike in the pyramidal cell was the spontaneous IPSP (inhibitory postsynaptic potential) which consisted of somatic and dendritic IPSPs. In such a pathological state the dendritic IPSP was lower in threshold than the somatic IPSP. Furthermore, in such a state, the IR (inactivation response), i.e., a prolonged, excessive depolarization with a superposed spike burst exhibiting a progressive spike inactivation and what we identified with a dendritic potential (Brain Research, 130, p89, 1977) triggered in the same pyramidal cell what we thought to be a dendritic IPSP. This may be taken as an indication that the IR produces spike discharges down in the axon. If this argument is accepted, it follows that once the IR is produced, the spike discharges set up in the axon become the only means through which informations are transmitted to the target cell, because the IR inactivates the soma spikes including the spike of the somatic trigger zone which normally carries informations to the next cell.

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ELECTROPHYSIOLOGICAL STUDIES OF EXCITATORY AND INHIBITORY INPUTS INTO THE HIPPOCAMPAL PYRAMIDAL CELLS IN VITRO. N. HORI, N. KATSUDA. Dept. Pharmacol., Fac. Dent., Kyushu Univ., Fukuoka

In the pyramidal cells of guinea pig hippocampal slices, our studies indicated that electrical responses evoked by mossy fiber stimulation were composed of some different elements in Ringer solution containing convulsants (pentetrazol, picrotoxin), i.e. a short latency full-sized spike, IPSP, depolarization shifts (DS) superimposed by train spikes and long lasting hyperpolarization (LLH). In normal Ringer solution also, mossy fiber stimulation usually induced the previous IPSP (5-10 mV, 100-200 msec) and the LLH (5-10 mV, 1-2 sec). The former is presumably mediated by basket cells. The DS (20-25 mV, 100-200 msec) induced by convulsants may be responsible for the powerful activation of the presumed excitatory interneurons, since specific neurons with repetitive firings (400-500 Hz) which synchronized with the DS could be detected in the stratum oriens. The LLH was temperature dependent and was disappeared by 2,4-dinitrophenol (10^{-5} M) and ouabain (10^{-6} M). These results indicate that the LLH is probably produced by the different mechanism from the DS and IPSP generation.

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VIBRISSA-SENSITIVE NEURONS IN THE RAT SOMATIC SENSORY CORTEX. Muneyuki ITO, Aichi Colony for the Handicapped, Kasugai 480-03.

Vibrissa-sensitive neurons in the rat somatic sensory cortex were studied under urethane anesthesia by recording unit responses to dorsal or ventral deflection of single whiskers. The time course of deflection was given by $A \cdot \exp(-t/\tau)$, where A and τ were the final amplitude and the time constant of deflection respectively. The minimum amplitude required to evoke responses in these neurons was determined at different values of time constant. Since the initial velocity of deflection (as of $t=0$) is expressed by A/τ and hence $\log A + \log(1/\tau) = \text{constant}$ for a given initial velocity, a slope of -1 on a threshold plot of $\log A$ versus $\log(1/\tau)$ would mean that the neuron is signaling the deflection velocity (velocity detector). On the other hand, if the neuron is sensitive solely to the stimulus amplitude (amplitude detector), this threshold measure would have a slope of 0. Most of the slopes examined were distributed around -1/2 and between 0 and -1. It was concluded that both components of velocity and amplitude were reflected in the activation of these neurons.

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AN ANALYSIS OF POLYSYNAPTIC PATHWAYS TO THE CORTICAL PYRAMIDAL TRACT CELL. K. ENDO
AND T. ARAKI Dept. of Physiol., Fac. of Med., Kyoto Univ., Sakyo-ku, Kyoto

Polysynaptic IPSPs and EPSPs in cortical pyramidal tract (PT) cells in the motor cortex of the cat evoked by stimulation of the pyramid, peduncle, thalamic specific (VL) and nonspecific (CM-Pf, CL, VA) nuclei, midbrain reticular formation and corpus callosum were analyzed, and PSPs in cortical interneurons responsible for producing these PSPs were investigated, in order to clarify the polysynaptic pathways to the PT cell. Cortical interneurons were classified into presumed several groups on the basis of their patterns of PSPs evoked by stimulation of various sources of the input and of their firing patterns; recurrent inhibitory, specific inhibitory, specific excitatory, nonspecific, common type etc. In addition to these methods of analysis, cross-correlation analyses of impulse discharges were performed with simultaneous recording from PT cells and cortical interneurons. Negative correlations were found between PT cells and interneurons of recurrent or specific type, whereas positive correlations were observed between PT cells and interneurons of specific or non-specific type. Thus, some of cortical inhibitory and excitatory interneurons in the polysynaptic pathways to the PT cell were identified.

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THE INTERACTIONS BETWEEN THE NOXIOUS (PULPAL) AND NON-NOXIOUS (TACTILE) INPUTS WHICH CONVERGED ON THE SAME NEURONS IN THE SOMATOSENSORY CORTEX (SI) OF THE CATS.
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With a single unit technique, the activity of the neurons, which were elicited by the multimodal stimuli, were recorded extracellularly in the anterior coronal gyrus (3b-area) and it was confirmed that the afferent inputs induced by the test stimuli were converged on the same cortical neurons. Varying interstimulus intervals, the series of the conditioning and test stimulus were applied sequentially. Then, the interactions between the inputs have been studied.

(1) Generally, the responses produced by the test stimuli were inhibited by the conditioning inputs but no excitatory effect was found. (2) When the single shock of the suprathreshold was employed as the conditioning stimuli to the tooth pulps, the responses obtained by electrical stimulation of other tooth pulp and the one by tactile stimulus of a contralateral whisker were inhibited for a period of 150-200msec. When the conditioning of the subthreshold was employed, the test responses were suppressed for 40-80 msec. (3) Conversely, the effects of the tactile inputs on the pulpal responses were less influenced than that of the pulpal input mentioned above.

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INTRACELLULAR STAINING OF PHYSIOLOGICALLY CHARACTERIZED AS GLIA IN CAT CEREBRAL CORTEX. M. TAKATO, M. USAMI, Y. NODA, E. SUGAYA. Div. of Pharmacol., Research Lab., Chugai Pharmaceutical Co., Toshima-ku Tokyo and Dep. of Physiology, Kanagawa Dental Col., Yokosuka Japan

Intracellular staining of cells in the cerebral cortex of the cat was carried out for studying the morphological structure of the cell electrophysiologically characterized as glia. Glass micropipettes filled with either Lucifer Yellow CH or Horseradish peroxidase (HRP) were used for both recording and intracellular marking of cells. Total 112 presumed glia were injected each dye iontophoretically. All of them were identified as protoplasmic astrocytes. The staining quality of the glia labeled with HRP was superior to that of cells injected with Lucifer Yellow. Many glial cells located close to the pia matter did have long processes which extended to the surfaces of blood vessels and formed perivascular end-feet. The observations indicate that the many previously reported studies on presumed glial cells in the cat cerebral cortex have characterized the behavior of protoplasmic astrocytes.

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DEVELOPMENT OF VISUAL EVOKED POTENTIALS RECORDED FROM THE TELENCEPHALON (THE WULST) OF THE CHICK EMBRYO.

OOKAWA, T. Dept. of Physiol., Gifu Univ. Sch. of Med., Gifu

The right hemisphere of the chicken's Wulst was explored for both VEPs and ERG with 20 Joules flash intensity under non-anesthetized and curarized conditions. Eighty-one White Leghorn chick embryos ranging between 14 and 21 days of incubation were used. Flash stimuli were given to the left eye with a xenon lamps of a photic stimulator (MSP-2R, Nihon-Kohden Co.) in a darkened room. The lamp was placed on the optic axis at a distance of 30 cm from the eye. Averaged responses of VEPs and ERG of 10 sweeps displayed on the screen of the ATAC 501-20 were photographed. On the 18th day of incubation (stage 44), both VEPs and ERG showed definite electrical changes in response to flash stimulation. VEPs of the 18th day of incubation as well as 19 to 21 days of incubation consisted distinctly of polyphasic potentials similar to those of adults, while the ERG consisted of a-, b- and c-waves at normal body temperature. The peak latency of P₁ and P₂ notches was 19.2 and 55.3 ms in 19-day embryos, and 15.0 and 43.8 ms in 20-day ones. The mean amplitude of peak negative deflection in 19-day and 21-day ones was 43.6 and 102.4 μ V, respectively.

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RESPONSES TO EPICORTICAL STIMULATION IN CAT MOTOR CORTICAL NEURONES. T. OSHIMA, K. EZURE, M. OGURI. Dept. Neurobiol., Tokyo Metropolitan Inst. for Neurosciences, Fuchu-shi, Tokyo.

In an attempt to identify a vertical transmission in the cerebral cortex related to the EEG arousal (cf. Inubushi et al., Jap. J. Physiol. 28, 689, 1978) weak single shock stimulation was applied to the surface of the precruciate cortex, and intracellular responses were recorded in 136 neurones sampled from all cortical layers just underneath the stimulated site in the encéphale isolé cat. The initial responses were depolarizing (D) in 89 cells and hyperpolarizing (H) in 47 cells. The D responses consisted of EPSPs. The H responses were either IPSPs or responses due to disfacilitation. The D responses were evoked in the cells of all cortical layers including fast and slow pyramidal tract cells. Their latency was 0.6-4.3 msec (median, 1.5 msec) and perhaps within the monosynaptic range in about 30% of sampled cells. The H responses occurred in the cells of layers III, V and VI, but not in layers I-II cells. The latency was 0.9-8.0 msec (median, 3.4 msec), being polysynaptic in all but a few cells. The latency and the time to peak of both the D and H responses tended to be prolonged in deep layer cells. These results suggest that epicortical stimulation initiates excitation in layers I-II cells which in turn transmit to deep cells the cascade of excitation and inhibition. This pattern of transmission is expected from the 'arousal' circuit model.

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AFFERENT CONNECTION TO THE VISUAL CORTICAL CELLS FROM X AND Y CELLS IN THE LATERAL GENICULATE NUCLEUS OF THE CAT.

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The afferent fibers to the striate cortex originate in the X, Y and W cells in the lateral geniculate nucleus (LGN). I studied the connectivity of these kinds of relay cells to the various types of cells in the striate cortex. The activity of a LGN cell and a cortical cell was recorded simultaneously and the synaptic connection between them was inferred from the cross-correlation between their spike trains. The Y cells indiscriminately exert excitatory monosynaptic action on all the types of cortical cells examined in this study; the simple cells in the layer 4, the standard complex cells in the layer 2+3, the standard complex cells in the layer 5 and 6, and the special complex cells in the layer 5 (Gilbert, 1977). The excitatory connection from the X cells to the last type of cortical cells has not been found. The other three types of cells were excited by the X cells monosynaptically, but the connection to the third type of cells was found only in a few cases.

Gilbert, C. D. (1977) J. Physiol. 268 391-421

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POSTCENTRAL AREA 2 NEURONS RELATED TO TACTILE FORM DISCRIMINATION

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The response characteristics of neurons to tactile stimulation were examined in a relatively circumscribed region of area 2 where the palmar skin was represented. Penetrations of this region revealed that cutaneous neurons of similar receptive fields clustered together forming a functional aggregate. Here some neurons were activated better when the broader area of the receptive field was stimulated at once. The most adequate stimulus was often the application of narrow and elongated objects in appropriate orientations or objects of certain other shapes to the receptive field rather than the localized skin stimulus by a hand-held probe. Furthermore a particular kind of neurons were activated differentially by more complex objects when the monkey grasped them.

The present results provide evidence that the hand region of area 2 in the monkey SI integrates the tactile information necessary to detect and discriminate certain object forms by palpation.

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PROJECTION OF SENSORY AFFERENT FROM THE ORAL CAVITY TO THE SOMATIC SENSORY CORTEX OF CATS

K. TAIRA, N. MATSUMOTO, T.A. SUZUKI. Dept. of Physiol., Sch. of Dent., Iwate med. Univ., Morioka, Iwate

Electrical or tactile stimuli were delivered to the oral structures such as palate, gingiva, tongue and tooth. Eight glass-inclosed metal electrodes were positioned on the somatic sensory cortex S1-S2 in millimeter steps. The oral area was represented bilaterally on a circumscribed region of the anterior coronal gyrus. Measuring the amplitude of positive primary responses to electrical stimulation, three dimensional representations for focusing area were attempted. Comparison of these focusing maps indicate that 1) contralateral responses were larger than ipsilateral responses, 2) anterior responses were larger than posterior ones, 3) mandibular responses were larger than maxillary ones, 4) molar pulpal responses were larger than canine ones, 5) these projections terminated on two foci in many cases. It was however difficult to isolate these foci as S1 and S2 strictly. On the other hand, the projection areas obtained by tactile stimulus were located on the region near the branch of middle cerebral arteries, and were found to be localized more rostrally than that by electrical stimulation. These findings were supported by the microelectrode technique. The results suggest that there are modality segregations in the oral afferent projection.

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THE VERTICAL DISTRIBUTION OF TEMPORAL FIRING PATTERN IN THE OLFACTORY BULB TO THE ARTIFICIAL SNIFF. N. ONODA, K. MORI.

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After double cannulation, the artificial sniff (AS) was given by negative pressure pulses through a postnasal cannula under anesthetics of urethane in rabbits. Extracellular recordings of single unit activity from the olfactory bulb (OB) were carried out. Two hundreds and seventy seven units were isolated whose discharge rate changed consistently in relation to the phase of the AS cycle. Out of 277, 28, 23 and 226 units were recorded at the mitral cell layer (MCL), the granule cell layer, and layers superficial to MCL, respectively. On basis of phase of periodical increases in the discharge rate during the AS, OB neurons were classified into two types, 'in phase' or 'out of phase' units. In absence of AS cycles, the formers did not discharge whereas the latter fired spontaneously. According to temporal firing patterns to the AS, bulbar units were separated into two groups, 'single peak' or 'multiple peak' units. The formers were located mainly in the glomerular layer and the superficial part of the external plexiform layer (EPL), whereas the latter were distributed predominantly in the deep part of EPL. In some of recorded units, their temporal firing patterns to the AS cycle clearly were modified during odor stimulation. This vertical distribution of temporal pattern suggested may be one of information processing features in the OB.

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THE EFFECT OF SACCADIC EYE MOVEMENT ON THE UPRIGHT STANDING IN MAN Y. IWASE, M. HASHIMOTO, T. TAKEGAMI, N. SUZUKI, Y. YAMAMOTO, T. UCHIDA. Dep. of Physiol., Kyoto Pref. Univ. Med., Kyoto 602

In order to examine the effect of saccadic eye movements on the posture control system and its mechanism, the oscillatory displacement of the center of gravity was recorded together with electro-oculogram and EMGs of soleus, medial gastrocnemius and tibialis anterior muscles. The body sways with lower frequency than 0.3 Hz remarkably decreased during the repetitive saccades in comparison with those during eye fixing. It was named here "sway-stabilizing effect". The effect was induced by the frequency of saccades from 0.2 to 1.0 Hz and by the amplitude from 5° to 30°, which was also observed with the voluntary repetitive saccades on the totally dark condition. There was no effect with continuous upward or downward rotation of the eyes. EMGs of soleus and gastrocnemius muscles became more active while the effect was observed. The above results suggest that the sway-stabilizing effect is induced by the mechanism as follows: the signal of saccadic eye movement affects the spinal motor system via a certain structure involving the brain stem and the cerebellum and causes the effect mainly through the activity of the lower leg muscles. In addition, the reduction in amplitude of the body sway was induced with repetitive voluntary blinkings and photic stimuli.

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ANALYSIS OF DYNAMIC BALANCE IN HUMAN STANDING POSTURE.-USING SEMICIRCULAR BOARD- Y. Mizuno. Daido Inst. Technol., Minami-ku, Nagoya R. Hayashi, Inst. Equilibrium Res. Gifu Univ. Sch. Med., Tukasa-machi Gifu

The dynamic balance mechanisms of the body were studied under unstable standing conditions by means of measurement of the movement of center of gravity, the activity of leg EMGs and the movement of the ankle joint. Normal subjects were instructed to maintain upright standing, forward leaning or backward leaning posture on the flat plate and the so-called goniometer (stable) and semicircular board (unstable condition). During standing on the semicircular board, the body fluctuation consists of characteristic slow component (less than 0.03 Hz) and abrupt one. They increased when the radius of the board decreased. It was suggested that this abrupt body fluctuation was induced by righting reflex. The magnitude of the power spectrum increased in wide range of frequency (D.C.-4.0 Hz) at leaning, especially at forward leaning, compared with at each posture on the semicircular board. The change of the ankle joint angle was contrary to those on the flat plate and on the goniometer. The activities of leg muscles were not depended on angle of the ankle joint, but on the position of the center of gravity of the body.

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DIFFERENCE IN ACTIVITIES OF MOTOR UNIT OF EXTENSOR DIGITORUM COMMUNIS MUSCLE IN MAN BETWEEN FORCE CONTROL AND POSITION CONTROL KANOSUE, K. AKAZAWA, K. and FUJII, K. Dept. of Engrg., Osaka Univ., Osaka

Behaviors of motor units of the left middle finger EDC muscle were examined for force control and position control. First, a brief stepwise extension was applied to the muscle when a subject maintained its isometric "force" at a constant level (force control). Secondly, the same mechanical stimulus was provided when the subject controlled the finger "position" against external force (position control). In steady states, no difference was observed in the activities of motor units between above two kinds of control. Firing rates of motor units increased transiently after the muscle extension and the amount of the increase was considerably greater during the position control than the force control. These results were examined by using a simple model for the motor control system. It was concluded that the velocity sensitivity of muscle spindle is higher during the position control compared to the force control. Therefore, the feedback gain of the m. spindle might be adjusted properly according to the purpose of motor control.

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THE CHANGES OF H-REFLEX ON RAPID VOLUNTARY MOVEMENT. Y. NAKAHARA AND T. KASAI, Dept. of Exercise Physiol., The Kokushikan Univ. Faculty of Physical Educat., Setagaya-ku, Tokyo.

It has been reported that there were the changes of H-reflex prior to the rapid voluntary movement. In present study, it was designed to examine the changes of H-reflex about the time course prior to the rapid voluntary movement (upper limb reaction by light signal). H-reflex was leaded by M.Soleus and tension was measured by FD-pick up (high sensitivity).

Results were as followed; 1) Tension were classified to Type A and Type B. Type A were shown the decrease of proceeding rapid tension rising and Type B were not the decrease. 2) H-wave amplitudes on Type A decreased to control level at 30-50 msec prior to the rapid voluntary movement. After that, rapid increasing tension were shown. 3) T_2 (a different time between the lowest and a set point about 200g of rapid tension rising) was shorter Type B than Type A, Type A was about 17 msec and Type B was about 30 msec. These results should be suggested that the upper center was participated to send some inhibitory discharge to motor neuron and motor commands from the upper center preceeds the voluntary movement about 50-100 msec.

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CHARACTERISTICS OF PURSUIT TRACKING MOVEMENT BY DISPLACEMENT OF CENTER OF GRAVITY. A. MIYAKE, R. HAYASHI, H. JIJIWA, S. WATANABE, K. YAMAJI, Inst. Equilibrium Res. Gifu Univ. Sch. Med., Gifu

Normal subjects were tested on a pursuit tracking task by displacing the center of gravity of body to forward and backward followinf a target displayed on an oscilloscope which moved verticall in either regular or irregular manner. Tracking at irregular sequences and low frequency of square wave initially showed an invert movement to signal direction with fairly fixed time delay, but at higher frequency square wave these responses were not found and revealed a predictive movement. Sine wave tracking was a predictive one, although jitter was seen. In the case of random signal (BW.0-0.5Hz, 0-1.0Hz) they responded preferably to higher component of signal with an apparent time delay. The analyses of response characteristics suggested that the control system is a nonlinear bang-bang control mode. Statically lower extremity muscle activities depended on the position of center of gravity of body, and dynamically the activity of the muscle increased in the phase of movement in which it acts as a resistive force.

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THE BODY SWAY DURING VARIOUS UPRIGHT STANDINGS IN MAN T. UCHIDA, T. TAKEGAMI, M. HASHIMOTO, Y. TAKANASHI, H. KOYAMA, N. SUZUKI, Y. IWASE. Dep. of Physiol., Kyoto Pref. Univ. Med., Kyoto

Antero-posterior body sways in normal upright standing, plantarflexed and dorsiflexed standings on a tilted base, and standing on tiptoe were studied with special references to EMG activities of the lower leg muscles and to the effect of periodic, saccadic eye movements. In normal standing components of the sway slower than 0.3 Hz were dominant during fixation of the eyes and related principally to the phasic EMG activity of medial gastrocnemius (MG). Saccades reduced these frequency components. Soleus (Sol) and MG showed strong and tonic EMG activities during plantarflexed standing, resulting in decrease in amplitude of the slower components of the sway and increase of components faster than 0.5 Hz and also in ineffectiveness of saccades on the sway. During dorsiflexed standing tibialis anterior (TA) became strong in EMG activity, while Sol and MG less active or nearly silent. But the sway was either larger or smaller than in normal standing, depending on the steadiness of TA activity. Saccade reduced the sway in some subjects. Standing on tiptoe made larger the sway slower than 1 Hz and evoked remarkable 3-6 Hz oscillations. These faster components had close connection with activity in long flexor and extensor muscles of the digits in many cases. These results suggest the steady activity of ankle muscles based on different sensory inputs and the central control is necessary to minimize the sway.

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PROPERTIES OF PHYSIOLOGICAL TREMOR DURING STROKE MOVEMENT

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Physiological tremor frequencies during stroke movement are analyzed based on an equation of motion. Clearly observable tremor having a line spectrum is induced by relaxing the antigravity muscles during stroke movement. The Laplace transform of the equation of motion including a physiological feedback term provides the condition for a sustained oscillation in terms of the phase angle. The physiological feedback is assumed to be a parallel connection of a short loop (monosynaptic reflex; delay time τ_1 , gain A_1) and a long loop (polysynaptic reflex; delay time τ_2 , gain A_2). Physical parameters are obtained from damped oscillation waveforms after a tap. The oscillating frequency is determined from the point of intersection of the physiological and physical terms in the graph of the phase angle. Double line spectra occur under certain loading conditions, from which the values of τ_2 and A_2/A_1 can be estimated. It is concluded that estimated values of τ_2 are about 70 ms and 100 ms for upper and lower extremities, respectively, and that gain A_1 is larger than A_2 for the hand and shank, and vice versa for the index finger. This model allows us to analyze the quantitative relationship between the long loop and physiological tremor.

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MECHANISM OF PRECEDING SILENCE OF ANTAGONIST EMG IN A QUICK SWITCHING MOVEMENT IN MAN.

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At a reaction time experiment in which the subject (S) responds by flexing his foot from preceding tonic extension, the onset of the pretibial EMG is preceded by disappearance of the triceps surae EMG by several tens of milliseconds (cf. Hufschmidt and Hufschmidt, 1954). This study aimed at clarifying whether the preceding silence of antagonist EMG is caused by active inhibition of motoneurons or not. S (n=6, adults) sat in a reclining chair and the foot was fixed to a pedal which was devised to measure isometric foot torque. The sequence of foot movements, tonic extension -- quick flexion, was controlled by a visually guided tracking method.

The triceps surae H-reflex, facilitated during extension, showed little depression just after the cessation of the triceps EMG but significant one only at or a few tens of milliseconds after the onset of the pretibial EMG. In contrast, the pretibial H-reflex could be evoked at the cessation of the triceps EMG, indicating a facilitation. It is suggested that the preceding silence of antagonist EMG is due to disfacilitation and the delayed onset of agonist EMG due to a time required for the command to excite the motoneurons under reciprocal inhibition.

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THE SUPPLEMENTARY MOTOR AREA: SINGLE UNIT ACTIVITY IN PROXIMAL AND DISTAL FORELIMB MOVEMENTS.

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Monkeys were trained to perform two different motor acts, one involving muscle activity in distal forelimb muscles and the other in proximal forelimb and shoulder girdle muscles. After confirming spatial and temporal dissociation of muscle activity in the two motor acts, single unit activity in the supplementary motor area (SMA) was recorded. SMA neurons related with the distal and proximal forelimb movements were found to be arranged rostrocaudally with a considerable overlap. In the overlapping region, neurons related with the distal movement were located more deeply in the cingulate gyrus. Although neurons related with forelimb movements were located within a region corresponding to the forelimb region described by Woolsey et al (1952), the rostrocaudal arrangement of distal and proximal forelimb region did not agree with the motor simulus drawn by them. The present study also made clear that a number of SMA neurons change their activity prior to muscle activity, thus suggesting their role in initiation of forelimb movements.

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BURST FORMATION IN THE LOBSTER CARDIAC GANGLION: EFFECTS OF PRESSURE CHANGES T. KURAMOTO & A. EBARA. Inst. of Biol. Sci. Univ. of Tsukuba

In the isolated heart of the lobster, motor outputs of the cardiac ganglion, periodic bursts, were recorded from ganglionic branches while heart pressure was changed. The ganglion cells could be divided into three groups as judged from soma sizes and bursting properties; four large cells (LC), one medium cell (MC) and four small cells (SC). The bursts recorded separately from LC, MC and SC were referred to L burst, M burst and S burst respectively. With increment of the heart distension, frequencies of both M and S bursts were gradually increased in similar courses (0.5 to 0.7 or 0.9 Hz) and duration of them were gradually increased and then, gradually decreased. However, S burst duration was far longer and had larger variation (0.7-1.2 s) than M one (0.2-0.35 s). On the other hand, L burst duration was short (40-100 ms) and had no change in any distension studied, and L burst frequency was higher and had faster increment than M or S one. Thus it is suggested that both SC and MC can interact each other with a similar pace but L burst is not always produced synchronously with S and M bursts. The burst formation processes were discussed with comparison of each burst described above.

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ISOMETRIC CONTRACTION OF MYOEPIETHELIUM IN ISOLATED SALIVARY GLAND SEGMENT OF RAT. A. NISHIYAMA, S. SAITOH and M. HIRAI. Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata City, Yamagata

Using a strain gauge transducer, contractile responses of an isolated segment of rat salivary glands (sublingual, submaxillary and parotid) to electrical field stimulation, and cholinomimetic and sympathomimetic agents were studied *in vitro*. Electrical field stimulation evoked a contraction which was blocked by an addition of atropine or tetrodotoxin. Acetylcholine evoked a contraction in all salivary glands. On the other hand sympathomimetic agents (phenylephrine, isoproterenol, tyramine) evoked a contraction only in the submaxillary and parotid glands. These findings seem compatible with morphological investigations that the submaxillary and parotid glands receive a dual innervation by cholinergic and adrenergic nerves, but the sublingual gland receives an innervation only by cholinergic nerve. The stimulant-induced contractions were inhibited not only by an omission of Ca^{2+} or by an addition of Ca^{2+} antagonists, but also by an omission of Na^+ from the solution. These findings seem to be explained by the general hypothesis postulated in smooth muscle that the stimulant-induced contraction is produced partly by increasing the Ca^{2+} permeability of the membrane, and partly by releasing bound calcium from a cellular store.

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CHARACTERISTICS OF THE SLOW α COMPONENTS OF CHILDREN'S EEG

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In the preceeding papers, we reported general features of α components in children's EEG. In this paper, we discussed on the characteristics of the so called slow α components which appear in the developing course of children's EEG. Auto- and cross-power spectra were obtained for the EEG of normal and mentally retarded children in the waking resting state. Statistical properties of the component were defined through various statistical parameters; spatial power distribution, coherence function between regions, coefficient of variation and higher moments of temporal distribution. It was verified that the slow α component showed either the statistical properties of θ or α component.

Based on these results, the slow α component was defined in relation to the component at about 10Hz and θ component. And these measures for spatial relationships gave some important informations about the features of frequency components of children's EEG.

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DEVELOPMENTAL CHARACTERISTICS OF THE EEG FREQUENCY COMPONENTS ON THE SCALP

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By means of the spectral analysis of children's EEG, distribution of the frequency components on the scalp were chronologically examined. EEGs were led monopolarly from 6 regions along the midsagittal line of the scalp and were led from 11 or 14 regions on both hemispheres in some children. Auto power spectra of EEGs were obtained by the digital computer for medical use.

Alpha component first appeared most dominantly at the occipital region, and in the course of the maturation, it spread widely all over the scalp, especially at both sides of the occiput. Some alpha and theta components appeared most dominantly at the central or parietal regions along the midsagittal line and they were considerably localized to those regions.

Based on these results, developmental characteristics of the EEG frequency components were discussed.

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EEG activities in kindled frog

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The "Kindling" phenomenon was investigated at an aspect of EEG activities in frog. The progressive changes resulted from repetitive electrical stimulations to the hippocampus were as follows.

- (1) Prolongation in after discharge duration and shortening in that intervals.
- (2) Occurrence and increase of spontaneous epileptiform discharges. These were suppressed by hippocampal isolation.
- (3) Increase in power and continuity of background EEG activities at a specific frequency (9 Hz in no-treated frogs and 5 Hz in hippocampal commissural bisected frogs). This frequency coincided with twofold of after discharge interval in steady phase.
- (4) Increase of late components (25 and 50 msec. to peak) in inter-hippocampal impulse responses estimated from background EEG through an autoregressive model. These were also suppressed by hippocampal isolation.

From the facts described above, we may conjectured that the alteration of background EEG generating system during the development of kindling participates with the sporadic epileptiform EEG activities.

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THE DIFFERENCES BETWEEN SOMATOSENSORY EVOKED POTENTIALS TO ELECTRICAL STIMULATION OF SINGLE CUTANEOUS PAIN AND TACTILE SPOTS. FUJITANI, Y., *OIKAWA, T. and YAMAUCHI, N.* Dept. of Physiol. and Dept. of Anesthesiol., Sch. of Med., Tottori Univ., Yonago

Single pain and tactile spots on the skin over the dorsum of the right hand in man were respectively stimulated by electric pulse of 0.5 msec in duration. The respective averaged potentials obtained over the contralateral somesthetic area in response to stimulation of either pain or tactile spot were almost similar in pattern with each other. In the recovery curves of each component wave examined by double shock with variable interstimulus intervals, waves P1 (1st positive wave) and N2 (2nd negative wave) showed each supernormal phase around at several tens msec in stimulation to pain spot and earlier until 10 msec in stimulation to tactile spot. There were no differences on the recovery functions of the late components. It was further noted in strength—amplitude relation that the more suppression of the late components' amplitudes in the range of the stronger currents was not brought about in stimulation to pain spot as in stimulation to tactile spot.

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ORIGIN OF HUMAN CORD DORSUM POTENTIAL BY DESCENDING VOLLEYS. H. SHIMIZU, Y. MARUYAMA, Y. SATO, K. SHIMOJI. Dept. of Anesthesiol., Niigata Univ. Sch. Med., Asahimachi, Niigata

Human cord dorsum potential recorded from posterior epidural space at the level of lumbar enlargement by epidural stimulation of the cervical cord consisted of initial spikes, a subsequent slow and sharp negative wave, followed by a slower positive wave. The wave forms and several characteristics of these slow negative-positive potentials elicited by the descending volleys are similar to those of the N₁ and P₂ waves evoked by segmental nerve stimulation, which were thought to reflect the interneuronal activities and primary afferent depolarization, respectively. Interaction between slow negative-positive waves by descending volleys and segmental volleys indicates that there are common elements in the path producing these slow potentials. Intravenous injection of thiamylal (10 mg/Kg) causes the increase in amplitude of the P₂ wave evoked segmentally and the slower positive wave by descending volleys. Thus, the slow negative and positive waves elicited by descending volleys might reflect the interneuronal activities and primary afferent depolarization.

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PROPERTIES OF THE POTENTIAL CHANGES IN THE LID CAUSED BY FLASH STIMULATION WITH SPECIAL REFERENCE TO THE GENERATING MECHANISM. HOSHINA, Y., TAKEO, T., OZAKI, T. and IGARASHI, K. (Dep. of physiol., Hirosaki Univ. Sch. of Med., Hirosaki and Dept. of Pediat., Hirosaki Univ. Sch. of Med., Hirosaki)

In healthy subjects and patients, the properties of the potential changes elicited in the eyelid by flash stimulation were investigated from the standpoint of their generating mechanism. The lid potential changes were obtained with the summation technique. The average responses of the evoked MV responses ERG, EOG and EEG were traced simultaneously. In addition, the power spectra of the average lid potential changes were obtained by the signal processor (7T08, SAN-EI) under various conditions. In the power spectra of healthy awake subjects with their eyes closed, several peaks were found in faster frequencies (about 30-90 Hz) in addition to slower frequency range, which is known to be principally electroretinographic. The faster frequency components were elucidated to originate in the orbicularis oculi and appear bilaterally through photopalpebral reflex, because of their appearance in the occluded eyelid of healthy awake subjects and in patients with an artificial eyeball. They were hardly recognized in the second and third stage of natural sleep. To the above results were discussed the existence of the lid potential changes related to the ERG, EOG and EEG.

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AUTOMATIC ANALYSIS OF SLEEP SPINDLES AND CHARACTERS OF THE APPEARANCE

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It was presented that on sleep spindles which are characteristic pattern in sleeping EEG, the frequency of the pattern, the continued time and the appearance-interval were measured by our simple program.

Method: The spindles in stage 2 and stage 3 classified by APSS were analyzed in eight normal adults. EEGs were monopolarly recorded in 10-20 electrode displacement. After recording them they were processed with NEAC 3200 Mini computer. After the detection of spindle patterns, the continued time and the appearance-interval were computed. Concerning the latter, the interval was measured from the first wave component of one spindle to that of next one, and the time relation was expressed as a transient matrix.

Results and Conclusion: 1) The frequency of each wave component consisting spindle was ranged approximately from 60 to 85(msec) and in one spindle the frequency changed under some of tendency. 2) Concerning the continued time, either short or long one succeeded after short duration, while after long duration relatively short one had a tend to succeed. 3) Either short or long one succeeded after short interval of appearance, while after long interval relatively short one had a tend to succeed.

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ALPHA BLOCKING AND GOMPERTZ CURVE H.ASHIDA, E.MARU, J.MORI, J.TATSUNO
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The desynchronization growth model of alpha blocking was proposed and according to this model, data processing was done. In this model, alpha wave is assumed to be the summation of the electric activities of the neuron colonies which are oscillating synchronously, and alpha blocking corresponds to desynchronization of these neuron colonies. As dynamics of the number of the synchronously oscillating neuron colonies, Gompertz differential equation known in population dynamics was adopted. The solution of this differential equation gives the explicit expression of alpha wave amplitude at alpha blocking, which is

$$y(t) = A[1 - B \exp(-kt)]$$

where A, B and k are constants and y(t) is the amplitude of alpha wave. These constants were determined by means of the least square method, using 33 data of 4 healthy male subjects. The average values of these constants were A=0.994, B=0.004, k=0.044 and fitness of data and y(t) was fairly good.

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COMPARATIVE STUDY OF THE SLOW POTENTIALS LED FROM THE SCALP OF THE HEAD AND THE SKIN SURFACE OF THE ARM IN MAN. SASAKI, S. (Dept. of Physiol., Hirosaki Univ. Sch. of Med., Hirosaki)

There are not yet clarified the generating mechanism and physiological significance of the direct current potentials so called slow potentials (SPs) in the cerebrum. It was very hard to record the SP for a long time, because there were some difficult problems in making non-polarizable electrodes and attaching the electrodes to the skin surface of the head or another place of body. The present experiments were studied from the standpoint of the time course of the SPs from the skin surface of the head (RP-N lead) and arm (Right arm-N lead) in 7 normal subjects. The SPs were traced continuously for about sixty minutes following setting the electrodes. The SPs were led unipolarly by using a pair of calomel non-polarizable electrodes, DC amplifier, recti-horizontal recorder and coronagraph. In addition to the SPs, the electroencephalograms were also recorded simultaneously. The respective fluctuations of the SPs were shown to remain stable considerably about 30 minutes following setting the electrodes, although the polarity of the SPs was positive or negative in most cases and very labile from immediately to several minutes. The values of the stable SPs were about -2.1 mV in the head and about -3.3 mV in the arm, respectively. From these results, it was suggested that the SP led from the head is not always originated in the cerebrum.

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CORRELATION BETWEEN BEHAVIORS AND THE FREQUENCIES OF THE THETA WAVE OF CORTICAL EEG

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The frequencies of the cortical EEG was measured in various behaviors, such as re-searching, locomoting, sniffing, groomings, resting and sleeping in the ICR strain mice. The frequencies of the cortical EEG showed behaviorally related characteristics in the theta wave region. The frequencies of the theta wave in a group of grooming behaviors were at 5-6 /sec, and at 7-8 /sec in a group of research-locomoting behaviors.

The effect of the brain extract from sleep deprived rats (BE-SDR) on the frequencies of the cortical EEG was investigated before and after intraperitoneal administration. The spectrogram pattern of the frequencies of EEG was analyzed in slow wave sleep, paradoxical sleep and waking state. There were no significant difference in the pattern of spectrogram between before and after administration of BE-SDR. The frequencies of the cortical EEG in the slow wave sleep was at 5/sec as a peak value, and at 7/sec in the peak value of the paradoxical sleep.

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ELECTROENCEPHALOGRAPHIC ANALYSIS OF OPTIC LOBE ACTIVITY IN THE UNRESTRAINED CARP.

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A long-term, stable recording of the optic lobe activity was performed in the carp under minimum restriction of swimming. Silver ball electrodes were used. Trouble with the recording was minimized by attaching a small-sized (17X16X5mm), water-proofed preamplifier to the skull. Frequency analysis of the spontaneous activity, either by a fast Fourier transform or by a linear prediction, revealed three dominant ranges of 4-7, 8-13 and 14-25 Hz. They became prominent in the light or in the hypoxic state. The power of high frequency was tended to be lowered during active moving. Approximate location of the electrode implanted could be estimated by the wave-shape of photically evoked potential; it was dominated by negativity in the rostral half of the lobe and by positivity in the caudal half, when the contralateral eye was illuminated diffusely in the light-adapted state. Four subcomponents for the on-response and two for the off-response could be identified in the rostral half. Frequency ranges of these sub-components were closely related to those of the spontaneous activity.

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ELECTROACUPUNCTURE EFFECTS ON THE SOMATOSENSORY EVOKED RESPONSE (SER) IN RAT

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Somatosensory evoked responses (SER) following dental pulp stimulation were recorded from the primary and the secondary somatosensory area (SI, SII). And the effects of electroacupuncture, 5 ms-duration constant current pulses delivered to the Geiko point of the Chinese meridian map at 45 Hz, on SERs were investigated. The negative deflections of the SER in SI (SER-SI) and in SII (SER-SII) were recorded from (A; 8-13 mm, L; 6-9 mm) and from (A; 6-9 mm, L; 9-11 mm) respectively, according to König & Klippel's brain atlas, both ipsi- and contralaterally. The mean latencies of the onset of negative deflection in above mentioned areas were as follows: contra-SER-SI; 6.2 ms, contra-SER-SII; 7.9 ms, ipsi-SER-SI; 10.3 ms, ipsi-SER-SII; 12.2 ms. And in these areas, though the SERs did not follow Stevens' power function exactly, the exponents "n" were, on the whole, larger in SER-SI than in SER-SII, and at the same time larger in ipsi-SER than in contra-SER. The contralateral SER was reduced to about 40 % of the control level after 15 min electroacupuncture stimulation, while the ipsilateral one to about 65 %, both in SI and SII. These results may suggest that dental pulp afferents have at least two different projections to the cerebral cortex, and that electroacupuncture suppresses both pathways to the same degree.

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RELATIONSHIP BETWEEN PAVLOVIAN INTERNAL INHIBITION AND SLEEP. MATSUMOTO, J., SANO, A., SANO, K., MASUDA, Y., ISHIKAWA, N. and UEZU, E. Dept. of Physiol., Tokushima Univ., Sch. of Med., Tokushima

From our recent results we discussed Pavlovian theory concerning sleep. (1) Extinction inhibition promoted induction of sleep in rats, comparing with the case of application of the positive conditional stimulus. There was no significant difference between the effect of inhibitory stimulus and neutral one. (2) When the protein synthesis inhibitor was given to rats, only paradoxical sleep was inhibited. (3) When the conditional stimulus was given (intracerebral electrical stimulation) during sleep in cats, the salivary conditional reflex was observed in slow wave sleep, and spontaneous salivary reflex was evoked in slow wave sleep and also in paradoxical sleep, which was never observed before the conditioning procedure.

It may be concluded as follows: Sleep is not promoted by the internal inhibition but by successive monotonous stimulation. Synthesis of protein is principally related with paradoxical sleep. Even during sleeping state cerebral function is not fully inhibited.

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THE EFFECT OF LATERAL SEPTUM ON A TACTILE STIMULUS INDUCING LORDOSIS RESPONSE OF THE FEMALE RAT. YAMAGUCHI, K. AND SHIMOKOHCHI, M. Dept. Behav. Physiol., Fac. Hum. Sci., Osaka Univ., Suitashi, Osaka.

A male's tactile stimulus during mounting is a very important factor inducing lordosis response of the female rat. As the response was inhibited by septal electrical stimulation, the stimulus seemed to result in a steep rise of threshold of the tactile stimuli necessary to evoke the lordosis response. In order to verify this assumption, the authors examined an effect of the lateral septal stimulation on the amplitude of cortical somatosensory and visual evoked potentials in acute preparation (CS-TS interval: 30msec.—1000msec.). The amplitude of these potentials was remarkably decreased by conditioning stimulus of the lateral septum. The decrease in the amplitude of the somatosensory evoked potential, however, was much more conspicuous than that of the visual one.

It seemed likely that the lateral septum has a strong inhibitory effect on the transmission of peripheral sensory impulse from the female skin contacted by the male rat.

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LEFT DOMINANCY IN THE BIRD VOCALIZATION
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Bird vocalization is produced by the syrinx. The paired syringeal muscles as a component of the syrinx are innervated bilaterally by the hypoglossal nerve. The functional dominance of the left hypoglossal nerve is well known in vocal behavior in any bird. The aim of our study is to clarify the physiological and morphological differences in the syringeal mechanism and its innervation pattern between canaries and chickens. Electrical stimulation of the left syringeal nerve of the chicken evoked similar potential change in the both muscles, while the right nerve evoked only an ipsilateral response. Such an asymmetrical response was not observed in the canary, i.e., the ipsi- and contralateral responses were evoked. Morphological innervation pattern of the syringeal muscles were studied by the HRP-labeling technique. In chicken, the HRP-labeled cells were always found predominantly on the left side of medulla oblongata when the injection was done to the muscle on either side. However, the labeling dominance was not observed in the canary. These results may suggest that the left dominance in the chicken is determined a priori, while in the canary it is formed by learning a posteriori.

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EFFECT OF THE ANTERIOR COMMISSURE SECTION ON INTEROCULAR TRANSFER OF LEARNING IN THE PIGEON. SHIGERU WATANABE, Dept. of Psychol., Keio Univ.

Two groups of pigeons were trained monocularly on a color or a pattern discrimination. The first group received a surgery of the anterior commissure section before the discriminative training and the second group after the training. The experimental chamber was an operant chamber for the pigeon with a single key. The surgery was administered with a stereotaxic apparatus modified for the pigeon. Then, the pigeons were retrained with their untrained eye. After completion of the experiment, brains were extracted for examination of the commissure section. In both groups, the subjects with the sectioned commissure showed impairment of interocular transfer of learning, while the subjects with the intact commissure showed complete transfer of learning. This result suggests unilateral formation of "memory" during the monocular training and ipsilateral "read-out" of "memory" during performance with the untrained eye.

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AUTORADIOGRAPHIC ANALYSIS OF 3H-VINBLASTINE INCORPORATION INTO THE MOUSE BRAIN. MURAKAMI, T.H., KISHIDA, A., KAWAKAMI, M., YAMAGUCHI, T., NISIDA, I. Dep. of Physiol. Okayama Univ. Med. School, Okayama.

Intraperitoneal administration of vinblastine interfered slightly with both acquisition and retention of the avoidance learning. Intracerebral injection of vinblastine interfered significantly with the acquisition and retention of the avoidance, and produced a profound loss of memory that had been acquired previously.

Autoradiographic analysis confirmed that 3H-vinblastine injected intraperitoneally was incorporated into the ependymal zone of ventricles in less than 1 h. One hour after stereotaxic infusion of 3H-vinblastine into the frontal lobes, grain density was highest over brain tissue immediately surrounding the ventricles, and extended into hippocampal regions.

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NEUROCHEMICAL CORRELATE OF LEARNING ABILITY IN CORN-FED TRYPTOPHAN DEFICIENT RAT. M. NOMURA and Y. NAGATA. Dept. of Physiol. School of Med. Fujita-Gakuen Univ. Toyooka, Aichi 470-11, JAPAN.

Newborn rats were fed on corn diet, which contains very low amount of tryptophan---an indispensable amino acid and the ultimate precursor of a neurotransmitter candidate, serotonin(5HT). The increase of body and brain weights of corn fed rats were remarkably inhibited. The contents of tryptophan and its metabolites, 5HT and 5-hydroxyindole acetic acid both in serum and brain of corn fed rats were considerably lower than that of normally fed ones.

Corn fed rats took nearly twice as much time as that of normally fed ones to make shape the learning task. In operant learning test, where S^+ and S^- stimuli were given at 1,000:1 brightness in Skinner box, and R^+ response was reinforced by a pellet, corn fed rats did not attain to the 80% of correct response ratio($R^+ / R^+ + R^-$) until the 30th session, whereas normally fed rat reached to the ratio of more than 85% on the 21st session. It might be suggested that the low concentration of tryptophan and its metabolites in rat brain could be strongly correlated with poor ability of learning task.

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SPEECH-PHYSIOLOGICAL STUDIES ON CHILDREN. (MOSTLY BY RECORDING)

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There are abundant causes of impediment, which changes by conditions in oral cavity. Our laboratory selected thirty-six subjects of preschool children, pupils and adults who speak standard language and have normal phonetic organ. We had them pronounce, under various conditions of upper front teeth, Sa, Si, Sw, Se and So, and made continuous observation by means of recording, palatograph and sonagraph. We also examined relationship between tooth, tongue and modulator point. It was found that with their root of pre-milk teeth left, preschool children made self-correction of pronunciation by tongue and defended against impediment. During the period of dentition changes of pupils, they successfully make correction by tongue. As for adults we observed that at loss of teeth they made no correction by tongue, getting into obvious impediment. The above facts shows that impediment on Sa, Si, Sw, Se and So come out clearly during the period of dentition changes and odontolodia. We confirmed, therefore, that appropriate treatment was necessary.

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PHYSIOLOGICAL INVESTIGATION OF FACIAL EXPRESSION FROM THE VIEWPOINT OF THE CHANGE IN MINOR TREMOR PATTERN K. NODA, H. SOEDA, K. YAMAMOTO, C. SAMEJIMA and K. WATANABE. Dept. of Physiol., Fukuoka Dental College, Nishi-ku, Fukuoka

Standing on the hypothetical idea of the neuromuscular origin of physiological minor tremor (MT), experimental clarification of a common experience that facial stiffness as one of the expression movements is dependent upon the state of lid opening or closing has been attempted. Possible neural reflex routes from the eye to the superficial facial muscles were presumed, and its output was buccal MT and inputs were qualitatively divided into retinosensory and extraocular spindular afferents. The latter was more effective in causing the MT change than the former. Actual index of the MT change in reflexive response to the signal from the eye was the decrease in integrated height of α waves which are principal component of MT, and the signal stimulus facilitated the reflex activity. The facilitation was owing greatly to extraocular spindle afferents and partly to retinosensory afferents.

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SYNCHRONIZATION OF SPONTANEOUS LOCOMOTOR ACTIVITY AND PLASMA CORTICOSTERONE IN SUPRACHIASMATIC NUCLEI-LESIONED RATS. WATANABE, K., M. ENDO and T. HIROSHIGE. Dept. of Physiol., Hokkaido Univ. Sch. of Med., Kita-ku, Sapporo 060

Suprachiasmatic nuclei (SCN) have been a focus of active investigation in searching the locus of the biological clock or clocks which control the circadian rhythm in mammals. In the present study, attempts were made to disclose the role of SCN in the rhythm expression by analyzing the mode of synchronization of plasma corticosterone with locomotor activity rhythm determined simultaneously in the same SCN-lesioned rats. Wistar male rats were fixed on a stereotactic apparatus and SCN were coagulated by passing electric current (DC 3 mA for 30 sec) through inserted electrode. At the end of experiments, the extent of SCN destruction was examined histologically. It was found that after the SCN lesion both functions lost a circadian rhythm and decomposed into an ultradian rhythm under constant darkness. The ultradian rhythm did not entrain to LD cycles. Furthermore, it was shown that the ultradian rhythm of plasma corticosterone was synchronous with that of locomotor activity. Power spectrum analysis revealed that the locomotor activity consisted of ultradian components with periods of 3 to 6 hr. The significance of the ultradian rhythm was discussed in relation to the role of SCN in the rhythm manifestation in mammals.

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ON INTENSITY OF DIRECT CURRENT NECESSARY TO FORM A DOMINANT FOCUS BY USING NEW TYPE OF ELECTRODE. HORI, YASUO. Second Dep. of Physiol. Osaka Univ. Med. School, Kitaku, Osaka.

It has been reported that optimal intensity of anodal direct current to form a defensive motor dominant focus in the motor cortex of chronic rabbit is in the range of 1-10 μ A. In some of these experiments, anode was silver ball, tip of which was placed in the cranial bone over the motor cortex. Cathode was large silver plate attached on ear lap. It was doubtful how much current really passed the cortical surface in this condition. In present experiment, new type of electrode was used. It was silver cylinder with diameter of 2 mm coated by dental resin except base. It was placed just on the dura mater with caution not to press down the cortex. It was found that anodal direct current with intensity of ca 50 nA or less was effective enough to form a cortical defensive motor dominant focus when applied to the motor cortex twice a week for 30 min. The rabbits which were applied such current showed all of or some of indications to suggest formation of the dominant focus which were confirmed in earlier experiments.

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SEXUAL BEHAVIOR OF MALE RAT AND A CONCOMITANT EVOKED POTENTIAL CHANGE BY INTRACRANIAL STIMULATION. M. HANADA, K. YAMAGUCHI AND M. SHIMOKOCHI, Dep. of Behav. Physiol., Fac. of Hum. Sci., Osaka Univ., Suita, Osaka

This study was undertaken to investigate the change of excitability in the brain during sexual behavior of male rat. For this purpose, the authors compared cortical evoked potentials obtained by weak electrical stimulation of midbrain reticular formation (MRF) or nonspecific thalamus (non-Th) during each behavioral category in the course of the sexual behavior.

As previously reported, the evoked potential in the motor cortex obtained by MRF stimulation showed consistent change in peak-to-peak amplitude according to the behavioral categories, being more conspicuous during Pursuit and Mount. ($PlN2$ increased and $N2P2$, $P2N3$ decreased) However, the evoked potential in non-Th obtained by MRF stimulation showed little change in amplitude, but peak latency ($Pl:7msec$, $N1:25msec$) was shortened markedly during Pursuit and Mount. The evoked potential in the motor cortex obtained by non-Th stimulation also showed little change in amplitude, except that $P2$ peak latency at 60msec was markedly shortened during Pursuit and Mount.

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VIBRATION DISEASE AND ITS SLEEP PROFILE WITH SPECIAL REFERENCE TO AUTONOMIC FUNCTIONS. MORITA, Y., SENO, H., IKEHATA, K. and ISHIKAWA, N. Dept. of Physiol., Tokushima Univ., Sch. of Med., Tokushima

Seven male patients (age:40-51 years) with vibration disease of occupational origin caused by prolonged use of vibratory tools were examined polygraphically during sleep with special reference to hand skin temperature (HST) and penile tumescence (PT). The data were compared with those of the normals matched by age and sex. The patients were characterized by sleep disorders due to a significant increase in stage 1 sleep and number of awakening during sleep and to a significant decrease in stages 2 and REM sleep without any modification of stages 3 and 4 sleep. We have previously reported that changes in HST are related to sympathetic tone and functional development of the cerebral cortex. All cases showed more or less decreased flexibility in the sympathetic tone. PTs during sleep were observed in all cases by our own method, but shorter in duration and rarer in frequency as compared with the normals. Especially, REM sleep-related PTs were obviously decreased in some cases of higher grade in severity of the disease. This fact may be associated with biogenic erectile dysfunction and not psychogenic.

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DIFFERENTIAL TEMPORAL DISTRIBUTION OF DELTA WAVE SLEEP (DS) AND REM SLEEP (RS) DURING RECOVERY SLEEP AFTER 12-H FORCED WAKEFULNESS (FW) IN DOGS; SIMILARITY TO HUMAN SLEEP. YASURO TAKAHASHI, KIYOHISA TAKAHASHI. Depts. of Psychology and Medical Chemistry, Tokyo Metropolitan Institute for Neurosciences, Musashidai, Fuchu City, Tokyo.

Twenty-four-h polygraphic recordings were made in 5 dogs under a light-dark condition (L 0600-1800; D 1800-0600), and scored in 1-min epochs into waking, light sleep, DS and RS. Percentages of DS and RS in total sleep time were calculated every 2 h. After baseline recordings on 7 consecutive days, 12-h FW was performed with an automatic device on 7 consecutive days in 3 ways: from 0900 to 2100 (N=5), from 2100 to 0900 (N=4), and from 0600 to 1800 (N=2). Under the baseline condition, there were no consistent temporal distributions of %DS and %RS during the 24-h period. During the 12-h recovery period after 12-h FW, %DS was initially high and gradually decreased in 10 of 11 sessions. The mean %DS + SE was $52.6\% \pm 2.8$ in the first 2 h of the recovery period, and $29.2\% \pm 2.7$ in the last 2 h ($P < 0.0005$ by paired *t*-test). In contrast, %RS was initially low and gradually raised in 8 of 11 sessions. The mean %RS was $19.1\% \pm 1.7$ in the first 2 h, and $28.2\% \pm 2.2$ in the last 2 h ($P < 0.01$). This differential temporal distribution of DS and RS in the dogs was very similar to that during nocturnal sleep in man. These results suggest that sustained wakefulness of adequately long duration prior to sleep onset is necessary for such differential distribution of DS and RS in dogs as well as in man.

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THE STRUCTURES OF AVIAN HYPOGLOSSAL NERVE UNDERLYING LEFT DOMINANCY IN THE VOCALIZATION UENO, M. and SAITO, N. Dept. Physiol., Dokkyo Univ. Sch. Med., Mibu, Tochigi

The birds are divided in two types with regard to their song ontogeny. Type I includes the canary. The strategy of the song ontogeny of this type develops the normal song referring to the auditory template. The Type II includes the chicken. Neither auditory feedback nor template is necessary at all in the Type II. The avian vocalization is performed by the paired syringeal musculatures (paired vocal cords) which are innervated by bilateral hypoglossal nerves. The song ontogeny is closely connected with left dominance between the paired hypoglossal nerves. The functional aspects of left hypoglossal dominance in the Type I and the Type II were reported elsewhere (LEFT DOMINANCY IN THE BIRD VOCALIZATION - Maekawa, Taniguchi, Saito, in this proceeding). Morphological records of the hypoglossal nerve correlate with the functional aspects. The electron micrographs of the cross sections of hypoglossal nerve permit to count the number of the fibers. Total fibers of the left nerve is more than the right by 10-30%. In the chicken, more than 10% (60 ± 10 fibers) of total fibers (400 ± 50) of left hypoglossal nerve bifurcate and cross over the trachea reaching the right syrinx. The left hypoglossal nerve of the chicken innervates bilateral syringeal musculatures, while the right nerve does ipsilaterally. For the canary, bilateral hypoglossal nerves (600-700 fibers) innervate in symmetrical pattern.

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EFFECTS OF ENRICHED REARING IN MICROCEPHALIC RATS DUE TO PRENATAL X-IRRADIATION AND MAM APPLICATION UPON HEBB-WILLIAMS MAZE TEST. S. KIYONO, M. SEO and M. SHIBAGAKI. Dep. of Physiol., Inst. for Develop. Res., Aichi Prefec. Colony, Kasugai, Aichi

Male microcephalic rats of the Sprague-Dawley strain due to prenatal X-irradiation (200 R on day 17 of gestation) and methylazoxymethanol (MAM) application (20 mg/kg, i. p., on day 14 of gestation) were differentially reared for 30 days after weaning. Then, enriched condition (EC) and standard colony condition (SC) in X-series and EC and impoverished condition (IC) in MAM series were compared using Hebb-Williams maze test (modified by Ravinovich and Rosvold, 1951). Initial errors, repetitive errors, total errors and running time were measured through 12 standard problems. The results revealed that in all measures 1) X-ray effect was significant and neither Environment effect nor interaction was significant in X-series (10 rats each in X-EC, X-SC, control-EC and control-SC) and 2) Environment effect was significant and neither MAM effect nor interaction was significant in MAM-series (8 rats in MAM-EC, 4 in MAM-IC, 9 in control-EC and 11 in control IC). The results obtained suggest that 1) the environmental enrichment is effective when EC is compared with IC, and 2) the severe brain damage is difficult to be alleviated by EC.

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VISUAL RECEPTIVE FIELDS OF PREFRONTAL NEURONS AS REVEALED DURING VISUAL FIXATION AND FIXATION-DETECTION TASKS.

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In order to determine visual receptive fields of prefrontal neurons, their responses to extrafoveal slit stimuli were examined, while 4 monkeys were performing visual fixation task (VFT) and fixation-detection task (VDT). In VFT, the monkey fixated their eyes for 0.5-5s on a spot at the center of a tangent screen. Slit stimuli ($1 \times 5^\circ$) were presented during fixation period. In VDT, the monkey pressed levers, depending on whether or not the slit was presented. A total of 278 task-related neurons were recorded. Of these, 96 responded to spot (78, increase; 18 decrease), and 178 responded to slit (142, increase; 33 decrease). In 26 slit-responsive neurons, sufficient number of responses were collected to demarcate roughly visual fields. Its size varied from about $10 \times 10^\circ$ to $60 \times 40^\circ$ (9; contra., 2; ipsi., 14; both hemifields, including fixation point). Activities to the same slit stimulus were compared in two tasks and only 6 of 71 showed slightly enhanced activities during VDT than during VFT. It appears that most of visually responsive prefrontal neurons have relatively large visual receptive fields and an attention to the extrafoveal visual stimuli is effective only a limited number of neurons.

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PHYSIOLOGICAL EFFECTS OF HEPATOPANCREAS EXTRACT ON CARDIAC GANGLION CELLS.
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The crustacean hepatopancreas extract have depressible effect to cardiac muscle activity and excitable effect to spontaneous activity on the cardiac ganglion trunk. From the experimental results on the crustacean heart, the extract showed tendency to increase the frequency of burst potential with high frequency impulses, and to abolish the heartbeat when the burst duration was shortened. The effects of shortening to the burst duration and abolishing to the heartbeat are very similar to those of GABA. And the effect of increasing to the frequency of burst with high frequency impulses is very similar to that of 5-HT. It is considered that the acceleratory effect to the spike discharge is due to the substance with 5-HT-like action and inhibitory effect to the burst duration is due to the one with GABA-like action. And so, the physiological effect of the extract to the cardiac ganglion trunk in crustacea may be occurred by sum of antagonistic action of these unknown substances.

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FACTORS ASSOCIATED WITH INDIVIDUAL EFFECTIVENESS OF ACUPUNCTURE ANALGESIA.
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Rats were classified to either acupuncture effective (E.A.) or acupuncture non-effective animals (non-E.A.) by significant increase ($p < 0.05$) of tail flick latency which was estimated as pain threshold. E.A. has 25 times higher units of endogenous morphine like factors evaluated by radio-receptor assay in the brain than those in non-E.A.

250mg/Kg of di-phenyl alanine converted non-E.A. to E.A. 0.5mg/Kg of morphine was also effective to cause analgesia in E.A., while it was not effective in non-E.A. Any detectable changes in the contents of opiate receptors between E.A. and non-E.A. were not observed in various parts of the brain.

Stimulation of periaqueduct central gray produced analgesia in E.A. while it did not cause analgesia in non-E.A. These results indicate that the effectiveness of A.A. is primarilyly due to contents of MLF in the brain and other factors other than MLF might be involved in individual effectiveness of A.A.

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VALPROATE ACTION ON EPILEPTIC NEURONS: MICROIONTOPHORETIC STUDIES.
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In order to investigate the mode of action of Valproate (DPA) in cobalt-induced epileptic foci of cat, the unitary activity of spontaneously firing neurons, and their excitatory responses to glutamate (GA) or to acetylcholine (ACh) were examined using microiontophoretic administration of DPA. The predominant effect of DPA (0.1-0.2 M) on the GA-evoked firing was profound and prolonged inhibition, which attained its maximum within 3 min, while the response to GA was completely blocked. This inhibitory response was generally less abrupt in onset. The inhibitory on ACh-induced firing or on spontaneous discharges on neurons was not clear. Various explanations of these phenomena are considered. It is suggested that the direct inhibitory action of DPA upon GA-firing may play an important role in the protection against the epileptic seizure.

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NEUROCHEMICAL STUDY ON THE INTRACELLULAR CALCIUM MOVEMENT DURING BURSTING ACTIVITY IN SNAIL NEURONS. M. Onozuka, T. Iwata, K. Yamada, T. Kobori & E. Sugaya. Dept. of Physiol. Kanagawa Dent. Coll. Yokosuka, Kanagawa.

Distribution change in intracellular calcium during bursting activity (BA) induced by pentylenetetrazole (PTZ) was examined using ^{45}Ca . Neurons of suboesophageal ganglion of snail, *Euhadra peliomphala*, were used. Following results were obtained:

- 1) During BA, PTZ induced calcium influx was decreased but efflux showed no change.
- 2) Lysosomal fraction showed a decreased incorporation of calcium by PTZ. Mitochondria and microsomal fractions did not show any change by PTZ.
- 3) Barbiturate and diphenylhydantoin inhibit the decreased incorporation of calcium into lysosomal fraction.

Above findings were exactly the same as that obtained by the examination using a computer controlled electron probe X-ray microanalyzer and suggest that the close relationship between the release of calcium from lysosome-like granule and occurrence of BA.

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CYTOSINE ARABINOSIDE-INDUCED MICROENCEPHALY IN RATS: NEUROCHEMICAL AND BEHAVIORAL STUDIES. MATSUTANI, T. NAGAYOSHI, M. TAMARU, M. and TSUKADA, Y. Dept. of Dev. Physiol., Inst. for Comprehensive Med. Sci., Fujita-Gakuen Univ., Sch. of Med., Aichi 470-11 *Dept. of Physiol., Keio Univ. Sch. of Med., Shinanomachi, Shinjuku-ku, Tokyo

We have already reported that the contents of monoamine in the cerebral hemisphere of rats with experimental microencephaly, induced by methylazoxymethanol (MAM) prenatal administration were significantly higher than those of the control. In order to obtain a model of microencephaly, cytosine arabinoside (ara-C) 280mg/Kg was injected i.p. to the pregnant rats on 15th gestation day. The total DNA contents per cerebral hemispheres reduced remarkably to be about 60% of the control. The contents of serotonin, nor-epinephrine and dopamine per gram-wet-wt. of the cerebral hemispheres increased clearly to be 1.4, 1.7 and 2.9 times respectively as much as the control, but those of the brain stem were unchanged. The CNPase activities in the cerebral hemisphere, brain stem and spinal cord did not differ from that of the control. It was found that the neurochemical results obtained from the ara-C-rats were quite similar to those of the MAM-rats. As to the brightness discriminative learning ability on four month old, the ara-C-rats were more retarded than the MAM-rat. It is suggested that an over-production of monoaminergic synapses in the cerebral hemispheres of MAM and ara-C-rats is a result of compensatory reaction, for prenatal deficit of neurons.

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POSTNATAL DEVELOPMENT OF RAT BRAIN IN MATERNAL PHENYLALANINEMIA: Y. TAKAGI, T. KANAMATSU, M. NAKABUSHI, H. ASO, S. HIRANO, Dep. of physiol., Toho Univ. Sch. Med., Ohmori, Tokyo

The elevated maternal blood level of phenylalanine damaged the intellectual development of the fetal rat, tested using discrimination learning apparatus.

In order to investigate neurochemical aspects of the learning ability reduced, four experimental groups of maternal phenylalaninemic rats to which L-phenylalanine was loaded during different period in gestation were produced and some enzyme activities of mantle region in developing rat brain were measured.

Learning ability was most reduced in the experimental groups loaded L-phenylalanine from 5th to 9th day of gestation.

Enzyme activities of Glycerol phosphate dehydrogenase and Butyrylcholinesterase in brain tissue at birth of this group diminished clearly, compared with the control.

It suggests that maternal phenylalaninemia affects postnatal developments of glial cells of the fetal brain, since it is well-known that these enzymes localize in glial cells.

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MYELIN GLYCOPROTEINS DURING MYELINATION OF CHICK SCIATIC NERVE.

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A great deal of evidences has been accumulating that membrane glycoproteins may play important roles in cell recognition and adhesion. We previously reported the purification of two glycoproteins (BR-P0 & PASII, Mol.Wt. 28,000 & 14,000), which are unique to peripheral nerve myelin membrane (Kitamura, Suzuki & Uyemura: *Biochim. Biophys. Acta*, **455**, 806, 1976). Developmental changes of those glycoproteins were examined. During early stages of myelination, 13-18 embryonic days of incubation, two glycoproteins (BR-P0 & PASII) increased in relative amount in good correlation with the degree of myelin formation in the sciatic nerve. The 23K glycoprotein (Mol.Wt. 23,000) was also observed in the early stages while it decreased in relative importance in the adult myelin. [¹⁴C]-Fucose was rapidly incorporated in two glycoproteins in the myelin, when it was injected in chick embryo *in vivo* at the stages of myelination. The possibility of involvement of lipid linked carbohydrate in biosynthesis of the glycoproteins in peripheral nerve myelin was examined. The transfer activity of glucose to glucosyl phosphoryl dolichol from UDP-glucose in chick sciatic nerve particulate at the stage of myelination was much higher than that of adult. This activity was inhibited by EDTA and strongly stimulated by exogenous dolichol monophosphate.

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PATTERNS OF INTERACTION AND RECEPTIVE FIELD IN THE PHOTORECEPTORS. K. MIMURA, Fac. Liberal Arts, Nagasaki Univ., Nagasaki

Interaction between two peripheral retinula cells in the compound eye of the fleshly has been reported previously. By ascertaining the direction of polarization plane, which showed the maximum polarization sensitivity in illumination of the photoreceptor, and the position of the recorded retinula cell in the compound eye, and by determining the position of the retinula cell, which would interact with the recorded cell according to the previously reported method, combinations of interaction were identified. Various interaction patterns were identified between two adjacent retinula cells. Furthermore, the shape of receptive field of retinula cell was drawn in detail by scanning with illumination of a spot of light emitted from a perimeter. Not only a small and round field as is well known was of course recorded, but also several types of shapes with wide fields were found. These field appeared to be related with the position of retinula cells among the compound eye. Results may suggest that the ommatidia, which had been considered to possess the same visual function in all of them, exhibit different functions each other.

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EFFECTS OF EFFERENT SIGNALS ON RESPONSE CHARACTERISTICS OF THE EYES OF THE ORB WEB SPIDERS, ARGIOPE BRUENNICHII and A. AMOENA. YAMASHITA, S. and TATEDA, H. Dept. of Biol., Fac. of Sci., Kyushu Univ., Fukuoka.

Effects of efferent activities on responses of the eyes of the orb web spiders have been studied. Efferent activity shows a circadian change, i.e. the efferent activity increases during the "night state" under constant darkness. When the efferent activity increases, the threshold for the ERG decreases gradually and the amplitude of the saturated state of the intensity-ERG response curve increases rapidly. When the efferent activity increases transiently, the ERG amplitude also increases transiently. The transiently increased ERG depresses markedly in low calcium-high magnesium saline. Furthermore, when the efferent activity increases, the membrane potential of the photoreceptor cell hyperpolarizes and the amplitude of light response increases. When the eyes are stimulated by light, efferent spike generation is inhibited during illumination, and enhanced for a short period after the cessation of illumination. After isolating the brain, the efferent spike from the brain increases during illumination. This shows that photosensitive neurons are present in the brain.

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EFFECTS OF STIMULATION OF CAT ORBITAL CORTEX ON SUPERIOR COLLICULUS CELLS. J. HADA, Y. HAYASHI, F. MORITA & Y. YAJIMA. Dep. of Physiol., Hyogo Coll. Med., Nishinomiya, Hyogo.

Effects of stimulation of the orbital cortex (OCx) upon neurons of the superior colliculus (SC) were studied in cats anesthetized with Nembutal or Chloralose. In 138 SC units, responses to stimulation of the optic chiasm (OX) were studied under conditioning stimulation of OCx; 92 were inhibited, 4 facilitated and 42 not affected. Response latencies to OX stimulation ranging from 2.3 to 39 msec did not differ between SC units which were affected by OCx stimulation and those which were not. The inhibition lasting for about 100 msec after the onset of OCx stimulation occurred regardless of whether the SC units were activated by conditioning OCx stimulation or not. Most of 44 units which responded to OCx stimulation with latencies ranging from 2.1 to 19.6 msec responded also to OX stimulation and their response latencies were correlated linearly with those to OCx stimulation. Among visually driven SC units, 12 direction-selective units out of 23 were inhibited by conditioning OCx stimulation. In two thirds of SC cells which were identified histologically as belonging to superficial layers by marking fast green spots, responses to OX stimulation were inhibited by OCx stimulation. Effective cortical regions were found histologically to be located within OCx.

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BRIGHTNESS SENSATION INDUCED BY POLARIZED LIGHT STIMULUS

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Experiments were performed to examine how human eyes are sensitive to polarized light. Light source from the direction of terrestrial magnetism was received at the center of the left eye, perfectly dark adapted, through a scattering plate, a monochromatic filter, one sheet of polarizing plate, a fan-shaped hole in a rotating disc. The intensity of the adjacent light which passed the polarizing plate was adjusted with gray filter to equalize the brightness. As the straight polarizing plate was rotated counterclockwise from the vertical direction (0°), the brightness sensation was whether 1) maximum at about 45° and minimum at 90° or 2) minimum at about 45° and maximum at 90° . Under the same condition the brightness sensation was symmetrical in the center of the right eye. When the duration of the stimulus was increased at a constant brightness, the brightness sensation at 45° and that of 90° were elevated antagonistically and stepwise. Equality points were distributed at about 0.025 sec intervals. These findings were similarly observed with monochromatic light of red, green, blue and neutral. This fact will contribute to the understanding of stereoscopic vision.

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BUMP AREA AND SENSITIVITY OF LOCUST RETINULA CELL. Y. TSUKAHARA. Research Center for Applied Information Sciences, Tohoku Univ., Katahira-cho Sendai

Relations between sensitivity recovery and the change of bump size were studied in locust retinula cells after single adapting flash.

1. Sensitivity was measured by calculating the reciprocal of the number of photons required to yield a constant photoreceptor response. The adapting flash decreased it down to about 30% of the dark-adapted value.
2. Average frequency of bump was not changed by adapting flash.
3. Amplitude of bump was decreased to about one half of the dark-adapted value.
4. The recovery of sensitivity after adapting flash was well followed by changes in (bump amplitude)².
5. As there is a significant correlation between (bump amplitude)² and bump area, it is concluded that the change in bump area is a main cause to change the receptor sensitivity.

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INFLUENCE OF RIBOFLAVIN ON THE REGENERATION OF RHODOPSIN

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The influence of riboflavin on the regeneration of rhodopsin was investigated in the retinas of frogs adapted to dark or light. The color of the skin of frogs adapted to the dark was dark brown, however, it turned yellow under light conditions. This adaptation was almost completed in more than five days in either condition. Both concentrations of riboflavin and rhodopsin in the retinas of dark brown frogs are greater than those in yellow frogs.

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RECIPROCAL RELATION BETWEEN INTENSITY AND DURATION OF LIGHT STIMULUS REQUIRED TO ELICIT AN ELECTRICAL RESPONSE IN SINGLE RODS

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Intracellular responses of single photoreceptor cells to light of various intensities and durations were recorded from the dark-adapted retinal preparation of the frog, Rana catesbiana. The cells were identified as red rods by dye marking with Procion Yellow.

The hyperpolarizing response to a flash lasting less than 50 msec was related to the product of intensity and duration of the applied stimulus; i.e., there was a reciprocal relationship between intensity and duration of a flash to produce a given response. Summated responses to two successive flashes of the same intensity at various intervals ranged 0 to 50 msec coincided in the amplitude and the shape.

Results in the present study of the single rods could be comparable to those obtained from psychophysical investigations, and the similarities between results from both studies were discussed.

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POTENTIATION OF THE FAST PIII RESPONSE AFTER ILLUMINATION ON THE ISOLATED FROG RETINA.

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The fast PIII response of the dark-adapted bullfrog retina increased in amplitude temporarily after exposure to a prolonged weak adapting light. The magnitude of potentiation after illumination varied with the duration and intensity of adapting light. Reducing Ca^{++} concentration in the extracellular fluid, the potentiation was more marked and had more rapid decay than that in the control fluid, but it was abolished by a decrease of external Na^+ concentration. The trans-retinal DC potential shifted temporarily to increase positivity on the vitreous side with respect to the scleral side after illumination. It is suggested that the potentiation of PIII response after illumination is due to an increase of dark current flow which has its sink in the outer segment region of the rods.

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DUPLEX SYSTEM IN THE RETINA OF A GASTROPOD MOLLUSC, ACHATINA FULICA.TASAKI, K. and SUZUKI, H. Dept. of Physiol., Tohoku Univ. Sch. of Med., Sendai.

Intracellular recordings were made from the retina of an African giant land snail with procion yellow microelectrodes. Four types of cells were distinguished: Sustained (S) type of cells have high photosensitivity and respond to photic stimulation with a train of sustaining impulses, and transient (T) cells are less sensitive to light and respond only transiently to light with fewer impulses. Less frequently encountered are spontaneously bursting (SB) cells whose firing pattern is not much influenced by light, and the other is inhibitory (I) type of cells of which background discharges are inhibited by light. Intracellular dye marking experiments revealed that the S and T cells correspond to the morphologically classified type I and type II cells, respectively. However, the latter two types of cells (SB and I) were found only in the optic nerve fiber layer, outside the retina which consists of the photosensory cells and pigment bearing supporting cells. Thus these two types of cell were concluded to be the ganglion cells.

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PATTERN REVERSAL VECPS TO HALF FIELD STIMULATION. E. ADACHI, J. CHIBA.
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Visually evoked cortical potentials (VECP) have been recorded in normal subjects to the lower and upper half field stimulation. The stimulus was a checkerboard pattern reversing at a rate of 12Hz. Monopolar recording from multiple electrode positions along the midline and the transverse line at a level of Oz was used with reference to the right ear lobe. A polarity reversal of the sinusoidal waveform of VECPS has been found in 18 cases out of 32 between the upper and lower field VECPS recorded at Oz. VECPS to full field stimulation were proved to be the sum of the separate half field VECPS in all cases. The polarity inversion and amplitude distributions of the VECPS to stimulation of the upper and lower field showed that the lower field VECPS distributed in the posterior direction and the upper in the anterior on the midline of a scalp. The lower field VECPS recorded from a transverse electrode row showed largest amplitude at Oz with attenuation in the remote position from Oz, while the upper field VECPS remained unchanged. The hypotheses of dipoles in the occipital lobe derived from the studies by Jeffreys and Halliday were discussed in relation to our results.

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NONLINEAR SPATIAL SUMMATION OF RECEPTOR INPUTS IN THE RECEPTIVE FIELD OF RETINAL HORIZONTAL CELLS. K. FUKUROTANI and H. HASE. Dept. of Electronic Engineering, Toyama Univ., Takaoka-shi, Toyama

We studied the spatial summation of receptor inputs in the receptive field of retinal horizontal cells of the carp. Photopic and scotopic L-type horizontal cells summed receptor inputs linearly when the amplitude of the receptor inputs was small. On the other hand, the spatial summation became nonlinear when the amplitude of the receptor inputs to the L-type horizontal cells was made larger by the stimulating light of more photons or more sensitive wavelength. Similar properties of spatial summation as those of L-type horizontal cells could be observed for each cone input in the receptive field of C-type horizontal cells. However, C-type horizontal cells summed each cone input in a different manner for a monochromatic light. For example, R/G-type horizontal cells summed the green cone input linearly but the red cone input nonlinearly for a red light. Such difference in the spatial summation of the different cone inputs in the receptive field of C-type horizontal cells suggested that R/G-type horizontal cells received the red cone input via photopic L-type horizontal cells where the red cone input had been already summed and Y/RB-type horizontal cells received red cone and green cone inputs via R/G-type horizontal cells where the cone inputs had been already summed.

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ELECTRICALLY EVOKED RESPONSE (E RESPONSE) OF ROD HORIZONTAL CELL IN THE CARP RETINA, K. WATANABE & O. UMINO. Dept. of Physiol., Tokyo Women's Med. Coll.. Shinjuku-ku, Tokyo

It appears generally accepted that E response by a transretinal electrical stimulation is a summated e.p.s.p. of horizontal cell produced by a transient excitation of the receptor terminals. In the present experiment recordings were made from the rod horizontal cells under scotopic condition of the live carp, and the properties of E response were examined. The E response versus S potential relation (E-S relation) obtained with constant electrical stimuli and variable intensity of illumination was linear, and the equilibrium potential estimated by extrapolation was at around the ground level. One of the characteristics of the rod horizontal appeared a damped oscillation superposed on the recovery phase of E response, which was marked in the dark but was fairly suppressed in the intense light. A transient depolarization of the membrane by intracellular current injection produced similar oscillation in the horizontal cell, suggesting that the oscillation would be one of the properties of the horizontal cell membrane itself.

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EFFECTS OF γ -AMINOBUTYRIC ACID ON NEURONAL ACTIVITIES IN THE DISTAL RETINA OF THE CARP; Y. SHIMODA, M. MURAKAMI, Dept. of Physiol., Keio Univ. Sch. Med., Shinjuku-ku, Tokyo

When a transient depolarization was evoked in horizontal cells by a transretinal current pulse, a small hyperpolarizing deflexion (probably IPSP) was detected in cones. The IPSP was abolished by superfusion of the retina with GABA-containing Ringer solution, being associated with a hyperpolarization of membrane potential of cones. These results suggested that, in the dark, a GABA-mediating negative feedback was operating from horizontal cells to cones, and terminated in the light. Application of GABA also caused remarkable changes in spectral response curves of horizontal cells, mainly because of suppression of responses to monochromatic lights of longer wavelengths. Therefore, it was concluded that the feedback plays an important role in mechanisms of conversion from the trichromatic processes in cones to the opponent color processes in horizontal cells.

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DIFFERENT GABA SENSITIVITIES AMONG VISUAL CELLS IN THE RAT SUPERIOR COLLICULUS. Fukuda, Y., Kayama, Y. and Iwama, K. Dept. of Neurophysiol. Inst. Higher Nerv. Activ., Osaka Univ. Med. Sch., Kita-ku, Osaka.

The superior colliculus (SC), especially its uppermost part, has been reported to contain a high concentration of GABA. In previous studies on the rat SC, we have distinguished several classes of visual cells which differed from each other in the conduction velocity of optic nerve afferents as well as in the recording depth. The aim of the present experiments was to see how these classes of SC cells differ in the susceptibility to iontophoretically applied GABA. After systematic analyses on spontaneous activity and on responsiveness to single optic chiasmatic shocks or to light spots moved across receptive fields, we have reached the following conclusions. 1) Spontaneous activity of all classes of cells was completely suppressed by a small amount of GABA ejected with currents of 20 nA or less. 2) Susceptibility to GABA assessed by the responsiveness to both electrical and visual stimuli differed from one class to the other, related to the conduction velocity of optic nerve afferents rather than related to recording depth.

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INTERCONNECTIONS OF INNER NUCLEAR LAYER NEURONS IN THE CARP RETINA. A. TAKABAYASHI, M. SAKAKIBARA, G. MITARAI. Dept. Aerospace Physiology, Res. Inst. Environment. Med., Nagoya Univ., Chikusa-ku Nagoya 464

Electrical coupling in the horizontal cell (HC) network was re-examined in isolated carp retina. DC-components of rectangular current of either sign applied in a L type HC (LHC) spread through the LHC layer, attenuating as to about one third in the next cell, while in the cell after next appeared on-off transients which remained but shortened the time constant as the cell to cell distance increased. The coupling of C type HCs (CHC) behaved similarly and it was noticed that this existed also between different spectral types, as R/G to Y/B. In contrast, from LHC to CHC or reverse, spread only transients, which considered artifacts. Sinusoidal current application revealed the coupling like a low-pass filter having phase-lag of about 20 msec both in LHCs and in CHCs within a small area, while with distance changed to a high-pass having phase-lead, so that the latter clearly is an artifact correlating the transient in rectangular pulse experiment. However, the sinusoidal current spread from LHC to CHC had a property like a band-pass. Consequently, the slow transients at least might not be artifacts. The present results provided evidence of electrical coupling of CHCs and also of inter-HC-relation independent of cell types, though the conclusive feature of the effect that the feedback from HCs to receptors should have on these couplings was remained for further studies.

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EFFECTS OF BIOGENIC AMINES ON HORIZONTAL CELLS IN THE FISH RETINA. NEGISHI, K. and DRUJAN, B. D. (Dept. Neurophysiol., Neuroinformation Res. Inst., Kanazawa Univ. Sch. Med., Kanazawa and Centro de Biofísica y Bioquímica, IVIC, Caracas, Venezuela)

The effects of biogenic amines in the superfusate were examined on the horizontal cell membrane potential in the fish (*Eugerres plumieri*) retina. Each of the catecholamines (dopamine, noradrenaline and adrenaline) and of the related compounds (α -methylnoradrenaline, 5-hydroxy dopamine and serotonin) tested produced an analogous effect on the hyperpolarizing response of all types of horizontal cells. The depolarizing response of C-type cells was found to change variably with the above agents. The effect of dopamine (DA) among them was most pronounced. The unique effect of DA (0.1-0.2 mM) was to augment the center response and to attenuate the surround response of horizontal cells; these reciprocal changes usually were associated with a 5-10 mV depolarization. The results indicate that the catecholamines (CA) do not directly affect synaptic transmission from photoreceptors to horizontal cells, but appear to selectively interfere with the lateral propagation of S-potential. Propranolol, haloperidol and apomorphine did not affect but phentolamine (0.5 mM) markedly diminished the DA action. Thus, α -adrenergic receptors appear to be involved in the CA-induced changes observed.

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EFFECTS OF BACKGROUND ILLUMINATION TO BIPOLAR CELL RESPONSE IN CARP RETINA.

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The dynamic characteristics of carpon- and off-center bipolar cells were studied to elucidate the spatial interactions within the cells' receptive field by use of white-noise modulated light input. In both types of the bipolar cells, the response to spot photostimulus at the center of the receptive field was much enhanced by a steady annular background illumination of a certain intensity than the response without background, and vice versa; the response to annular photostimulus was also much enhanced by steady central background illumination than the response without background. These suggest that the response enhancement caused by the steady background illumination with proper intensity is originated from the mutual interactions between center and surround within the bipolar cell receptive field. The steady background illumination at either center or surround in the receptive field may serve to adjust the maximum sensitivity of the bipolar cell according to the steady background level.

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SPECTRAL AND ELECTRICAL PROPERTIES OF OFF-CENTER BIPOLAR CELLS IN THE CARP RETINA. T. SAITO, H. KONDO. Dep. of Physiol., St. Marianna Univ. Sch. Med., Kawasaki-shi, Kanagawa

Intracellular recordings were made from off-center bipolar cells in the carp retina. A large number of off-center bipolar cells showed a spectral response maximum at 575 nm under mesopic condition and some of them at 625 nm under photopic condition, providing evidence that they receive input from red cones as well as rods or green cones. The hyperpolarizing center response was accompanied by a resistance increase and reversed its polarity at about +49 mV (mean value from 4 cells). The depolarizing surround response was accompanied by a resistance decrease and reversed its polarity at about +25 mV (a value from one cell). These results may suggest that the center response is mediated by the same ionic channel which generates the surround response. If we assume that ionic distribution across bipolar cell membrane is the same as that of the nerve and muscle cell membranes, the ion that could have a positive reversal is sodium. It is suggested, therefore, that the center and surround responses are generated by a decrease and an increase in the sodium conductance, respectively.

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DUAL SYNAPTIC ACTION OF HERMISSENDA PHOTORECEPTORS TADASHI AKAIKE, D.L. ALKON*. Dep. of Physiol., Nagoya University School of Medicine and* NINCDS NIH, Marine Biological Laboratory, Woods Hole, USA

Nudibranch mollusc *Hermissenda crassicornis* have primitive lens eyes which contain five photoreceptors, pigment cells and supporting cells. Two type A and three type B photoreceptors are classified according to anatomical and electrophysiological criteria. Both types of photoreceptor evoke depolarizing generator potential and the superposed impulse trains in response to light. They have inhibitory synaptic actions on the neighbouring photoreceptors and optic ganglion cells. Recently two classes of second order visual neurons were identified in the cerebropleural ganglion cells. One class of the neuron received IPSPs, the other received EPSPs which were produced by each impulse of one type B photoreceptor. Latencies of these EPSPs and IPSPs were of comparable magnitude. These evidence suggested dual synaptic action of type B photoreceptors.

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LIGHT RESPONSES AND MORPHOLOGICAL IDENTIFICATION OF PINEAL GANGLION CELLS. Y. MORITA, T. NAKAMURA*. 1. Dept. Physiol. Hamamatsu Univ. Sch. Med. & Grad. Sch. Electr. Techn. Shizuoka Univ, Hamamatsu*.

The direct light-sensitive pineal complex in lower vertebrates has 3 types of cells, 1) photoreceptor cells with lamellated outer segments, 2) supporting cells, 3) ganglion cells which make synapses with the basal processes of receptor cells. Intracellular recording of light response and successive staining with iontophoretic injection of procion yellow were performed to correlate the potential changes and morphological properties in the isolated pineal of lamprey, *Lampetra japonica*. The receptor cells showed slow graded potentials in hyperpolarization by light. Ganglion cells in the periphery from receptor layer showed processes as axon and dendrites. The spontaneous spike discharges from these cells were inhibited by light stimulation, accompanied by hyperpolarization. These sustained hyperpolarizing responses were followed in many cases by OFF-rebound in depolarization. The size of cells with OFF-rebound was smaller than the cells without rebound. Number of processes and arborizations was larger in the cells without rebound than the other group.

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MORPHOLOGICAL AND NEUROCHEMICAL OBSERVATIONS ON LIGHT DEPRIVED RETINA AND TECTUM FROM CHICK

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Effects of monocular light deprivation obtained by lids suture of the right eye just after hatching on the development of retina and tectum were examined. On 30 days of age, the activity of glutamic acid decarboxylase (GAD) was lower and that of 2',3'-cyclic nucleotide 3'-phosphohydrolase (CNPase) was higher on the light deprived retina than those of the control side. While the activity of choline acetyltransferase (CAT) was not changed. The protein profiles obtained by SDS-polyacrylamide gel electrophoresis showed some changes on the deprived retina. It was suggested that there would be some impairments of GABAergic synaptogenesis and myelination on the deprived retina. The incorporation of 2-deoxyglucose into deprived tectum was clearly decreased. The gain in total wet weight of the deprived tectum was suppressed by 13% of the control side, but DNA content per g.w.w. was not changed. This indicated a decrease of the cell number on the deprived tectum. The activities of CAT, GAD, CNPase and acetylcholinesterase did not show any differences between both sides of the tectum. The protein profiles showed also no difference. Then, it was considered that the tectum of deprived side developed normally except for the number of cells.

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CHANGES IN THE D-WAVE PROPERTIES OF THE FROG ERG BY A LIGHT AND DARK ADAPTATION.
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The d-wave of the ERG changes its properties by a light or dark adaptation. We studied on effects of preillumination and changing $[Na^+]_o$ or $[K^+]_o$ on the b- and d-wave recorded from the isolated frog retina. The amplitude of b-wave became smaller and that of d-wave became larger after the illumination, then they gradually returned to the original amplitudes. Decreasing $[Na^+]_o$, almost the same effect was found on the b- and d-wave. Increasing $[K^+]_o$, both responses were depressed, but the effect on the b-wave was more remarkable. These results suggest that origins of the b-wave and d-wave are not the same. The d-wave generating cell has synaptic connections with visual cells because the d-wave cannot be observed by the application of L-aspartate. On the mechanism of d-wave generation, it was suggested that the d-wave generating cell is sensitized by the illumination and desensitized by keeping in darkness. It was suggested, furthermore, that as the d-wave generating cell is less sensitive to $[K^+]_o$ than the b-wave generating mechanism, the d-wave is mainly generated by non glial cells.

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MODIFICATION OF THE ERG BY TRANSRETINAL CURRENT. Y. SASAKI, Dept. of Physiol., Tokai Univ. School of Medicine, Bohseidai, Isehara, Kanagawa 259-11, Japan.

Effects of extrinsic transretinal direct current on the ERG in a localized retinal area were examined in the excised opened eye of the bullfrog. The vitreous humor was removed as thoroughly as possible, and recording and current electrodes were placed each other in close vicinity on the retinal surface, so that a relatively small amount of current, often less than 5 μ A, was sufficient to produce enough current density within the small retinal area around the electrode tips, and hence, to observe the remarkable effects of current on the ERG. With the vitreous side as cathode the transretinal current enhanced b- and d-waves, while with the current of opposite direction, the retina responded with a negative wave both at onset and offset of each light stimulus and showed no positive wave. Depending upon the current intensity, both negative waves became much larger in amplitude than the a-wave of the control response. Nature of these negative waves remains open for further study. The transretinal current was found also to leave some effects on the ERG after cessation of flowing: the current of vitreous-negative direction made the ERG amplitude smaller and that of vitreous-positive direction made it larger than the control before current, but neither left any substantial change in the main features of the ERG. These after-effects subsided gradually with time.

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FAST AND SLOW CORTICO-GENICULATE PROJECTION SYSTEMS AND EFFECTS OF MONOCULAR VISUAL DEPRIVATION. T. TSUMOTO, K. SUDA, Dept. of Physiol., Kanazawa Univ. Fac. of Med., Takara-machi KANAZAWA

Using Nembutal-anesthetized cats, striate cortical neurons projecting to the dorsal lateral geniculate nucleus (LGN) were identified on the basis of antidromic responses to electrical stimulation of LGN and the optic radiation (OR). Conduction velocities of their axons were estimated from differences in response latency between the both stimulations.

In 5 normal, adult cats, conduction velocities of 27 cells ranged from 5.0 to 24 with the mean at 15 ± 5.9 (S.D.) m/sec, whereas those of the other 6 from 0.3 to 1.9 at 0.9 ± 0.7 m/sec. Most of the former (fast cells) had large receptive fields (RF) classified as complex, while 4 of the latter (slow cells) were not visually driven and the other 2 had small RFs of simple type. Spontaneous firing rates were 4.0 ± 3.3 Hz in 16 fast cells but zero in all the slow cells. Histologically 64 % of the fast cells were found in layer VIA of the cortex, whereas 83 % of the slow cells were in layer VIB.

In 12 cats, which were monocularly deprived from 2-3 weeks to 3.5-9 months of age, the mean velocity of the total cells was slower and a sampling ratio of the slow cells higher than in 7 control cats aged within the same range. Early monocular deprivation may induce changes in the corticofugal as well as corticopetal projection systems.

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CATECHOLAMINERGIC CELLS IN THE CARP RETINA. HAYASHI, T. and NEGISHI, K. (Dept. Neurophysiol., Neuroinformation Res. Inst., Kanazawa Univ. Sch. Med., Kanazawa

Histochemical studies on catecholaminergic (CA) cells were conducted with the carp (*Cyprinus carpio*) retina. The CA cell bodies appear sparsely distributed among amacrine cells in the innermost cellular row of the inner nuclear layer (INL) and occasionally in the outer half part of the inner plexiform layer (IPL); only exceptionally are they found among ganglion cells. The fluorescent cells interspersed with amacrine cells and in the IPL send their fiber processes towards both the outer plexiform layer (OPL) and IPL; the fine fibers form dense networks in the INL and IPL. Pretreatment of the fish with intramuscular injection of reserpine (6 mg/kg; 20 hours prior to enucleation) completely depleted CA from the retina. The fluorescence of CA cells was enhanced, and the number of the visible cells was increased 2 to 5 times, by intravitreal injection of L-DOPA, dopamine (DA) and noradrenaline (20 µg, respectively; 3 hours prior to enucleation). Since benztropine prevented NA-uptake of these cells while desmethylinipramine did not interfere with it in incubation experiments with reserpine-pretreated retinas, the CA cells in the fish retina appear to be dopaminergic. Further, since an exposure of fluorescent preparations to a gas phase of HCl did not bleach the fluorescence, the endogenous CA observed is assumed to be DA.

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FOUR KINDS OF CILIARY- AND RHABDOMERIC-TYPE PHOTORECEPTOR CELLS IN *Onchidium verruculatum*. Y. Katagiri, N. Katagiri*, K. Fujimoto**, Department of Physiol., *Department of Anatomy, Tokyo Women's Medical College, Shinjuku-ku, Tokyo. ** Senshu Univ. Chiyoda-ku, Tokyo.

Electron microscopic and electrophysiological studies have revealed four kinds of photoreceptor cells in *Onchidium verruculatum* (Opisthobranchia, Gastropoda). 1) Ciliary-type cells of dorsal eye. 2) Rhabdomeric-type cells of dorsal eye (so-called lense cells). 3) Rhabdomeric-type cells of stalk eye. 4) Rhabdomeric-type cells scattered in mantle papillae (dermal photoreceptor cells). Receptor cells of stalk eye and of dermis have numerous spherical vesicles (photoc vesicles) while both-types of receptors of dorsal eye do not. Intracellular responses to light were recorded from these photoreceptor cells. Hyperpolarizing response was obtained from the ciliary-type cells and depolarizing responses from other three kinds of rhabdomeric-type cells. Both hyperpolarizing and depolarizing responses were associated with an increase in membrane conductance. Spectral sensitivities of both-types of receptors of dorsal eye were identical to a nomogram for a rhodopsin with λ_{max} at 440-460nm and other two receptors with λ_{max} at 510-520nm.

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IDENTIFICATION OF DISPLACED GANGLION CELLS IN CARP RETINA BY USING THE HORSE RADISH PEROXIDASE TECHNIQUE M. TACHIBANA, A. KANEKO. Dept. of Physiol., Keio Univ., Sch. Med., Shinjuku-ku, Tokyo

Identification of retinal ganglion and amacrine cells from response types or recording depth is unreliable, since both types of cells show similar responses and a few ganglion cells have been found displaced to the inner nuclear layer (INL). The aim of the present study is to classify the proximal neurons in the carp retina into ganglion and amacrine cells using the retrograde axonal transport of horseradish peroxidase (HRP).

The carp was anesthetized with MS-222 and HRP was injected into the tectum. Many HRP-positive cells were found 48 h after injection in the retina contralateral to the injection site. Almost all cells in the ganglion cell layer contained HRP reaction products. The density of the HRP-positive ganglion cells were about 1500 cells/mm². In the amacrine cell layer, where the cell density was about 10⁴ cells/mm², only 2.5 cells/mm² or 1/4000 cells were HRP-positive. The inner plexiform layer contained only few cell bodies (130 cells/mm²). Among these about 10 cells/mm² were HRP-positive.

The present study demonstrated that a small fraction of ganglion cells are certainly displaced to the amacrine cell layer. But their population is small and it seems safe to identify the spiking cells frequently recorded in the INL as genuine amacrine cells.

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RHODOPSIN CYCLE IN THE ISOLATED RHABDOM OF THE MANTIS SHRIMP, SQUILLA ORATORIA.
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Microspectrophotometric measurements of visual pigment of the mantis shrimp revealed the presence of two thermally stable states which were mutually photoconvertible. When the preparation was illuminated for 3 minutes with a bright orange light ($\lambda > 560$ nm), there were a absorbance fall in the region between 480 nm and about 650 nm and a rise between 400 nm and 480 nm. The effect of orange light was cancelled by the subsequent bright blue light ($\lambda < 500$ nm) illumination, and the initial absorption spectrum was restored. In the presence of 5% glutaraldehyde the rhabdoms were photobleached, and maximum absorbance changes at 540 nm were about 0.06 log units. Spectral sensitivity curve obtained from intracellular recording of the receptor potential also had maximum sensitivity at 540 nm. From these results the long-wavelength-absorbing pigment was concluded to be rhodopsin. Subtraction of the rhodopsin component from the difference spectrum obtained from the fresh rhabdom yielded the absorption spectrum of metarhodopsin with maximum absorption at 460 nm. Partial bleaching experiments revealed the isobestic point at 480 nm indicating that in the rhabdom studied only one visual pigment was present. The absorption spectrum of screening pigment was broader than that of rhodopsin, and the absorption was maximum at about 530 nm.

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NEURAL REPRESENTATION OF SPEECH PARAMETERS.

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Speech parameters are divided into two groups, which are correlated with the voice source or the vocal tract articulation, respectively. The vocal tract articulation is assumed as a time-varying resonator or filter. The speech sound can be regarded as the output of the resonator to the input excitation, which is the glottal pulse train or the random noise burst. The parametric representation of the vocal tract characteristic was investigated on the auditory response of the inferior colliculus to the human speech or synthetic speech-like sound. The formants were simulated by a set of band-pass filters. The output of the band-pass filter to a pulse train input was used as a simulated vowel. The response of the collicular neuron was intimately related with the combination of filters. The formant combination, which is a distinctive feature of the vowel, may be neurally represented on the inferior colliculus. The band-pass filter simulation of the vocal system may be well suited to the study of the combination logic recognition.

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ADAPTATION AND DYNAMIC RESPONSE IN THE AUDITORY ORGAN

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Transmitter release from sensory hair cells was studied in the saccule of goldfish by recording excitatory postsynaptic potentials from primary afferent fibers. Spike potentials were blocked with tetrodotoxin. On stimulation with a constant sound intensity the rate of release showed a marked adaptive decline and settled at a level much lower than at the start of the sound. But the release showed brisk changes in response to alterations in the sound intensity. Namely, the transmitter output from hair cells was found to show marked dynamic responses. Since no corresponding changes were found in the amplitude of the microphonic potentials, the adaptation and dynamic response must be attributed to processes concerned with the transmitter release. Although these findings are mostly explicable from the "multicompartment model" put forward by Dr. Matsuura of Osaka City University and Myslef, some of the results requires further elucidation. Unit discharges from the mammalian cochlear nerve was reported to show dynamic changes similar to those mentioned here.

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PLASTIC CHANGES IN THE BRAIN STEM AUDITORY PATHWAYS AFTER MONOAUURAL DEPRIVATION IN THE RAT :

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Activity changes of nuclei were compared after unilateral cochlear deprivation between right and left auditory pathways by [¹⁴C]-deoxyglucose (DG) autoradiographs and by evoked potentials in the inferior colliculi (ICs). Immediately after deprivation, an asymmetry of activity in the auditory nuclei was seen, i.e., the potential in the IC contralateral to the intact ear was larger than the ipsilateral, and the uptakes of DG were dominant in the ipsilateral cochlear nucleus (iCN), the contralateral superior olivary complex (cSO) as well as the contralateral IC (cIC). The uptakes were improved in iLSO, iMSO, and iIC 7 and 23 days after deprivation, while not in cCN. Deprivation caused disappearance of the first positive peak of the potential in iIC and decrease in the succeeding second positive peak and negative wave, while those of cIC changed little. Seven to 14 days after deprivation, a positive component appeared with a latency longer than that of the disappeared peak by 0.4 msec, and the negative wave of iIC increased. These results suggest the plasticity in the pathways via iLSO and iMSO to iIC 1 to 2 weeks after deprivation.

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RESPONSES OF AUDITORY CORTEX NEURONS TO THE RESTRICTED BAND OF NOISE

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As reported previously, most of auditory cortex neurons exhibited sustained responses to the restricted band of noise of AM type (:AM-BN; where amplitude fluctuates in a random way) in cats paralyzed with flaxedil under an artificial respiration. On the basis of best bandwidth (B.B.W.), these neurons were divided into 3 types; N type (B.B.W. < 50 Hz), M type (B.B.W. $\approx$ 180 Hz) and W type (B.B.W. > 1000 Hz). In the present experiments, the AM-BN and the FM-BN where frequency fluctuates in a random way were used as the stimulus sound. In almost all cases, the B.B.W. was not different between AM-BN and FM-BN stimuli. N type units, firings of which seemed to correlate with an amplitude change of AM-BN, responded well to FM-BN even though it has no amplitude change. In some of M type and W type units, AM-BN and FM-BN produced nearly the same effect, while in the others the effective bandwidth and the effective center frequency were more restricted for FM-BN than for AM-BN. These results suggest that for the response of auditory cortex neurons characters in frequency domain of stimulus sound are more important than those in time domain.

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RESPONSES OF TOAD AMPHIBIAN PAPILLA NERVE FIBERS TO SINGLE CYCLE SINE WAVE STIMULI. OOYAMA, H., SUGAI, T. and YANO, J. Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa

In more than half of amphibian papilla units in the toad (*Bufo bufo japonicus*), at 200-600Hz higher than their characteristic frequencies (CF's), thresholds for tone bursts are 6-10dB higher than those for single cycle sine wave stimuli with corresponding frequencies. In this type of units, effects of paired single cycle sine wave stimuli were studied. At the above mentioned frequencies the second stimulus, when consecutively applied to the first stimulus, is very effective in suppressing the response for the first stimulus. The duration of this suppression by the second stimulus is short, 0.4-0.5msec long. This might indicate the set-in of peripheral inhibition by the second stimulus.

At the CF, firing probability for the second stimulus oscillates after an application of the first single wave stimulus, and this oscillation dies out gradually within several cycles. The period of the oscillation approximately corresponds to the CF of the unit. This may indicate the actual presence of a mechanical damping oscillation at the hair cell level with a frequency similar to the CF of the unit.

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FURTHER EVIDENCE OF ULTRASONIC COMMUNICATION AMONG RODENTS: COCHLEAR MICROPHONICS THROUGH ULTRASONIC STIMULATION. K. KAMEDA, T. KAMADA and N. YONEZAWA Department of

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Ultrasonic emission among several species of rodents had been studied previously (Kamada, *Jap. J. oral Biol.*, 1978). We will report here about ultrasonic reception using cochlear microphonics as an indicator of audibility. Mongolian gerbil (*Meriones unguiculatus*) was used because of its easy accessibility to inner ear structures. Threshold curves showed that the most sensitive frequency range was 2 - 8 kHz, and upper audible limit was over 30 kHz. When the frequency was higher, the directional sensitivity difference was greater and effects of auricle more remarkable. Tones of 30 kHz or more, which were usually emitted by this species, would be useful for short range signalling than long range because of sharp directional sensitivity and poor audibility.

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ALTERATION IN CM FROM NONLINEAR TO LINEAR RESPONSE BY TRAUMATIZING TONE
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CM input-output functions in guinea pigs were measured simultaneously in two positions with intracochlear electrodes. The following results are those obtained in apical-side position corresponding to 13-14 KHz tone as to the maximum of BM vibratory pattern. Measurements for several frequencies between 10 and 20 KHz were made for fundamentals by using a band-pass filter (B & K 2107) before and after exposure to a 13 KHz traumatizing tone. In 17 KHz for example, remarkable nonlinear functions before exposure to the traumatizing tone altered to the linear after the exposure as compared in a range of sound-pressure level. Also, in the pre-trauma functions there were shown remarkable hystereses, while in the post-trauma functions were found less hystereses. The above phenomena, which are not to be explained from any non-mechanical process, suggest the occurrence of alteration from entropy- to energy-spring in an elastic polymer substance of the cochlear partition. The alteration should be possible by the oriented crystallization under a large extension of the substance.

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DIFFERENCES OF THE LATENCIES OF AMPHIBIAN PAPILLA NERVE UNITS TO THE PHASE OF CLICK STIMULI BETWEEN TWO SPECIES, BULLFROG AND TOAD. YANO, J., OYAMA, H. and SUGAI, T.
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In the amphibian papilla (AP) of the bullfrog, latencies for click stimulation are shorter for rarefaction than for compression, in fibers with a low characteristic frequency (CF). The reverse is true in those with a high CF. In the toad, the above relations, between the CF's and the latencies for compression and rarefaction, are absent. For high CF units, the difference between latencies for compression and rarefaction is larger in the toad than in bullfrog. The possibility that these differences might come from ciliary orientation of hair cells being suspected, a comparative study of the AP maculae of the two species was carried out with a scanning electron microscope. In the bullfrog anterior macula, hair cells are polarized in two directions, anterolateral and posteromedial. In the posterior macula, orientations are multi-directional. Cells with similar orientations are grouped in a mosaic pattern. In the toad anterior macula, orientations are also multi-directional, and cells are grouped in a mosaic. In the posterior macula, two groups of hair cells, with polarities opposite to each other and tangential to the macular margin, are arranged in two bands along the posterior macula. Morphological results seem to explain the differences of latencies of AP nerve units between two species and also to suggest tonotopic organization of the AP.

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CYCLIC AMP, CATECHOLAMINES AND TASTE RECEPTION. Y. KASAHARA AND K. SHIMOTAHIRA. Dep. of Oral Physiol., Kagoshima Univ. Sch. Dent., Kagoshima

Previous studies in our laboratory have demonstrated a possible role of cyclic AMP in receptive process in the taste cell. This study was undertaken to clarify cyclic AMP's function in the taste cell. Intravenous application of norepinephrine (40 µg/kg) increased summated response of the chorda tympani to four basic taste stimuli and the response reached 120% of control within 15-30 min. while epinephrine did not show any effect. This effect of norepinephrine was almost the same as that of cyclic AMP. Tyramine causes rapid liberation of all catecholamine and behave as if it was α -blocker in result of displacement of norepinephrine. Tyramine (7 mg/kg) inhibit the summated response to taste stimuli and the response reached 80% of control within 10-15 min. The effect of cyclic AMP on taste receptive process was also vanished by preceding application of tyramine. On the other hand, propranolol (1 mg/kg) which was β -blocker had not any effect on summated response of the chorda tympani to taste stimuli. These drugs had naturally systemic actions (i.e. blood pressure etc.), but these actions were very transient as far as doses used in this experiment and systemic effects disappeared within 5 min. From the result of this experiment, it is indicated that cyclic AMP and α -adrenergic agents, i.e. norepinephrine, may have close connection with the receptive process in the taste cell. The transmitter released from the taste receptor might be norepinephrine.

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BINDING OF ^{35}S -SACCHARIN TO PROTEIN EXTRACTED FROM RAT TONGUE EPITHELIA
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Rat tongue epithelia, homogenized in 0.1M phosphate buffer, was centrifuged at 105,000xg for 60 min. Three $(\text{NH}_4)_2\text{SO}_4$ fractions (0-40, 40-60, 60-80% sat.) each were obtained from the supernatant, and from the sediment, treated with buffer containing 1% Triton X-100. Binding of ^{35}S -saccharin to each of six $(\text{NH}_4)_2\text{SO}_4$ fractions was studied by using equilibrium dialysis and gel-filtration with Sephadex G-100. Marked binding of ^{35}S -saccharin to 40-60% sat. $(\text{NH}_4)_2\text{SO}_4$ fraction, extracted with buffer, and to 0-40% sat. $(\text{NH}_4)_2\text{SO}_4$ fraction, extracted with 1% Triton X-100 was observed. The binding to the former fraction was displaced by 10mM saccharin to about 20% of the control, while that to the latter was reduced to 80-90%. When the 40-60% sat. fraction together with ^{35}S -saccharin was subjected to gel-filtration, a high radioactivity appeared at the effluent, which showed the maximum of the eluted protein. The binding of ^{35}S -saccharin was also displaced to about 50% by the addition of 30mM saccharin Na. The protein specifically binding to saccharin appears to possess a m.w. of 160,000, and to be the same as that binding to sugars.

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STRUCTURE AND FUNCTION OF ENCAPSULATED ENDINGS IN CAT'S ORAL MUCOSA
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Encapsulated endings, Merkel cell-neurite complexes, Ruffini-type endings and free nerve endings are present in the cat's oral mucosa. Of these, the endings chosen as the objects of the investigation are encapsulated endings. Sixteen hundred and nine endings in the cat's oral mucosa were divided into five groups according to the behaviour of axon and inner core. The first group are simple encapsulated endings, the second those with branching of the axon, the third those with divided corpuscles, the fourth rosary-like endings and the last coiled terminals.

Although there is a great variation in the morphological feature of the encapsulated endings, all of them manifest phasic response to ramp mechanical stimulation and no response to cooling and warming. The identification techniques of these receptors used in this study consist of the localization of the receptors with stimulating bar, 300 µm in tip diameter, on the mucosa and staining of the whole thickness preparation with methylene blue. The exact morphological identification of 188 rapidly adapting encapsulated endings were possible by this technique.

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RESPONSES OF THE MINNOW PALATINE NERVE TO AMINO ACIDS AND 5'-RIBONUCLEOTIDES. YAMASHITA, S. AND KIYOHARA, S. Biol. Inst., Lib. Arts Col., Kagoshima Univ., Kagoshima

Responses of minnow palatal chemoreceptors to a variety of amino acids, peptides and 5'-ribonucleotides were recorded from the palatine nerve by using an electric summator. Minnow palatal chemoreceptors responded all the stimuli tested. Of 18 amino acids the highest sensitivity was caused by L-proline for which the threshold concentration was estimated below 10^{-9} M and there existed an approximately linear relation between log concentration and the magnitude of response through an intermediate concentration range, although the magnitude of response showed a tendency to deviate from the straight line at very high or low concentrations. The effectiveness of L-amino acids was greater than that of their corresponding D-isomers and responses to peptides were, in general, smaller than the algebraic sum of responses to their constituent amino acids. The threshold concentration for 5'-ribonucleotides lay between 10^{-6} and 10^{-5} M and a linear stimulus-response relation was observed over all the concentrations examined. These results suggested the extremely high sensitivity and the broad responsiveness of minnow palatal chemoreceptors.

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EVOKED POTENTIALS IN THE MEDULLA OBLONGATA FOLLOWING STIMULATION OF THE GLOSSOPHARYNGEAL (IXth) NERVE IN FROGS. T. HANAMORI, N. ISHIKO. Dep. of Physiol., Miyazaki Med. Coll., Miyazaki

The bulbar distribution of field potentials evoked by electrical stimulation of the bullfrog's IXth nerve was studied by recording the potentials from the dorsal surface and from inside of the medulla oblongata while monitoring afferent spikes in the peripheral nerve. At suprathreshold stimulation of the nerve, each evoked potential consisted of two presynaptic deflections (S_1 and S_2) and 4 negative waves of postsynaptic origin. The peak latency of the latter waves, N_1 , N_2 , N_3 and N_4 , were found to be 5, 8, 30 and 80 msec, respectively. By lowering the stimulus strength to the threshold for mechanoreceptor afferents only S_1 followed by N_1 was produced, the latter wave being distributed mostly along the ipsilateral longitudinal surface with the maximal amplitude at 1-2 mm rostral to the obex and 0.5-1 mm lateral from the midline. Impulses in high-threshold afferents were responsible for S_2 and N_2 . The surface distribution of N_2 was found similar to that of N_1 but the intramedullary location of the maximal negativity for the latter and former was found at 900 and 500 μ m in depth, respectively.

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GUM HARDNESS DISCRIMINATION AND BITING FORCE. M. TAKAFUJI, M. WATANABE, K. KARITA*. Dep. of Prosthet. Dent., Tohoku Univ. Sch. of Dent., Dep. of Physiol., Tohoku Univ. Sch. of Dent., Sendai

Gum hardness discrimination ability of ten young subjects was tested. One test piece of 10mm in thickness was placed between the upper and the lower incisors, alternating with test pieces of five different gum hardness. Biting forces were electrically measured with strain gauge during the tests. The subjects were asked to assess whether a test piece was felt same, harder or softer compared with reference piece. One process contained 50 trials. Number of misestimates, biting forces and standard deviations of the biting forces (SD) were compared between with and without the local anaesthesia of periodontal ligament (PL) in order to investigate the mechanism of hardness discrimination. Furthermore, same experiment was tested with pieces of 40mm in thickness. The results were as follows: (1) The number of misestimates and biting forces were increased not only with anaesthesia of PL but also by changing mouth opening degree from 10mm to 40mm. (2) SD was remarkably increased only with anaesthesia of PL. (3) There was close correlation between biting forces and misestimates at 10mm test pieces. These results suggested that PL functioned to maintain biting forces regularly and was essential to the hardness discrimination.

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TEMPORAL PATTERNS OF THE GUSTATORY IMPULSE TRAINS WITH CHANGE IN STIMULUS CONCENTRATION.

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Impulse discharges of rat chorda tympani nerve fibers in response to gustatory stimulation were recorded. Stochastic properties of the impulse trains were studied by computing an interspike interval histogram, a joint interval histogram, a serial correlogram and an autocorrelogram with special reference to the relationship between the temporal patterns of impulse discharges and the stimulus concentration. In NaCl and saccharin stimulation, the pattern of the interspike interval histogram generally changed from the exponential to the gamma distribution with increase in the stimulus concentration, while the impulse trains were assumed to be stochastically independent irrespective to the stimulus concentration. Rhythmic burstlike firing of the impulses was elicited in some units by KCl stimulation at a certain concentration.

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SYNERGISM AMONG SUGARS IN A *DROSOPHILA* TASTE RECEPTOR CELL. K. ISONO, Y. TSUKAHARA. Research Center for Applied Information Sciences, Tohoku Univ. Katahira-cho Sendai

Effect of simultaneous two sugar stimulation was studied in the labellar chemosensory hair of *Drosophila melanogaster* for various sugar combinations. For certain combinations the magnitude of response considerably exceeded the expected value of simple addition. The enhancement was characterized as follows:

- (1) The magnitude of enhancement was dependent on the total sugar concentration of the mixture.
- (2) The optimum concentration ratio of two sugars was different for each sugar combination.

Expected behaviour of a receptor model which contains two specific sites of binding for different sugars fits quantitatively to these observations while another model of a single non-specific site with different affinity to each sugar does not. It is also suggested that the synergism is not simply caused by increased number of the activated sites.

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INFLUENCE OF EXPERIENCE OF SUCROSE INTAKE ON GUSTATORY NERVE RESPONSES OF DEVELOPING RATS TO FOUR BASIC TASTE STIMULI.

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The influence of experience of sucrose intake on the developmental change in the taste sensitivity of rats was studied in three periods of time from the 17th to 22nd, the 24th to 29th and the 45th to 50th postnatal day by recording the impulses of the chorda tympani nerve to taste stimulation with sucrose, NaCl, HCl and quinine hydrochloride (Q-HCl). A half of pups of each litter were applied a filter paper soaked with 40% sucrose solution to the tongue during preweaning periods of 2-22 days, and during 23-43 days after weaning they further drank 40% sucrose solution and deionized water available ad lib from two bottles. The control half were given only water by the same methods before and after weaning. The results obtained were as follows: (1) In the test groups which were subjected to sucrose, gustatory neural response to sucrose became larger than the control groups, but no significant difference in threshold was found between the two groups. (2) Neural responses to the other three stimuli (NaCl, HCl, Q-HCl) did not change significantly between the two groups.

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EFFECT OF ADAPTING SOLUTION ON RESPONSE OF FROG GUSTATORY NERVE FIBER TO QUININE.

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Change in gustatory nerve fiber response in first 1 sec to 1 mM Q-HCl was investigated after the bullfrog tongue was adapted to 0.5 M NaCl, 10 mM caffeine, 0.5 M sucrose and 1 mM acetic acid for 10 sec. A fungiform papilla was drawn into a suction electrode and antidromic impulses conducted from neurally connected papillae were recorded during taste stimulation. After an adapting solution the response of single units to Q-HCl decreased, increased or unchanged in comparison with the control response after water. The percentage of units showing decrease and increase in response to Q-HCl after NaCl, caffeine, sucrose and acetic acid were, respectively, 48 and 17, 44 and 21, 31 and 14, and 34 and 29. The difference in number of impulses to Q-HCl, which was obtained by subtracting impulses after water from impulses after adapting solution, was -2.9 ± 1.1 (the mean $\pm$ S.E., $n = 54$) after NaCl, -2.3 ± 0.7 ($n = 61$) after caffeine, -1.4 ± 0.6 ($n = 91$) after sucrose and -0.1 ± 0.6 ($n = 85$) after acetic acid. The decrease and increase of Q-HCl response after taste adaptation can be explained mainly by similarity of receptor sites to adapting and Q-HCl stimuli and chemical modification of receptor site to Q-HCl with an adapting solution.

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PROPERTIES OF FUNGIFORM PAPILLAE UNDER DUAL INNERVATION. N. MURAYAMA,

N. ISHIKO. Dep. of Physiol., Miyazaki Med. Coll., Miyazaki

Fungiform papillae in the frog tongue receive sensory fibers from the medial or from the lateral branches, or from the both of the glossopharyngeal nerve. Of 320 single papillae of the last type studied, the majority were distributed within overlapped zone between the lateral and medial branch fields. Responses of individual papillae to electrical, mechanical and gustatory stimuli were studied by recording afferent impulses from the two branches, simultaneously. Most of single papillae were found to receive two mechanosensitive fibers of one fast and one slow adapting type. Of all the papillae, each of which received a salt-sensitive fiber from one of the two branches, only 7% was supplied by the same modality of fibers, 28% by quinine-sensitive fibers and 42% without innervation by gustatory fibers from the other branch. Antidromic stimulation of one of the branches at a rate of 100Hz for 30sec resulted in a period of depression of taste responses recorded from the other branches, indicating inhibitory interaction between the lateral and medial branch fibers which supply a single papilla.

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RESPONSIVENESS OF THE RAT CHORDA TYMPANI FIBERS TO DIFFERENT RATES OF RISE OF CURRENT STIMULATION APPLIED ON THE TONGUE

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Responses of the rat chorda tympani fibers were obtained to stimulation of the tongue with linearly rising anodal current of varying rate of rise, cathodal current and 4 chemical solutions (NaCl, tartaric acid, sucrose, QHCl). The relationship between the frequency of the dynamic phase of the response and the rate of current rise was fitted to a power function in 32 out of 43 fibers. Exponents of power function were different among 4 different fiber groups. Mean exponent of NaCl group to which fibers predominantly responded to NaCl belonged was 0.90 ± 0.16 ($n=19$), those of tartaric acid group, sucrose group and QHCl group were 0.68 ± 0.08 ($n=8$), 0.35 ± 0.07 ($n=2$) and 0.45 ± 0.15 ($n=3$) respectively. Other 6 fibers tonically responded to the current stimulation were well sensitive to sucrose. Remained 5 fibers responded to cathodal stimulation were well sensitive to QHCl.

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RESPONSES OF THE CHORDA TYMPANI FIBERS AND CORTICAL TASTE CELLS TO D.C. ANODAL STIMULATION OF THE TONGUE IN RATS. T. YAMAMOTO. Dep. of Oral Physiol., Osaka Univ. Dental Sch., Kita-ku, Osaka

Response characteristics of the first-order taste neuron (chorda tympani: CT) were compared with those of the final cortical taste cells in response to D.C. anodal electrical stimulation of the tongue surface. The mean onset latency of evoked responses decreased from 53 to 23 msec in the CT and from 63 to 38 msec in the cortical cells with increasing the stimulus intensity. Both evoked responses of the CT and cortical taste cells followed Stevens' power function with stimulus intensity; the exponent of the function was 0.47. Single unit responses to electrical stimulation were significantly correlated to those to NaCl and cold (5°C) water stimulations at both CT and cortical levels. Weak electrical stimulation with a fine wire electrode revealed that the receptive field innervated by single CT fibers was narrow and contained about 5 fungiform papillae, while that by single cortical cells was larger and in some cases it extended to the contralateral side of the tongue.

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DEVELOPMENTAL CHANGE OF TASTE ORGANS OF XENOPUS AND BULLFROG DURING METAMORPHOSIS

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Developmental change of taste organs in oral cavity of frog during metamorphosis were investigated. Fungiform papillae of bullfrog tadpole were fully differentiated at late metamorphic stage, investigating with scanning electron microscopy. Taste responses to 1 M sucrose and 0.01 M quinine hydrochloride were recorded from the glossopharyngeal nerve. Taste responses to 0.02 M ammonium chloride in addition to the above solutions were observed at early metamorphic stage. At early metamorphic stage, pre-metamorphic papillae were observed in oral cavity, though fungiform papillae were not. Scanning electron microscopic observation on the premetamorphic papillae also indicates that the premetamorphic papillae play as chemoreceptor organs in the tadpole. In Xenopus tadpole, taste organs similar to fungiform papillae of bullfrog appeared in oral cavity at late metamorphic stage. At early metamorphic stage, many small mounds in oral cavity were observed, but at now it is not clear whether they are premetamorphic papillae or anlage of fungiform papillae.

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PROPERTIES OF UNITS RESPONDED TO CANINE MECHANICAL STIMULATION IN CAT SI SOMATOSENSORY CORTEX. T. TABATA, M. WATANABE*, Y. MUNAKATA*, K. KARITA. Dep. of Physiol., Tohoku Univ. Sch. of Dent., * Dep. of Prosthet. Dent., Tohoku Univ. Sch. of Dent., Sendai

Single unit responses in SI somatosensory cortex to the mechanical stimulation of maxillary canine (CM-ST) were recorded in the cat anaesthetized with urethane-chloralose and immobilized with gallamine triethiodide. 1. Many of the units were elicited by the face tactile stimulation (FT-ST) and/or the transient mouth opening (TMO). 2. Units in the anterolateral part of coronal gyrus were activated by CM-ST, FT-ST and/or TMO. The receptive fields of these units recorded near the cortical surface were in contralateral half of face and some other teeth, and units in the deep portion of cortex had receptive fields in both sides of face and all of teeth. On the other hand, units in the posterolateral part of coronal gyrus responded to FT-ST and/or TMO, but not to CM-ST. 3. All units showed transient responses to CM-ST, firing at the start and/or the end of CM-ST. ON type, ON-OFF type and OFF type in proportion were 58.8%, 39% and 1.5%, respectively. 4. Proceeding TMO suppressed ON responses to CM-ST in about a half of units, but inhibited OFF responses in all units.

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QUANTITATIVE ESTIMATION OF DIVALENT CATIONS ACCUMULATED WITHIN THE AESTHETASC HAIRS OF THE CRAYFISH.

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It has been reported that the inner lumen of the crayfish aesthetasc hairs on the external flagellum of the first antenna is filled with materials containing calcium and magnesium which were clearly stained by various histochemical methods. The histochemical coloration of these spots were measured with a microscopic spectrophotometer, and analyzed with an application of the chromaticity co-ordinate system. Their stained spots were distributed at the zone where the dendritic twigs of the sensory cells were present. The calcium concentration is observed at two different spots, one at the margin of the basal segment and the another at the lower portion of the middle segment. The concentration at the former spot ranged from 70 to 140 mM, while the another showed higher concentration level. The magnesium concentration at the base of the basal portion ranged from 1 to 5 mM. The amount of calcium is changed according to the acclimatization to various salinity concentrations.

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Water and odorant responses of the frog olfactory epithelium (II) Arito, H. and Takagi, S.F.* (Nat. Inst. Ind. Health and Dept. of Physiol., Sch. of Med., Gunma Univ.*)

The water and odorant responses were recorded extracellularly from olfactory bulb neurons of the frog, when the ipsilateral olfactory epithelia were stimulated with distilled water and 1.5 mM and 15 mM ethyl n-butyrate (ENB) solutions which were dissolved in an isotonic NaCl solution. 1) Response types of 50 neurons to the ENB solutions were composed mainly of facilitation, inhibition and no response, whereas those of the same 50 neurons to water were composed mainly of facilitation including delayed-facilitation. 2) The neurons showing facilitatory response to 1.5 mM ENB were localized in the anterior and central regions of the bulb, whereas those showing no response were localized in the other regions. The neurons showing facilitatory and delayed-facilitatory responses to water were widely distributed over the entire regions. 3) The responses to water tended to continue longer than those to the ENB solutions. The facilitatory responses to the ENB solutions were shorter in duration than the inhibitory ones. 4) The water response was selectively blocked by treatment of the olfactory epithelium with 20 mM uranyl ions, whereas the odorant response was selectively blocked by 0.5 mM PCMB.

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ON THE IMPORTANCE OF ODOR DILUTION AND DELIVERY METHODS IN THE PSYCHOPHYSIOLOGICAL STUDIES. R. MAEZAWA AND F. MOTOKIZAWA. Dept. of Physiol., Nara Medical College, Kashihara, Nara

In the ideal solution it is generally hold true that the partial vapor pressure of a solute in the head space above a solution is directly proportional to a concentration of the solution. We examined this by indirectly measuring partial vapor pressures at various concentrations of an odorant solution with the aid of gas chromatography. Odor substances used were acetone, benzaldehyde, benzene, iso-butanol, 1,2-dichloroethane, methyl acetate, 1-propanol and pyridine. These were diluted by an odorless mineral oil. The linear relationship between log concentrations of an odorant solution and partial vapor pressures of the odorant was not obtained for all of the substances tested. Next, in 21 students threshold concentrations to detect odor were compared in two methods. One is the open method in which the subject sniffs odor from a filtration paper containing gradedly diluted odorant solution, the other is the closed method in which the subject sniffs odor from an odor bag filled with odorant vapor diluted by pure air. The threshold concentration was not the same but lower in the latter than in the former in the majority of the subjects. It is concluded that, in the solvent dilution method, in which odorants were diluted by liquid solvents, the concentration of the odorant in the vapor can not always be expressed by the concentration of the odorant in the solution.

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FACIAL CUTANEOUS CHEMORECEPTION IN THE CARP, T. MARUI, K. KAWAKITA AND M. FUNAKOSHI, Dep. of Oral Physiol., Gifu College of Dentistry, Hozumi, Motosu, Gifu

The electrical responses of the external chemoreceptors in the carp were recorded during application of various chemical solutions. The integrated responses from the whole nerve of the ramus buccalis to chemical and mechanical stimulations revealed that those might be caused by canal and pit organs on the cheek, and those of the ramus mandibularis and maxillaris of the trigemino-facial complex nerve by the cutaneous taste buds. The single fiber analysis was performed for 62 preparations of these two branches (the communis root). Twenty-five of them (40.3 %) responded well to salt and acid, and ten (16.1 %) were found to be excited by sucrose. Only 2 preparations of them (3.2 %) showed inhibitory responses to quinine-HCl. Twelve single unitary discharges were recorded from the anterior lateral line nerves, which responded well to salt and acid, but none of them to sucrose. The threshold for NaCl was about 0.005 M and for acetic acid or tartaric acid about 0.00002 M. In the communis, the threshold for the former was about 0.01 M and for the latter about 0.001 M. On the responses to amino acids, the communis fibers responded to proline, alanine, arginine and glycine. On the other hand, anterior lateral line nerves responded well to glutamic acid and aspartic acid.

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EFFECTS OF DEUTERIUM OXIDE ON THE LATERAL-LINE ORGAN. K. SHIOZAWA, E. YAMADA, and K. YANAGISAWA. Dept. of Physiol., Tsurumi Univ. Sch. of Dent. Med.

Effects of deuterium oxide (D₂O) on the sensory organ have not been well understood. Using a mudpuppy (Necturus maculosus), the effect of D₂O on the lateral-line organ was studied. The free neuromast of the mudpuppy has dual functions, chemoreception and mechanoreception. Using suction electrode, afferent spikes were recorded from a neuromast and various stimuli were applied to other neuromasts in the same stitch. The number of afferent spikes was increased by application of D₂O to the surface of this organ. The threshold concentration of D₂O was about 60% (v/v) and the effect was enhanced with increasing D₂O concentration. Comparing each response to Na⁺, K⁺ and Ca²⁺ dissolved in D₂O with those in H₂O, responses to cations in D₂O were larger than those in H₂O. However, subtracting the amount of response of D₂O itself from above responses in D₂O, net effects of Na⁺, K⁺ and Ca²⁺ were almost the same in two solvents. The suppressive effect of divalent cations on the stimulating effect of monovalent cations was also seen in D₂O as in H₂O. The effect of D₂O on synchronization, probability for the occurrence of afferent spikes related to the stimulus phase during mechanical stimulation, was suppressive. This suppressive effect on the mechano-sensitivity depended on D₂O concentration.

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RESPONSIVENESS OF CUTANEOUS MECHANORECEPTORS TO SINUSOIDAL STIMULATION IN FROGS. H. OGAWA AND K. MORIMOTO. Dept. of Physiol., Kumamoto Univ. Med.Sch., Honjo, Kumamoto

A total of 86 mechanoreceptor afferent units, with fast conducting axons in the sciatic nerve innervating the foot, were isolated in anesthetized American bullfrogs, Rana catesbeiana in situ.

Twenty-five very rapidly adapting units (vRA), 35 less rapidly adapting units (lRA), and 26 slowly adapting units (SA) were differentiated from each other, according to the presence of discharges in the SA units during steady indentation of the skin in the receptive field, and the characteristic tuning curves in the RA units. The SA units showed a few sensitive spots localized at skin warts in the receptive field. The conduction velocity of the vRA units ranged from 15.0 to 23.6 m/s, the fastest of the three groups, and those of the lRA and SA units were from 8.8 to 17.5 m/s and from 10.0 to 14.9 m/s respectively. The vRA units responded to a single sine cycle of 10 to 100 Hz but could not follow a continuous sinusoidal indentation of any frequency. The lRA units showed their best tuning frequency at 1 to 10 Hz and SA units at 0.1 to 1 Hz. Cycle histograms showed phase-locked discharges in the lRA units.

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THE SITE OF ORIGIN OF CALCIUM SPIKES IN FROG MUSCLE SPINDLE. ITO, F.,
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Calcium spikes were found at the afferent nerve terminal of isolated frog muscle spindles during stretching at high velocity in Ringer solution with TTX. The responses at the nerve terminal were recorded across an air-gap made upon the myelinated segment of the sensory axon just outside the capsule.

The amplitude of the calcium spikes depends upon the concentration of external calcium from 1 to 10 mM. Removal of Ca^{2+} from the Ringer or administration of EGTA decayed the amplitude and finally removed the spikes. The calcium spikes were reversibly blocked by addition of 5 mM Co^{2+} or Mn^{2+} , or of 15 mM Mg^{2+} . Strontium and barium were able to substitute for calcium as a current carrier in calcium spikes for muscle spindle. The calcium spikes could be also elicited by depolarizing current stimulations over 3.5 nA in TTX Ringer. It is suggested that the calcium spikes may be initiated in the vicinity of the site for generating receptor potential and that the spike may play an important role for producing afferent impulses (sodium spikes).

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The effects of D_2O and low temperature on the stretch receptor of the crayfish.
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A total substitution of D_2O for H_2O in the Harreveld solution reversibly decreased the amplitude of the receptor potential recorded from the stretch receptor neuron of the crayfish to 34% (the amplitude was measured at 1 sec from the onset of the stretch). Noticeable changes in the resting potential, the input resistance and the input capacity were not observed. The visco-elastic property of the receptor muscle was not altered. On the other hand, lowering the temperature of the bathing solution from 25°C to 5°C did not decrease the amplitude of the receptor potential but increased the input resistance by two fold. This indicates that when the temperature was lowered, the receptor current was reduced. The increase in the input resistance compensated for it and kept the amplitude of the receptor potential constant. The compensation mechanism of the resistance increase is considered to be the cellular basis for the relative insensitiveness of the transduction process of the stretch receptor to the temperature changes.

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DIFFERENT PATTERNS OF RESPONSE IN THE MUSCULAR AFFERENT NERVE FIBERS OF THE JAW OPENERS: WITH REFERENCE TO THE FUNCTIONAL TYPE OF THEIR RECEPTORS. T. SUMI, S. HANAI.
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In anesthetized adult rabbits, the afferent activities of functionally single units dissected from the mylohyoid nerve bundle were analysed. Twenty five units were found to be muscular origin from the responses to stretch of either the mylohyoid or the digastric muscle.

Responding to a steady continuous stretch, 11 units were slowly adapting, 6 rapidly adapting, and 8 unclear. Nine units discharged multiple impulses at rising phase of contraction, 4 at falling phase, and 12 showed unclear responses. When the muscle was stretched in advance, a continuous discharge ensued thereby ceased completely at rising phase of contraction only in the units that discharged at the falling phase. In 4 out of 11 slowly adapting units, a high frequency discharge of impulses, reaching 200 Hz at the maximum, were elicited by intra-carotid injection of succinylcholine (Sch). The minimum dose capable of eliciting the enhancement of the activity was 250 g, and the maximum discharge frequency and the duration of the enhancement depended on the amount of Sch.

From the features of the response of the sensory units, it may be concluded that at least two types of receptors can be differentiated in the jaw opening muscles.

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RESPONSES OF SNAKE LONG CAPSULE MUSCLE SPINDLES TO MOTOR STIMULATION AT LONG INTERVALS. M. ICHIKI. Dept. of Physiol., Mie Univ. Sch. Med., Tsu, Mie

The intrafusal fiber of long capsule spindles in snakes has twitch contraction and little 'tonic' unit action on the afferent discharges from the spindles was observed (Cliff & Ridge, 1973). In this study, it is shown that indirect stimulation with paired stimuli to the intrafusal fibers at intervals between 80-160msec. can cause the increase of afferent discharges from single long capsule spindles of the snake, Elaphe quadrigata, suggesting slow contraction of the intrafusal fibers or 'tonic' motor unit activities on them. The duration of the sustained responses is markedly prolonged, sometimes for up to 1000msec. The prolonged latency at 20-60msec. interval stimuli is shortened at this interval (80-160msec.). The latency means the interval between the second stimulus and the first spike elicited. The slight increase of afferent discharges caused by stimulation at intervals between 6-16msec. and the relative shortening of the latency have been reported already. These two types of responses produced by double stimulation at various intervals may suggest different types of motor activities on the single intrafusal fiber. The diameters of the motor axons supplying grape or plate endings on the intrafusal fibers are measured and found to have a significant difference between them.

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EFFECTS OF NEMBUTAL AND ACUPUNCTURE STIMULATION ON ACTIVITY OF CENTRAL NERVOUS SYSTEM IN THE CAT

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ECOG and spontaneous discharges of thalamic ventrobasal (VB) neuron in the cat were recorded. The effects of electrical acupuncture (EA) compared with of Nembutal injection by time series analysis of power spectrum, spike firing rate and interval histograms (IIH). In control, the time history of firing rate of VB neuron has two types; stationary and exponential tendency. After EA to the appropriate points of Hoku and Tsusanli, firing rates were changed. Every VB neuron showed particular tendency; increase, decrease or stationary. In IIH probability of short interval occurrence increased in about a half neurons which observed. While after EA between peripheral receptive field and Hoku or Tsusanli, many neurons' firing rate became stationary but IIH showed little change.

Each EA methods changed ECOG and power spectrum in few cases. After Nembutal injection, it was showed that spike firing rate decreased dependent to dose. It was observed typical spindle wave in ECOG.

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RESPONSES OF CAROTID BODY TYPE I CELLS

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The carotid body and its own nerve were removed from anesthetized cat. Intracellular recordings were made under superfusion with modified mammalian saline in vitro using microelectrodes filled with either 4M potassium acetate or 6 % procion yellow. Identification of the recorded elements was made by injecting the dye through the same micropipette after having examined the responses to several chemical stimulants.

By applications of the chemical stimulants which increase afferent impulses of the nerve, long lasting (mean 13 sec) depolarization of the impaled cell was sometimes evoked. The depolarization was graded according to the increasing amount of the chemical stimulant applied and accompanied by increases of voltage fluctuations of the membrane potential. The depolarization was accompanied with a decrease of the membrane resistance, when measured by passing constant electric current through the electrode.

In some cases, hyperpolarization was evoked in the type I cells by chemical stimulants, with a increase of the membrane resistance.

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MECHANISM OF MOTION SENSITIVE TECTAL UNITS IN THE SNAKE INFRARED SENSORY SYSTEM. SHIN-ICHI TERASHIMA, RICHARD C. GORIS, Dept. of Physiol., Sch. of Med., Tokyo Med. & Dent. Univ., Bunkyo-ku, Tokyo 113

Units of the crotaline infrared sensory system recorded from the ipsilateral trigeminal ganglion and medulla, and from the contralateral tectum opticum are compared in regard to their receptive areas and response. Summation and rapid adaptation cause higher order units to have enhanced dynamic response and decrease static response. As a result, central units respond mainly to an ON-stimulus or a moving stimulus. CNS units have larger receptive areas than peripheral units, indicating convergence of peripheral input. The large receptive areas enable the units to retain a moving stimulus for a longer period of time. On the tectum there is spatiotopic organization, and there is a high degree of overlap of tectal receptive areas on the pit membrane, indicating divergence of peripheral input. The overlapping permits fine localization of a stimulus by calculation from the combination of firing units.

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AFFERENT IMPULSES FOR OVIPOSITION IN CRICKETS. III. NEURAL INFORMATION FROM TERGUM AND STERNUM BY MECHANICAL STIMULATION AND ACTIVITIES OF LATERAL OVIDUCT AND GENITAL CHAMBER. N. AI, R. OHSAKI. Dept. of Biol., Tokyo Gakugei Univ., Koganei-shi, Tokyo

Nine pairs of lateral root have been dispatched from the lateral abdominal ganglion in crickets, and the 3rd root(N3) has innervation to the lateral oviducts and its adductor muscles of genital chamber, and the 5th root(N5) innervates to the muscle bundle(MI) of ovipositor. Mechanical stimulation to ovipositor have been evoked afferent signal in the several roots, N1, N3 and N5, and this signal is mainly originated in tergum and sternum. Otherwise, by simultaneous extracellular records from lateral root and muscles, N3(adductor muscle) and N5(genital chamber) are clarified the efferent impulse for muscle contraction to movement of ovipositors. Electrical stimulation being given to each lateral root, induced muscle potentials were recorded intracellularly for the purpose of finding on the connection of afferent and efferent pathway in the ganglion. Central neurons with spontaneous activity have connection with N4, N5, N6 and N7 root.

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STUDY OF SARCOMERE LENGTH-TENSION RELATION IN SKELETAL MUSCLE ACTIVATED BY RAPID COOLING METHOD.

USUI, S. and SAKAI, T. Dept. of Physiol., Jikei Univ. Sch. of Med.

The length-tension relation of caffeine-RCC was investigated in the presence of various concentration of caffeine, and our results were compared with the schematic summary proposed by Gordon, Huxley & Julian (1966) and Ter Keurs, Iwazumi & Pollack (1978). The sarcomere lengths of the isolated toe muscle (M. ext. digiti longus IV) were measured from the first order of laser diffraction line before and after the caffeine-RCC. In some experiments, the sarcomere lengths were measured on many points along the muscle fibers. Measurements of maximum tension and rate of tension development on caffeine-RCCs were done at various points after rapid cooling at the sarcomere length from 2.2 to 3.8 μm in normal and depolarized muscles. From these experiments, we obtained the results as follows: ① In the length-maximum tension relation of caffeine-RCC, the descending line remarkably shifted to right and did not cross the zero level at the sarcomere length of 3.65 μm . On the other hand, the descending line in the length-dP/dt relation of caffeine-RCC crossed the zero level at the sarcomere length of near 3.65 μm . ② In the range of the sarcomere length from 2.2 to 3.8 μm , the efficiency of interaction between two kinds of filaments showed maximum at the sarcomere length of 2.8 μm .

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TIME-RESOLVED X-RAY DIFFRACTION OF FROG SKELETAL MUSCLE DURING ISOTONIC SHORTENING.

H. SUGI, Dept. of Physiol., Teikyo Univ. Sch. of Med., Itabashi-ku, Tokyo

Time course of change in the intensity ratio of 1,0 and 1,1 equatorial reflections ($I_{1,0}/I_{1,1}$) was studied on frog skeletal muscles during an afterloaded isotonic twitch under various loads, by means of a time-resolved X-ray diffraction technique. The intensity ratio started to decrease from the initial value of about 2.0 on stimulation, reached a minimum value during the early phase of isotonic shortening, and then returned to the initial value after the beginning of relaxation. The minimum value of the intensity ratio attained in a twitch was about 1.0 under a load of 0.02-0.03Po, and about 0.5 under a load of about 0.3Po. If it is assumed that the intensity ratio is a measure of the attached cross-bridges, the above results indicate that the number of the attached cross-bridges is smaller during isotonic shortening under a load of 0.02-0.03Po than during isometric condition, while it does not differ significantly from the isometric value during isotonic shortening under a load of about 0.3Po.

Time course of change in the transverse spacing of the 1,0 lattice showed that the isovolumic behaviour of the filament-lattice exists in isotonically shortening muscle.

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ON THE RAPID COOLING CONTRACTION OF THE FROG MUSCLE TREATED WITH 4-AMINOPYRIDINE. M. ANRAKU and S. HASHIMURA

Dep. of Physiol., Fac. of Med., Kagoshima Univ., Kagoshima

The effect of 4-aminopyridine(4-AP) on the rapid cooling contraction (RCC) was studied in the frog toe muscle. Under the presence of 4-AP the rapid cooling of the muscle induced the repetitive contraction accompanying with the action potential (AP-RCC). Starting from 0.005mM AP-RCC increased proportionately with the concentration of 4-AP and reached to the maximum at 0.3 mM staying steady up to 3 mM. The effect of 4-AP took a slow time course in either the development or the recovery. In the muscle with the destroyed T-system 4-AP was ineffective. Both of TTX and d-TC inhibited AP-RCC completely. The muscle depolarized less than 10 mV during the rapid cooling in both of 4-AP and d-TC. AP-RCC was inhibited partially by 10 mM Mg and completely by 5 mM Mn. These results suggest that 4-AP does not affect, if any, either of the sarcoplasmic reticulum or the muscle membrane, but enhances the release of ACh from the nerve ending. It is concluded that AP-RCC is resulted from the voltage sensitive Ca influx during the depolarization of the nerve ending by the rapid cooling.

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RELATIONSHIP BETWEEN CURRENT ACROSS T-SYSTEM AND ONSET OF CONTRACTION IN SKELETAL MUSCLE FIBER. T.OBA, K.HOTTA, Dep. of Physiol., Nagoya City Univ. Med. Sch., Mizuhoku, Nagoya

To clarify the role of T-system on E-C coupling, membrane current (inward and outward) was measured with a conventional two microelectrode voltage clamp technique in semitendinosus muscle fiber of bull frog (holding potential fixed at resting potential, at 4°C). Contractile force was recorded simultaneously on a polyrecorder, together with the membrane current. Initial inward current was disappeared with TTX treatment and outward with either TEA or 3,4-diaminopyridine (DAP). Late inward current sometimes developed in 100 μ M DAP containing medium and reached to its peak about 47 msec after the peak of initial inward current. The time lag from peak of the initial Na current to onset of tension development was 25.7 ± 1.7 msec (mean $\pm$ SE, n=11). This indicates that this inward current, masked by outward K current in normal Ringer solution, may play a key role on the release of activator Ca from sarcoplasmic reticulum. This suggestion was also supported from a significant prolongation of this time lag by dantrolene (31.7 ± 1.2 , n=8, $p < 0.05$).

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BIPHASIC POTASSIUM CONTRACTURE AND EXCITATION-CONTRACTION COUPLING IN EACH COMPONENT OF THE CONTRACTURE. TAKAUJI, M., TSUTSU-URA, M. AND NAGAI, T. Dept. of Physiol., Sapporo Med. College., Sapporo.

We previously examined the properties of biphasic potassium contracture (initial component and secondary component) in the frog single twitch muscle fibers and suggested that the mechanical activation process of the initial component is independent from that of the secondary component. In the present report, we further demonstrated the results which support this view: A preceding repetitive stimulation period of 1.5-2.0 min at 2 Hz inhibited mainly the secondary component. The threshold of the activation curve of the initial component (50-60 mM K) was higher than that of the secondary component (about 32 mM K) and more largely shifted to the left at 0.18 mM Ca^{++} . In addition, it was demonstrated that the biphasic time course of the inactivation (inactivation 1 and inactivation 2) of the secondary component was clearly different from that of the initial component and the rate of inactivation of the secondary component was more strongly accelerated at 0.18 mM Ca^{++} . From these results, we concluded that the activation and inactivation processes of the initial component are independent from those of the secondary component.

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ON TRANSIENT CHANGES IN ELECTRICALLY-INDUCED CONTRACTION DURING RAPID REPLACEMENT OF EXTERNAL SOLUTION IN SINGLE TWITCH FIBRE. C.ISOJIMA DEPT. of PHYSIOL., St. Marianna Univ. School of Medicine, Sugao, Kawasaki, Kanagawa External solution was diluted about 150 times within 0.4 sec. by an automatic liquid exchange system. Muscle fibre was stimulated by electric field of linearly increasing current and the relation between isometric tension and stimulating current was recorded by X-Y recorder. The time interval between the finishment of exchange of external solution and the beginning of stimulation was quantitatively changed.

Since single fibre of *Rana japonica* purchased in winter was found very difficult to isolate, a new method of isolation of single fibre whose electrical excitability is nearly equal along its whole length.

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PICROTOXIN DEPOLARIZES MUSCLE RESTING POTENTIAL IN HYPERTONIC SOLUTION.
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With the addition of 5 mM picrotoxin, resting potentials of frog (*Rana catesbiana*) sartorius muscle fibers equilibrated in hypertonic Ringer solutions slowly decreased by ca. 30 mV. About 20 min. was required for the depolarization to reach nearly steady level which retained at least for one hour. The depolarization occurred in solutions made hypertonic with sucrose, NaCl or CaCl₂, and at pH 5.6 or pH 7, although some difference was noticed with the solutions. Picrotoxin did not depolarize the fibers in isotonic Ringer solution. The results suggest that the action of picrotoxin to induce depolarization is triggered in solutions which are hypertonic. The depolarization was reversible. This infers that the action of picrotoxin is functional and not due to any damage to the fibers caused by hypertonicity. 10 μ M d-tubocurarine did not affect the depolarization, which indicates that picrotoxin acts directly on muscle component, but not via neuromuscular effect. Transfer from normal Ringer to hypertonic solutions containing picrotoxin also caused depolarization of the fibers which showed somewhat different modes.

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STRUCTURAL COMMUNICATION BETWEEN LATERALE SAC (LS) AND T-TUBULES (T).
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Electron microscopic studies using ruthenium red (RR) were done: RR was not contained in fixative; staining was not made, unless otherwise stated. Results: If surface membrane of muscle cell is damaged, LS is clearly stained with RR. Immersion of frog sartorius muscle in normal Ringer with RR shows no sign of presence of RR within cell, especially, in longitudinal tubules (LT) and LS; whereas, immersion in hypertonic Ringer with RR (condition A) produces a sign, though weak, of the presence in LT and LS. If, in this case, muscles are re-immersed in normal Ringer without RR, LS appears as a distinct, electron-dense area. The appearing does not occur, if muscles treated with glycerol are used. Supporting these behaviors of intracellular structures, some thin electron-dense communicative structures between LS, LT and T are seen, if muscles are stained under condition A. RR shifts tension-potential curve towards depolarization-side; depolarizing effect of RR is enhanced by hypertonicity and inhibited by hypotonicity ("tonicity effect" previously stated).

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THERMODYNAMICS OF Ca²⁺ BINDING TO TROPONIN-C RELATING TO THE ACTIVATION HEAT PRODUCTION OF MUSCLE. K. YAMADA. Dep. of Physiol., Medical College of Oita, P.O.Box 37, Oita 870-91

Microcalorimetric titrations have been performed to study the binding of Ca²⁺ to isolated troponin C at pH 8.4 and at different temperatures of 5°, 15° and 25°C. The enthalpy titration curves show a biphasic increase with added Ca²⁺. ΔH values in the presence of 1mM Mg are about in agreement with the values in the previous measurements at 10°C. In the presence of 1mM Mg, $-\Delta H$ values for high-affinity sites increase linearly with temperature, indicating that ΔC_p of Ca²⁺ binding to troponin-C is negative (about -0.7 kJ mol⁻¹ K⁻¹). But ΔC_p for low-affinity sites is positive. In the absence of Mg the heat production is greater than in the presence of Mg, but ΔH is no longer a linear function of temperature, indicating that the unfolding of troponin-C molecules occurs even at 5° or 25°C.

Heat of Mg²⁺ binding to troponin-C has also been studied at 15°C. The results indicate that the heat of Mg²⁺ binding cannot explain the reduction of the heat of Ca²⁺ binding to troponin-C in the presence of 1mM Mg.

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EXTENSIBILITY OF MYOFILAMENTS BY STRETCH OF RIGOR MUSCLE. S. SUZUKI, N. HIRAO, H. SUGI. Dep. Physiol., Sch. Med., Teikyo Univ., Itabashi-ku, Tokyo.

Extensibility of myofilaments in glycerinated rabbit psoas muscle in rigor state was studied by means of electron microscope and physiological techniques. In rigor state, one half of a small fiber bundle was stretched by 5 - 30%, while the other half was kept isometric to serve as a control. Both halves were simultaneously fixed for electron microscope observation. The amount of overlap between the filaments in the stretched half of the fiber bundle did not differ significantly from that in the non-stretched half, indicating no appreciable sliding between the filaments, though the sarcomere length in the former was definitely longer than that in the latter. The elongation of each sarcomere was mainly due to the elongation of the H-zone and the I-band. Transverse serial sections showed that the filaments were continuous over the extended regions. The stretch of 5% L_0 during the first rigor tension development did not affect the second development of rigor tension, suggesting that the thick and thin filaments are actually extensible in physiological conditions. It seems possible that the compliance of the filaments may contribute to the series elasticity of muscle fibers in addition to the compliance of the cross-bridges.

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PROPERTIES OF THIN FILAMENTS OF SKELETAL MUSCLE STUDIED BY ELECTRO-OPTICAL EFFECT. UMAZUME, Y. and NATORI, R. Dept. of Physiol. Jikei Univ. Sch. of Med. Minatoku, Tokyo 105

Skeletal muscle fibers act as a diffraction grating to visible light. When electric field is applied along the fiber axis, intensities of all observable optical diffraction lines increase. The nature of this electro-optical effect is the changes of the orientation of thin filaments induced by the interaction between the electrical field and a permanent dipole which directs from the free end to the Z-line. The decay rate (τ) of the response to the square field is a indicator of the flexibility of thin filaments. Here we report the effect of ionic strength to τ .

$\Gamma/2$	τ (ms)	n	calcium ion	
0.15	1.01 ± 0.06	14	free	
0.15	6.05 ± 0.20	5	1mM	1) Biophys.J.15,163 (1975)
0.08	0.85 ± 0.60	2	free	2) Biophys.Cem.8,305 (1978)
0.05	0.38	1	free	3) Biophys.Cem.8,317 (1978)
0.02	0.40 ± 0.05	4	free	
0.01	0.38 ± 0.07	6	free	

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ELECTROPHYSIOLOGICAL PROPERTIES OF E-C COUPLING SITES. M. FUJINO, Y. SATO, T. ARIMA, H. TAKAI. 1. Dep. of Physiol., Natl. Def. Med. Coll., Tokorozawa.

A. Extra-charge movement experiments. Using frog sartorius muscle fibers, extra-charge movement was measured in hypertonic solution under the presence of various anions. Results give that curve to show the relationship between the moved extra-charges and depolarization steps is almost not shifted by anions tested (Br^- and NO_3^-)

B. Potential probe experiments. Using merocyanine-oxazolone dye (NK-2367) of $1-2 \times 10^{-4}$ g/ml, light absorption changes were measured at wavelength 680 nm in single muscle fibers of frog. If staining of about 10 min is done, the changes can be observed for about 60 min. The changes did not appear at 720 nm. From the comparison between recordings of electrical and light-absorption changes during single excitations, changes obtained by potential probe seem to show greatly the behaviour of T-tubule membrane.

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INACTIVATION AND RESTORATION OF POTASSIUM CONTRACTURE IN SINGLE TWITCH MUSCLE FIBERS OF THE FROG. KOSAKA, I. AND NAGAI, T. Dep. of Physiol., Sapporo Med. Col., Sapporo, Japan.

The inactivation and restoration of potassium contracture were investigated in detail on single twitch fibers isolated from semitendinosus muscle of the frog. The time dependence curve of inactivation was composed of two phases. The inactivation in these phases were more promoted under $[Cl]_o = \text{const.}$ (120 mM) than under $[K]_o[Cl]_o = \text{const.}$ (300 mM²). The recovery from full inactivation induced by 190 mM K (95 mM K₂SO₄) occurred below 20 mM K under $[Cl] = \text{const.}$ and below 35 mM K under $[K][Cl] = \text{const.}$, and reached almost maximum after about 1 min and 1.5 min, respectively, followed by a decline. The extent of restoration was smaller under $[Cl] = \text{const.}$ than under $[K][Cl] = \text{const.}$ in all the range of the time course of recovery. Determined at the time when the restoration was maximum, the restoration curve under $[Cl] = \text{const.}$ was shifted towards left in comparison with that under $[K][Cl] = \text{const.}$; K concentration at which the restoration was half was lower about 15 mM under $[Cl] = \text{const.}$ than under $[K][Cl] = \text{const.}$. The inactivation curves determined at the conditioning time of 1 min and 1.5 min under $[Cl] = \text{const.}$ and $[K][Cl] = \text{const.}$, respectively, nearly fitted the restoration curves under each condition. It is concluded that the inactivation curves determined by either "inactivation method" or "restoration method" nearly fit each other if they are determined at 1 min or so under the same ionic milieu, while the inactivation is more accelerated under higher $[K]_o[Cl]_o$ product.

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SARCOMERE LENGTH AND SR-T JUNCTION. T.YOSHIOKA, K.NAGAMI, M.NARUSAWA AND S.NAKANO. Dept. of Physiol., The Tokai Univ. Sch. of Med., Isehara, Kanagawa.

It has been reported that the SR-T junction was closely packed in its formation of Japanese frog skeletal muscle treated with various circumstances using electron microscopic technique at 54 and 55th general assembly.

In present study, alteration of distance of SR-T junction and sarcomere length (SL) by stretched skeletal muscle were presented. M.Sartorius, M.Extensor Digitorum Longus (EDL) and M.Hyoglossus of Rana esculenta were used. All samples were fixed settled SL by He-Ne Laser, and fixed, dehydrated embedded in Epon and ultrasectioned longitudinally. Results were as followed: 1) SL of whole portion along the fibre were extended proportionally in medial and distal portion, suggestively, by stretched. 2) SL of M.Hyoglossus, of its distal portion, was more extended than other portion. 3) No remarkable change about mean SL was observed in M.Sartorius and EDL by stretched. 4) Variable SL was obtained in slow fibre of EDL, especially, both proximal and distal portion. 5) Settled SL by He-Ne Laser was differed from its length which was measured accurately to EM photo (myosin filament length as 1.5 μm). 6) Lacking in variety of distance of SR-T junction was observed in all portion of fibre by stretched. These results should be suggested that SL was extended without proximal portion of fibre proportionally and SR-T junction was closely combined by stretched.

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CONTRIBUTION OF CALCIUM TO THE ADRENALINE RESPONSE IN THE GUINEA-PIG TAENIA COLI. S. USUNE and T. TOMITA. Dept. of Physiol., Sch. of Med., Fukuoka Univ., Nishi-ku, Fukuoka

Adrenaline (Ad) hyperpolarizes the membrane of the guinea-pig taenia coli, mainly by increasing the K conductance, as an α -effect. In the absence of external Ca (the solution contains no added Ca and 0.5 mM EGTA), the first application of Ad produces only a transient (about 1 min) effect during a continuous application of Ad, but the second application causes no effect. When Ca is readmitted in the presence of Ad, the membrane is hyperpolarized in accompany with a reduction of the membrane resistance, although their onset is slower than those of Ad action observed in normal solution. For the full recovery of Ad effect, Ca has to be readmitted at least 1 min before Ad application. Mn (1-3 mM) strongly suppresses the α -effect. It is speculated that there is a limited Ca storage site at the outside of the membrane, probably in the caveolae, and that Ad facilitates translocation of Ca from this site to the inner surface of the membrane, resulting in an increase in the K conductance.

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DEPOLARIZATION PRODUCED BY Na REMOVAL IN THE CIRCULAR MUSCLE OF GUINEA-PIG STOMACH. Y. SAKAMOTO, T. TOMITA and H. TOKUNO. Dept. of Physiol., Sch. Med., Fukuoka Univ., Nishi-ku, Fukuoka

When external Na was removed the circular muscle of guinea-pig stomach was depolarized by 15-20 mV accompanied by contracture. A decrease in external K had a weak effect on the membrane potential in control solutions, while it produced large repolarization in Na-free solution. The membrane resistance was smaller during the depolarization. The depolarization was reduced by removing Ca, but 3 mM Mn had a weak repolarizing effect, although it completely suppressed the contracture. When the temperature was reduced to lower than 10°C, the Na-free depolarization became very small. Addition of more than 5 mM Na to Na-free solution repolarized the membrane. Ouabain had little effect on the repolarization. Recovery from Na-free solution nearly completed within 1-2 min, but the recovery was very slow when Ca had been removed from Na-free solution. These results may indicate that the Na-free depolarization is due to facilitation of depolarizing electrogenic Na-Ca exchange or to abolition of hyperpolarizing electrogenic Na-Ca exchange or to both.

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HYPERPOLARIZATION-CONTRACTION COUPLING OF THE VASCULAR SMOOTH MUSCLE. KITAMURA, K., SUZUKI, H., KURIYAMA, H. Dept. of Pharmacol. Fac. Med. Kyushu Univ. Fukuoka 812, Japan.

The membrane potential of the rabbit superior mesenteric artery was -63 mV and that of guinea pig coronary artery was -44 mV. ACh ($>10^{-8}$ g/ml) hyperpolarized the membrane in both tissues. Increased concentrations of ACh hyperpolarized the membrane further. However, in young rabbit mesenteric artery, a higher concentration of ACh (10^{-6} - 10^{-5} g/ml) produced a smaller hyperpolarization. These potential changes produced by ACh in both superior mesenteric artery and coronary artery were suppressed by treatment with atropine (10^{-7} g/ml). Even with the hyperpolarization of the membrane ACh produced the contraction in both tissues. However, ACh relaxed the contraction induced by excess $[K]_o$ in the adult rabbit, while ACh enhanced the contraction in the immature rabbit mesenteric artery and in the guinea pig coronary artery. In Ca-free EGTA solution, the action of ACh on the mechanical response evoked from the above tissue was markedly suppressed. It is postulated that ACh hyperpolarized the membrane by increasing the K-permeability and consistently generated contraction by increasing the Ca-permeability of the membrane of coronary artery and superior mesenteric artery. These ACh actions of the superior mesenteric artery were modified by aging.

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EFFECTS OF TEMPERATURE AND METABOLIC INHIBITORS ON HIGH-K INDUCED CONTRACTURE OF VAS DEFERENS. S. SUNANO, E. MIYAZAKI. Dept. of Physiol., Sapporo Med. Coll., Chuo-ku, Sapporo.

Effects of temperature and some metabolic inhibitors on the tonic component of high-K induced contracture of guinea-pig vas deferens were studied. Slow decrease in temperature during the course of the tonic component caused an elevation of tension. The elevation appeared from 25°C and maximum elevation was observed at 20°C. At the temperature below 15°C, however, the tension began to fall and relaxation was observed at 10 and 5°C. Metabolic inhibitors caused relaxation. The elevation by low temperature was enhanced by increasing Ca concentration and abolished by the removal of Ca or by the addition of verapamil. La and Mn also depressed the tension development by lowering the temperature. It has been known that the tonic contraction is induced by the equilibrium of the influx and extrusion or intracellular accumulation of Ca and that the accumulation is active process. Therefore, the inhibition of extrusion or accumulation would cause the elevation of tension. The result that the elevation was abolished by La support the former possibility (inhibition of extrusion). Rewarming the preparation caused relaxation possibly by activating the extrusion mechanism. Tension decrease by metabolic inhibitors may be explained by the depletion of energy for the contraction or the inhibition of Ca influx rather than by the change in Ca extrusion.

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EFFECTS OF La^{+++} ON THE CONTRACTILE RESPONSE OF THE ISOLATED STOMACH MUSCLE OF GUINEA PIG. M. ISHIZAWA, & E. MIYAZAKI. Dep. of Physiol. Sapporo Medical College, 060, Sapporo.

The effects of La^{+++} on the contractile responses induced by isotonic K^+ , acetylcholine (ACh) and prostaglandins (PG) were investigated in the isolated smooth muscle of guinea pig stomach. Low concentrations of La (10^{-6} – 10^{-5}M) suppressed the phasic response induced by high K without affecting the tonic response, and the contractions induced by ACh (10^{-6}M), PGE_1 and PGE_2 (10^{-7}M). The high K-induced contraction produced a marked increase in ^{45}Ca uptake for 30 min, and PGE_2 produced only a small increase. In the presence of La, these increases in ^{45}Ca uptake were not depressed. The ^{45}Ca efflux from muscles washed out in Ca-free solution was increased by PGE_2 and ACh, and also by La.

These results suggest that low concentrations of La may displace a sequestered Ca in the muscle membrane without affecting the Ca entry, and that ACh- and PG-induced contractions and the phasic response of high K-induced contraction may largely depend on the inward release of the sequestered Ca from the muscle membrane.

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MYOELECTRICAL AND MECHANICAL ACTIVITIES OF THE STOMACH AND DUODENUM IN FASTING STATE OF DOGS. ONOYAMA, E., SHIRAISHI, Y., FUJITANI, Y. and OIKAWA, T. Dept. of Physiol., Sch. of Med., Tottori Univ., Yonago

Electromyograms and contraction curves of the stomach and duodenum were recorded using chronically implanted electrodes and force-transducers under unanesthetized and unrestrained state of 4 adult mongrels. Every dog was fed once a day. Electrical potentials obtained were composed of so-called basic electric rhythm (BER) and second potential accompanied by each contraction. According to variability of gastric BER intervals in the uncontractile period of the fasting state, dogs examined were classified into 2 types, i.e. stable and variable ones. The coefficient of variation of gastric BER intervals in the stable and variable types were respectively 4.7 and 41.3%. In the contractile period, however, those were almost identical with each other, i.e. 26.9 and 28.3%. Similar values of the duodenum were 3.5% in the contractile period and 1.5% in the uncontractile one. It was further noted that antral giant contraction waves were accompanied by suppression of both the contraction curves and the second potentials of the duodenum in the contractile period of the fasting state.

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PACEMAKER POTENTIAL AND CARDIAC NERVE IMPULSES EVOKED BY STIMULI OF THE VAGUS NERVE. GOTO, K. Dept. of Physiol., Gunma Univ. Sch. of Med. Maebashi

The relationship between pacemaker potential and cardiac nerve impulses evoked by stimuli of vagus nerve was studied intracellularly in the frog's sinus venosus. 1) There were three major groups of nerve fibres as judged by conduction velocity in the cardiac nerve branch. 2) The fast groups vary in conduction rate from 20 m per sec. to approximately 8 m per sec., may be regarded as B fibre. 3) The slow groups vary in conduction rate from 2 m per sec. to approximately 0.3 m per sec., regarded as C fibre. 4) The fast groups had a lower threshold and the slow and intermediate groups had a higher threshold. 5) The post tetanic hyperpolarization (PTH) in the C fibre showed the maximum value in stimulus duration between 30 and 75 msec. It agreed very closely with that of hyperpolarization of pacemaker. 6) Both hyperpolarization of C fibre and pacemaker cell were inhibited by α -blocker. From these results it could be presumed that spontaneous activity in pacemaker cell was similar to activation of electrogenic sodium pump of C fibre in the PTH.

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Effect of calcium ion on the electrical activity of S-A node cell of the rabbit. I. Seyama. Dept. Physiol., Sch. Med., Hiroshima Univ., Hiroshima 734 Japan

The contribution of Ca ion to the electrical activity of S-A node cell was studied by the voltage clamp method using two microelectrodes. By increasing $[Ca^{2+}]_o$ from 1.8 to 18 mM, the following changes in electrical activity of S-A node were observed: 1) The maximum rate of rise of the action potential became twice as large as that in the control and 2) the half-duration of the action potential and frequency of spontaneous beating decreased to a third and a quarter of those in the control, respectively.

The contribution of Ca ion to the transient current was confirmed by observing a shift of the reversal potential with change in $[Ca^{2+}]_o$. The slope per decade change in $[Ca^{2+}]_o$ was estimated to be 21.5 ± 1.4 mV. Increase in $[Ca^{2+}]_o$ enhanced the delayed rectification of S-A node cell. This effect was eliminated by the application of Zn, Mn and La ions. Since these polyvalent ions suppressed the transient current of S-A node cell, the inflow of Ca ion appears to be closely related with the electrical activity of S-A node cell. It is therefore assumed that in high $[Ca^{2+}]_o$ medium, the increase in $[Ca^{2+}]_i$ due to enhanced inflow of Ca ion during the rising phase of action potential causes an increase in K permeability, which in turn brings rise to both reduction of action potential duration and decrease in frequency.

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EFFECTS OF CALCIUM IONOPHORE X-537A ON FROG ATRIAL MUSCLE

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Effects of ionophore X-537A (5-100 μ M) were studied on frog atrial muscle with double gap method, aiming to clarify the effects of increased $[Ca^{++}]_i$ on membrane potential, currents and tension components. X-537A (X) released endogenous catecholamine which was blocked by propranolol (10^{-6} M). In the presence of propranolol, X hyperpolarized the membrane and shortened the action potential duration, and consequently depressed the twitch contraction. With high concentration of X ($> 50 \mu$ M), resting tension increased and active tension decreased, while the effects on action potential were the same as in low concentration but appeared rapidly. These effects were not observed in Ca-free, EGTA Ringer, suggesting the action of X needs extracellular calcium ion.

Voltage clamp study revealed, 1) slow inward calcium current (I_{Ca}) and I_{Ca} -dependent tension were simply depressed. 2) Instantaneous outward current (i_{K1}) was augmented, suggesting an increase in potassium conductance. 3) Time dependent outward current (i_X) was rather unchanged. And 4) I_{Ca} -independent tonic tension was generally enhanced, but depressed when contracture occurred.

These results suggest that lipophilic complex of X and Ca^{++} increased $[Ca^{++}]_i$ by facilitating calcium ion diffusion across the membrane, which was not related to slow channel.

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VENTRICULAR FIBRILATION CAUSED BY REDUCTION OF EXTERNAL SODIUM CHLORIDE CONCENTRATION. KASEDA, M., KUMAGAI, Y. Dept. Biol., National Defence Med. Coll., Tokorozawashi Saitama TSUMURAYA, Y., MURATA, H. Dept. Physiol., Nihon Univ. Sch. Med., Itabashiku, Tokyo

The whole heart excised from *Rana Catesbeiana* was perfused with reduced sodium-Ringer's solution in the air. In the course of time the ventricular electrogram and aortic pressure were recorded synchronously. 1) In the perfusion of sodium-Ringer's solution with isoosmotic pressure (added glucose up to isoosmotic pressure), the spike potential is reduced. It breaks up into many small spikes interposed by a single large spike. Its repolarization phase shows hyperpolarization. plateau potential decreases. At last, series of small spikes and fibrillation potential are brought about. 2) In the perfusion of reduced sodium-Ringer's solution (hypotonic), spike potential initially grows and then decreases. It breaks up into two peaks. It shows hyperpolarization. Plateau potential disappears. Series of small spikes and fibrillation potential can not be seen.

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EFFECT OF CADMIUM AND ITS pH DEPENDENCY ON THE CONTRACTILITY OF THE FROG CARDIAC MUSCLE. HORIUCHI, E. AND HAYASHI, H. Dept. of Physiol., Saitama Med. Sch., Irumagun, Saitama

In order to examine the pH dependency of Cd effects on cardiac muscle, the electrical and mechanical activities in the bullfrog heart was investigated in relation to various external pHs and concentrations of Cd. The amplitude and duration of the action potential or the spontaneously beating frequency in an atrium were not significantly affected for the 3 min administration of various concentrations of Cd in various pHs, but the isotonic contraction at the end of the same period was greatly altered: the lower the external pH solution, the more Cd decreased the contractility of atrium. This pH dependency of Cd effect was also observed in the SO_4 -Ringer's solution. Decrease in contractility in Cd-Ringer's solution, was counteracted by excess Ca. The lower the pH of the Cd-Ringer's solution, the more the amount of Ca was necessary to counteract the same amount of Cd. The amount of Cd-uptake into the atrium was analyzed after soaking the atrium in the various concentrations of Cd-Ringer's solution. No pH dependency, however, was noticed in this relationship.

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DEPRESSION OF SLOW INWARD CURRENT BY ACETYLCHOLINE IN MAMMALIAN VENTRICULAR MUSCLE. OCHI, R., AND HINO, N. Dept. Physiol., Juntendo Univ. Sch. Med., Bunkyo-ku, Tokyo

The role of the vagus nerve in modulating the electrical activity of the mammalian ventricular muscle has remained a puzzle. In the present study the effect of acetylcholine (ACh) on the membrane currents of guinea-pig papillary muscle was examined by a single sucrose-gap voltage clamp technique. The slow, Ca-sensitive, inward current (I_s) was depressed by concentrations of ACh greater than 5×10^{-6} M, and correspondingly the plateau phase of action potential was depressed. On the other hand, the time-independent background current which gives N-shaped current-voltage relationship was little affected by ACh (2×10^{-6} M). At this concentration the time-dependent outward current during large depolarizations diminished slightly sometimes. The amplitude of I_s was estimated by subtracting capacitive and background current during depolarizations in the presence of 2 mM-Co^{2+} . This amplitude of I_s was depressed to 60-70% by 2×10^{-6} M ACh, the time course and the reversal potential of I_s being little affected. It was concluded that in mammalian ventricular muscle ACh, the vagal transmitter, could modulate the electrical activity by depressing the slow inward current rather selectively. Similar depression of I_s by ACh was observed in the presence of adrenaline.

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EFFECTS OF INSULIN ON THE MAMMALIAN MYOCARDIUM (IX): CORRELATION BETWEEN INTRACELLULAR c-AMP AND MEMBRANE $\text{Na}^+\text{-K}^+$ ATPase ACTIVITY WITH REFERENCE TO A POSITIVE INOTROPIC ACTION OF INSULIN. I. IMANAGA*, T. KANEDA AND T. TOGASHI. Dep. of Physiol., Kanazawa Med. Univ. Ishikawa-ken; *Present address: Dep. of Physiol., School of Med. Fukuoka Univ. Fukuoka

1) Insulin (glucagon free, bovine crystalline, 0.3 IU/ml) increased intracellular c-AMP level in the rhythmically contracted canine ventricular papillary muscle to 159% of control (100%) ($P < 0.001$). 2) c-AMP decreased dose-dependently the activity of membrane $\text{Na}^+\text{-K}^+$ ATPase isolated from the ventricular muscle, to 72.7% ($P < 0.1$), 79.6% ($P < 0.1$) and 94.9% ($P > 0.2$) of control (100%) at concentration (M) of 5×10^{-6} , 10^{-6} and 10^{-7} respectively. 3) An enhancement of the twitch tension of the isolated ventricular papillary muscle by application of insulin after dibutyryl c-AMP (DBc-AMP) (0.4 mM) or theophylline (1 mM) preincubation was remarkably more rapid than that by application of DBc-AMP or theophylline after insulin preincubation. Since insulin stimulates effectively the insufficiently activated enzyme (our previous report, 1978), insulin may stimulate the enzyme activity inhibited by c-AMP produced by the hormone itself. These results suggest that a positive inotropic action of insulin is associated with an activation of Na-pump.

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OSCILLATORY AFTERPOTENTIALS AND TRIGGERED-ACTIVITY IN VENTRICULAR MUSCLE FIBERS.

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When ventricular muscle fibers from dog hearts were exposed to K^+ -free, high- Ca^{++} solutions after K^+ -free, Ca^{++} -free perfusion, oscillatory afterpotentials (OAPs) and triggered-activity were elicited following a train of driven action potentials induced by applied impulses. These activities developed at the potential level more negative than -70 mV. OAPs showed dependence on the mode of preceding applied impulses. They were evoked in 3.6 mM- or higher- Ca^{++} , and their amplitude showed dependence on external Ca^{++} . OAPs and triggered-activity were enhanced by the application of isoproterenol. They were suppressed by the application of verapamil and in the presence of 1.35 mM- or higher K^+ or Rb^+ . OAPs were associated with the tension development of the small amplitude. These results suggest that increased internal Ca^{++} play important role for the genesis of OAPs and the block of the active Na^+ -pump may also participate in their appearance.

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2-NICOTINAMIDOETHYL NITRATE INCREASES POTASSIUM CONDUCTANCE OF THE MEMBRANE OF ATRIAL MUSCLE FIBERS OF THE DOG. T. YANAGISAWA AND N. TIRA. Dep. Pharmacol., Tohoku Univ. Sch Med, 2-1 Seiryomachi, Sendai.

The effects of 2-nicotinamidoethyl nitrate (SG-75) and methacholine (MeCh) on the transmembrane potential of atrial muscle fibers of the dog were studied with conventional microelectrode techniques. SG-75 and MeCh decreased action potential (AP) duration and increased the resting membrane potential (RMP), AP amplitude and maximum rate of rise of AP. These effects of SG-75 were not modified by the concentration of atropine which was enough to block the effects of MeCh. These effects of SG-75 and MeCh were also not modified by either replacement of NaCl by sodium isethionate in Tyrode solution or treatment with ouabain. With raised concentrations of external potassium the decrease in RMP for a tenfold increase in external potassium was greater in the presence of either SG-75 or MeCh than in the absence of these drugs. These results indicate that SG-75 increases potassium conductance of the membrane of atrial muscle fibers without mediation through muscarinic receptors.

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SHORTENING VELOCITY OF RABBIT PAPILLARY MUSCLE UNDER VISCOUS OR INERTIA LOADING.

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A dashpot containing diluted glycerol was used for viscous loading and an inertia lever of which the equivalent mass could be adjusted to 400 g was used for inertia loading. The dashpot or the inertia lever was connected to an isotonic lever through a thin chain, so that it might not oppose the contraction during relaxation (negative velocity) or negative acceleration phase. At the start of contraction, the muscle developed the extra force to overcome the viscous or inertia loading, but it fell to the after-load level in the deceleration phase. If the equivalent mass of the inertia lever was increased from 0 to 20-40 g, the shortening velocity was augmented by 10-30%. Further increase in the equivalent mass decreased the shortening velocity. Small amount of viscous loading also increased the velocity. These results were explained by the slow onset of the active state and by the deactivation due to muscle shortening. The mechanical work done by muscle could be described with two terms; the work to lift a load and the work to impart velocity to the lever. The work to impart velocity was very small if the muscle was stimulated at 6/min, but it amounted to 50% of the total work in the conditions of positive inotropic interventions such as increase in stimulation rate, increase in Ca concentration or addition of epinephrine.

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TRANSIENT RESPONSES OF CONTRACTILE FORCE TO CHANGES IN MUSCLE LENGTH AND LOAD IN IN SITU CANINE PAPILLARY MUSCLE. HIROYUKI SUGA, Dep. of Cardiac Physiol., Research Inst., National Cardiovascular Center, Suita, Osaka

In in situ papillary muscles, I studied transient responses in peak isometric force at control length after contraction was suddenly switched from isotonic contractions at various forces and isometric contractions at different lengths. Peak isometric force rapidly decreased after isotonic contractions at relatively low forces and isometric contractions at shorter lengths. In contrast, peak isometric force rapidly increased after isotonic contractions at relatively high forces and isometric contractions at longer lengths. There was no transient response when preceding isotonic force was about half of present peak isometric force. Magnitude and direction of transient force response depended on magnitude and direction of the change in the mean muscle force level produced by sudden switch of loading conditions, not on the changes in the mode of contraction and the extent of shortening. Transient force responses were accompanied by simultaneous changes in time to peak isometric force in the same direction. Sudden changes in coronary perfusion produced similar changes in force and time. (Done in Dr. Sagawa's lab. in Johns Hopkins Univ.)

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EFFECTS OF NOREPINEPHRINE AND PROPRANOLOL ON ACTION POTENTIALS OF PURKINJE FIBERS OF 24-HOUR-OLD MYOCARDIAL INFARCTS IN DOGS. K. KUBOTA, T. IKEDA, A. FUJIKI, T. KOYAMA, T. INASAKA, N. HATTORI. The 1st Dept. of Int. Med., School of Med., Kanazawa Univ., Kanazawa.

The effects of norepinephrine (N) and propranolol (P) of 1.0mg/L on action potentials of Purkinje fibers were studied in 24-hour-old myocardial infarcts in dogs.

Action potential duration (APD), effective and functional refractory period (ERP and FRP) and conduction of premature impulses were all longer in the infarcted zone (IZ) than those in the normal zone (NZ). With N, APD and FRP prolonged significantly in IZ, but not in NZ. On the contrary, P induced more decreases in both APD and ERP in IZ than those in NZ, and lesser decrease in FRP in IZ compared to that in NZ. N increased conduction of premature impulses in IZ, but with P, conduction decreased conversely.

Therefore, the effects of norepinephrine and propranolol on transmembrane potential of Purkinje fibers in the infarcts are different from those effects on fibers in normal hearts.

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THE EFFECT OF Ca ION ON THE PROLONGED ACTION POTENTIAL PRODUCED BY INTRACELLULAR OR EXTRACELLULAR APPLICATION OF TEA IN CULTURED CHICK EMBRYONIC HEART CELL.

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The action potential of cultured chick embryonic heart cell was abolished by Mn ion, though it was insensitive to TTX. The increase in external Ca ion concentration produced the enhancement of overshoot and max. rate of rise and the shortening of duration of action potential. When cultured cell was incubated for approx. 2 hr in Ringer solution containing 20 mM TEA or intracellularly injected with TEA by iontophoretic technique, the duration of action potential was prolonged markedly. This prolongation effect was reversed by an increase in external Ca ion concentration. This result shows that the inflow of Ca ion in the initial upstroke phase regulates the duration of action potential by modifying the K-conductance.

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MORPHOLOGICAL CHANGE OF CULTURED MYOCARDIAL CELLS DUE TO EXCESS Ca^{2+} UPTAKE.

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Increase in the extracellular Ca^{2+} concentration from low ($<10^{-7}$ M) to normal (10^{-3} M) caused morphological changes of cultured myocardial cells obtained from fetal mouse heart. Increase in the extracellular Ca^{2+} concentration from 10^{-8} M to 10^{-3} M also caused excess uptake of $^{45}\text{Ca}^{2+}$ by cultured myocardial cells. Treatments, such as addition of verapamil, which reduced the genesis of morphological changes, reduced the rate of $^{45}\text{Ca}^{2+}$ uptake by myocardial cells. These facts show that the morphological changes of myocardial cells induced by increasing the extracellular Ca^{2+} concentration from low to normal are due to excess uptake of Ca^{2+} by the myocardial cells. The morphological changes were reversed on further incubation of the cells in medium with or without Ca^{2+} .

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MEASUREMENT OF BIOMAGNETIC FIELDS AND HUMAN MAGNETOCARDIOGRAM

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The discrimination of the micromagnetic signals from the human heart against the large magnetic background was made by using superconducting quantum interference device (SQUID) system provided with first and second derivative gradiometer without using shield room. Magnetocardiogram (MCG) and electrocardiogram (ECG) were recorded simultaneously at the same position of the chest leads (V_1 - V_6) and they were compared with each other in normal subjects and patients with heart diseases. The magnetic signal from the normal human heart was about $3-5 \times 10^{-7}$ gauss at the peak of ventricular depolarization. Deflection of P wave, QRS complex and T wave were found simultaneously in MCG and ECG, but they were different in shape. The observation of MCG in the heart disease such as the arrhythmia and disease of heart muscle showed that the important informations for the diagnosis of heart disease in ECG are also found in MCG and frequently more perspicuous informations than in ECG are found in MCG.

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USE OF OPTICAL RECORDINGS TO THE MAMMALIAN SINUS NODE.

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Changes in absorption of light by a merocyanine oxazolone dye (NK2367) were shown to correlate with variations of membrane potential in squid giant axons. There has been, however, no report on its application to mammalian heart. Thin and small preparation of S-A node was incubated in 1.0 to 2.0 mg/ml of the dye for 10 to 30 min. Absorption changes were measured using an apparatus made by Kamino et al. The experiments were done in a Ca^{2+} -free solution. Several types of absorption signal were obtained in the stained preparation: a type similar to the action potential, a biphasic type and an M shaped type. Amplitude of initial portion of each recording was decreased by changing filter 675 nm to white light (no filter). The initial part of optical signal coincided with the rise of action potential and was wavelength dependent. Simultaneous recording of optical signals from two different positions of S-A node shows that an analysis of especially abnormal excitation of the sinus node and its vicinity becomes possible by examining their initial parts.

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IONIC CURRENTS RESPONSIBLE FOR THE PACEMAKER ACTIVITY OF RABBIT SINO ATRIAL NODE CELLS. K. Yanagihara and H. Irisawa, Dept. Physiol. School of Med., Hiroshima Univ.

Using the double electrode method, we performed the voltage clamp experiment on rabbit sino-atrial node specimens. Two time-dependent currents were identified except a transient inward current. One is the time dependent outward current activated by depolarization, which is considered as a potassium current (IK), the other is a time-dependent inward current. The latter current has a single exponential time course with the very long time constant at the potential from -50mV to -80mV. This time constant was extremely shortened by depolarization. This current was named as the ultra slow inward current (I_{usic}). The kinetic property of IK according to the Hodgkin-Huxley type equation was analysed. The IK was important outward current when a S-A node membrane hyperpolarized after a plateau phase but it was unimportant at the pacemaker potential. Because this current changed very slightly at this potential region. The I_{usic} must be unimportant at the pacemaker potential, for this current has very long time constants at this potential region. Moreover, I_{usic} must be small considering from its kinetic property. These facts indicate that the slow inward current (I_{sic}) plays the major role in producing the pacemaker potential of the S-A node.

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MODIFICATION BY CALCIUM OF ATRIOVENTRICULAR CONDUCTION IN THE DOG HEART. S. MOTOMURA AND N. TAIRA. Dept. Pharmacol., Tohoku Univ. Sch. Med. 2-1, Seiryō-machi, Sendai.

In the canine excised, blood-perfused atrioventricular (AV) node preparation, CaCl_2 injected into the AV node artery caused a decrease or a biphasic increase-decrease in AV conduction time. The prolongation of AV conduction time induced by infusion of KCl, verapamil, nifedipine and MnCl_2 was restored by a bolus injection of CaCl_2 . The effect of CaCl_2 on KCl-induced delay was the most prominent and was not affected by tetrodotoxin. Methacholine-induced delay was restored by CaCl_2 in a few cases, but in the majority an initial prolongation was enhanced or unmasked and a long-lasting restoration followed. In the latter case, the enhanced prolongation by CaCl_2 during methacholine infusion was prevented by simultaneous infusion of KCl but not by tetrodotoxin. These results suggest that calcium restored AV conduction delay through an enhancement of the slow Ca current and that methacholine impaired AV conduction through at least in part the inhibition of the slow Ca current.

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CA BINDING OF ISOLATED NEXUS MEMBRANES RELATED TO INTERCELLULAR UNCOUPLING. HIROSHI NISHIYE, HIDENOBU MASHIMA AND AYAKO ISHIDA. Dept. Physiol., Sch. Med. and Sch. Physical Educ., Juntendo Univ., Hongo 2-1-1, Bunkyo-ku, Tokyo, 113 Japan.

Nexus membranes were isolated from cardiac muscles of guinea pig or ox. The isolated nexus usually formed a vesicle or a plaque. The bridge structures between paired nexus membranes were well preserved. It was confirmed by the electron microscope autoradiography that Ca actually bound with nexus, and by the atomic absorption spectroscopy that bound Ca increased extensively at $[Ca]$ higher than $10^{-6}M$ to $10^{-5}M$ and showed the doseresponse relationship against $[Ca]$. The dissociation constant (K_d) was $5.4 \times 10^{-4}M$ and Hill's coefficient (n) was 1.01. The bound Ca was frequently observed on the nexus when loaded with $5 \times 10^{-5}M$, but not observed when loaded with $2 \times 10^{-7}M$. The concentration of bound Ca ($[B \cdot Ca]$) was $1.25 \times 10^{-5}M$ to $3.58 \times 10^{-4}M$, which was obtained from the number of bound Ca per unit length of nexus. If Ca binds to a connexon particle of nexus, the dissociation constant (K_d') can be calculated from $K_d' = [B] \cdot [Ca] / [B \cdot Ca]$, in where $[B]$ is the concentration of connexons (as Ca binding sites), $1.37 \times 10^{-3}M$. Thus obtained values of K_d' are within the range of $1.74 \times 10^{-4}M$ to $4.95 \times 10^{-3}M$. The value of K_d is fallen within this range. This coincidence strongly suggests that the bound Ca is located on the nexus membrane, especially on the connexon particle.

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TRANSIENT TENSION RESPONSES OF HEART MUSCLE IN Ba^{2+} CONTRACTURE TO STEP LENGTH CHANGES. Y. SAEKI and T. SHIBATA*. Dept. of Physiol., Tsurumi Univ. Sch. of Dent. Med. and Dept. of Pediat., Sch. of Med. Yokohama City Univ.*

To characterize mechanical properties of activated heart muscle, kitten papillary muscles in Ba^{2+} contracture were stretched or released stepwise and the transient tension responses were analyzed. Various amplitudes of step length change (0.1-1.0% of L_{max}) were tested from different initial lengths and at different temperatures. The tension response to either stretch or release showed four different phases, which were nearly symmetric when the input length change was 0.1% of L_{max} . When the length changes was 1%, the second phase of stretch response became shorter whereas that of release response became longer. The third phase of stretch response was prolonged whereas that of release response became obscure. The peak tension (F_1) in the first phase was linearly related to the amplitude, whereas those in the second and third phase were not. With an increase in temperature from 23 to 36°C, the magnitude of the first phase decreased to almost one half. The time course in the second and third phase also showed marked temperature dependence. Their Q_{10} were nearly equal (about 4) and independent of initial muscle length. All the results were consistent with the properties of heart muscle in Ba^{2+} contracture which we previously characterized by the frequency response analysis using sinusoidal length changes.

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EFFECTS OF SODIUM SALICYLATE ON THE GUINEA-PIG PAPILLARY MUSCLE OHBA, M. (Dept. Physiol., Fukuoka Univ., Sch. Med., Fukuoka)

Sodium salicylate (Sal.), which in its lower dose (1-2 mM) may not increase the negative surface potential, shortened the action potential duration (APD) markedly (80-90% of control). The resting membrane potential (RP) was transiently hyperpolarized and then depolarized, however the degree of effects was less notable. Thus a small change in RP would not account for the marked shortening in APD. The change in the maximum rate of rise of the action potential was also small. Even the lower concentration (0.1 mM) of Sal. alone showed the transient prolongation of APD and then reduced the plateau level. Sal., when applied together with 1 μM ouabain could not prevent the shortening of APD from the toxic level of ouabain but rather reinforced the ouabain action. Sal. also depressed the force of contractions and blocked the slow regenerative response appeared when muscle cells were depolarized by elevating $[K]_0$. These results suggested that Sal. may block the Ca conductance and this action is attributable partly to the shortening of APD although the contribution of i_x remains to be clarified.

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CARDIAC MUSCLE FIBERS OF DIFFERENT TYPES AS REVEALED BY INTRACELLULAR POTENTIAL RECORDING AND STAINING

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After recording intracellular potentials from various cardiac muscle fibers of the dog, rabbit and guinea pig, Procion Yellow was injected intracellularly through the same electrodes.

In Purkinje and working muscle fibers, a cylindrical portion extended 15-35 μm in transverse direction with 70-150 μm in longitudinal direction was stained. Since a few cells were found to be stained in a single cylindrical portion, Procion Yellow molecules can be transported through the intercalated discs by electric currents to a certain extent. In S-A and A-V nodes a group of small hederiform fibers, extended with the portion of 15-40 μm in width and 50-100 μm in length was stained. In some fibers double staining method with Procion Yellow and Water Blue was attempted to determine a more exact location of the recording micro-electrode. Larger staining portions could be obtained in frog cardiac muscle fibers by electric currents of lower intensities than those to applied mammalian.

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EFFECTS OF COENZYME Q₁₀ ON ACTION POTENTIAL AND CONTRACTION DURING METABOLIC INHIBITION IN GUINEA PIG VENTRICULAR MUSCLE. KIYOSUE, T., ARITA, M. AND IMANISHI, S. Dep. of Physiol., Fac. of Med., Kyushu Univ. and Oita Medical College.

Effects of Coenzyme Q₁₀ (CoQ) were studied with microelectrodes in fast and slow responses of papillary muscle whose metabolism had been suppressed by hypoxia (95%N₂ + 5%CO₂) in presence of glucose (10mM). Slow responses were initiated by high K⁺ (22mM) with barium (0.2mM) or isoproterenol (10⁻⁷M). CoQ (20-100 $\mu\text{g/ml}$) partially reversed the reduction of action potential (AP) duration and contraction induced by hypoxia in fast response; $\dot{V}_{\text{max}}$ of AP upstroke was unchanged. In barium-induced slow response, CoQ increased $\dot{V}_{\text{max}}$ but decreased contraction. In isoproterenol-induced slow response, CoQ increased both $\dot{V}_{\text{max}}$ and contraction. This contraction could be divided into initial tonic and late phasic components. The CoQ effect was found mainly on the late one, the strength of which appeared proportional to the amplitude of $\dot{V}_{\text{max}}$. These results suggest that exogenous CoQ reverses hypoxia-induced deterioration of AP and contraction in both fast and slow responses by increasing the availability of slow channels, probably via facilitation of ATP synthesis.

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REFLEX BRADYCARDIA VIA AORTIC NERVE DURING THE ACUTE BRAIN ISCHEMIA IN NEWBORN RABBITS.
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Effects of transection of the depressors and vagi as well as stimulation of these afferents on the bradycardia associated with the brain ischemia were studied in 8 newborn rabbits. The heart rate, systemic arterial pressure and respiratory movements were simultaneously recorded. The brain ischemia was elicited by interrupting completely the blood flow in both carotid and vertebral arteries bilaterally for 30 seconds. The heart rate was decreased at the maximum of the elevated arterial pressure during the brain ischemia and was estimated to 29.3 % of the control value in the intact animals, and when the right depressor was transected, this value was 21.5 %. Successive transection of the left depressor, left vagus and right vagus produced an increase of the heart rate, on the contrary, by 1.1, 1.2 and 2.7 % respectively. Electrical stimulation of the left depressor concomitant with the brain ischemia reproduced the bradycardia equivalent to that estimated before denervation. As gross microscopically measured, the left depressor was much greater diameter than the right one. The results suggest that the depressor afferents may play an important role for the production of the reflex bradycardia during the brain ischemia in newborn rabbits, and the left depressor may be predominant to the right one.

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A STUDY ON NEURAL CONTROL OF CARDIOVASCULAR SYSTEM BY LIMBIC SYSTEM.
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This study was made to clarify the changes in cardiovascular system by electric stimulation of the amygdala (AMYG) in unanesthetized rabbits. The stimulations (8, 100 Hz) of AMYG produced decreases of blood pressure (BP) and heart rate (HR). These effects were mainly induced by stimulation of nucleus amygdaloid lateralis pars posterior, basalis and centralis. There were, however, a few cases of BP increase and these changes were reduced by the administration of phenoxybensamine. When the seizure discharges were induced by stimulation of AMYG, decreases of BP and HR were enhanced, comparing with cases of no seizure discharge. The decrease of HR was lessened by an incision of the bilateral vagus nerves as well as the administration of atropine sulfate, while that of BP was not influenced, but this decrease of BP was abolished by a destruction of the medial forebrain bundle. When BP and HR were decreased by stimulation of AMYG, common carotid blood flow volume increased and femoral blood flow volume decreased.

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NEURAL MECHANISMS OF REFLEX FACILITATION AND INHIBITION OF GASTRIC MOTILITY DUE TO STIMULATION OF VARIOUS SKIN AREAS IN RATS
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Experiments were performed on chloralose-urethane anesthetized rats. Gastric motility and/or gastric muscle tonus decreased when abdominal skin was pinched, and increased when the skin of a paw was pinched.

It was concluded that reflex increase of efferent activity of the gastric vagi was responsible for the gastric motility facilitation produced by paw stimulation, and that reflexly increased efferent activity of the gastric sympathetic nerves was the mechanism by which the gastric motility inhibition was produced by abdominal skin stimulation.

After spinal transection at the cervical level, the reflex facilitation of gastric motility which had previously been produced by stimulation of a paw was either completely abolished, or reversed to slight reflex inhibition, while reflex inhibition of gastric motility produced by stimulation of abdominal skin remained.

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ROLE OF THE SYMPATHETIC NERVE IN THE RECTO-RECTAL REFLEX. M. TAKAKI, T. NEYA and S. NAKAYAMA. Dep. of Physiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama

Our recent study revealed that the sacral defecation center in the guinea pig accelerates the excitatory effect on rectal motility induced by local reflex, while it is under the excitatory and inhibitory control of the supraspinal center. However, the role of the sympathetic nerve is uncertain. To clarify the role of the sympathetic nerve in the recto-rectal reflex, the present study was performed. The excitatory effect on rectal motility induced by rectal distension (recto-rectal reflex) attenuated after Th13 transection, but the reflex reappeared after pithing the L1-L3 or cutting the L1-L3 dorsal roots. Accordingly, the sympathetic nerve mediated inhibitory and the pelvic nerve mediated excitatory reflex occur in the case of excitation of rectal motility in defecation. Since the former reflex center is inhibited by the higher center in intact animals, excitation of rectal motility results in.

The afferent pathway in the supraspinal reflexes is mainly the pelvic nerve, because reflex excitation was abolished after L3 transection. Furthermore, the spinal inhibitory center is probably accelerated via pelvic afferents, since the excitatory reflex was abolished after Th13 transection and reappeared after L3 transection.

Our study revealed that the sympathetic inhibitory reflex is involved in defecation reflex.

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AUTONOMIC NERVE ACTIVITY DURING THE PROXIMAL-DISTAL COLONIC REFLEX IN DOGS. HIROMASA OKADA & KIYOKO FUKAI. Dept. of Physiol. (2nd), Kawasaki Med. School, Kurashiki

Relationships were examined between outflows in the lumbar colonic nerve (S) and in the rectal branch of the pelvic nerve (P) and distal colonic motility (DCM) during the proximal-distal colonic reflex in the unanesthetized and decerebrated dogs. In dogs paralyzed with gallamine and ventilated artificially, distension of the proximal colonic loop elicited reflex increases in the S and P outflows as well as an initial inhibition following an augmentation in DCM. Reflex increases in the P outflow and in DCM were demonstrable after transection of the brain stem at the subcollicular level, but they were abolished after the mid-pontine transection at the level immediately caudal to the pontine defecation reflex center. The afferent pathways were involved mainly in the vagal nerves and partly in the abdominal sympathetic nerves. While a reflex increase in the S outflow and a decrease of DCM were still obtainable after bilateral cervical vagotomy as well as spinal transection (Th5-6), but they were abolished after spinal local anesthesia with 1% xylocaine or after destructions of the spinal cord.

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AUTONOMIC RESPONSES INDUCED BY VESTIBULAR NERVE STIMULATION. ISHIKAWA, TOMOE. MIYAZAWA, TAEKO. and FUJIWARA, TAKAYUKI. Dept. of Physiol., Nihon Univ., Sch. Med., 30 Ohyaguchi Kamimachi, Itabashiku, Tokyo.

Chloralose anesthetized, succin immobilized cats were used under artificial respiration. The heart rate, blood pressure and renal nerve discharge frequency were recorded continuously. The conditioning stimuli were 5 train pulses of 1 msec duration, 3 msec train pulse vestibular or glossopharyngeal nerve. The test stimuli were applied to the left peroneal nerve or second lumbar nerve, as a weak skin nerve stimulation. 1) Any conditioning-test combination stimulus with weak stimulation evoked a depressure response with unchanged heart rate. 2) Vestibular and glossopharyngeal nerve stimulation induced almost the same sympathetic reflex discharge and subsequent silent period, during weak electrical stimulation. 3) Vestibular and skin nerve stimuli evoked an arousal response in the cerebral cortex, and a simultaneous sympathetic response. 4) These results suggest that vestibular and/or glossopharyngeal excitation and excitation from skin nerves are combined in the medulla oblongata, and the medulla-to-spine centrifugal pathway runs in the same descending tracts of the supraspinal sympathetic reflex.

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EFFECTS OF ANGIOTENSIN II ON THE GUINEA-PIG SYMPATHETIC GANGLION CELLS. YONEMURA, K., YAGISHITA, Y. and MATSUOKA, Yoko. Dept. of Physiol., Kumamoto Univ. Med. School, Kumamoto

Dun, Nishi & Karczmar (1978) have analyzed the effects of angiotensin II (AT-II) on the isolated cat superior cervical ganglia by means of intracellular microelectrode techniques. The present study on the guinea-pig ganglia confirmed their results, and added observations on the antagonistic actions of an AT-II blocker, [Sar¹, Ile⁸]-AT-II.

AT-II in concentrations of 0.4 to 4 μ M produced a dose-related membrane depolarization with a reduction in membrane resistance. These effects were almost completely antagonized by the AT-II blocker, as applied in equimolar concentrations to AT-II. However, the blocker did not eliminate responses of ganglion cells to acetylcholine or bradykinin, indicating a specificity in its blocking action. Neither action potentials nor excitatory postsynaptic potentials were affected by AT-II. It was also shown that the depolarization by AT-II is related to external Ca^{++} concentrations; the lower the Ca^{++} concentrations are, the greater the depolarization by AT-II appears.

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NEUROTENSIN IN NERVE TISSUES OF THE RAT. K. SUNAYASHIKI, T. OHNO, M. SORIMACHI, K. KATAOKA. Dep. of Physiol., Ehime Univ. Sch. of Med. Shigenobu-cho, Ehime 791-02.

The distribution of immunoreactive neurotensin (IRNT) in different areas of brain as well as peripheral nerves of the rat was studied by radioimmunoassay using specific rabbit antisera to synthetic neurotensin. Highest concentrations were present in the hypothalamic areas and the interpeduncular nucleus. There was found a relatively selective distribution of IRNT in the thalamic regions. Low values were in the cerebral and cerebellar cortex. Considerable amounts were found in the vagal and the sympathetic nerves. When isotonic sucrose homogenates of hypothalami were subcellularly fractionated, IRNT was mainly recovered in ordinarily sized synaptosomes. The interpeduncular IRNT concentration was markedly reduced in the rats having lesions in the habenula or the stria medullaris, a finding which suggested presence of neurotensin containing neurons in the habenulo-interpeduncular tract.

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SLOW HYPERPOLARIZATION OF PARASYMPATHETIC GANGLION CELL EVOKED BY REPETITIVE PREGANGLIONIC STIMULATION

SUZUKI, T. Dept. of Oral Physiol., Matsumoto Dent. Coll., Shiojiri-shi

The mechanism of electrogenesis of slow hyperpolarization in hamster submandibular ganglion cells was analyzed with intracellular microelectrodes. Pre- and postganglionic nerves were stimulated through suction electrodes. In 5 mM Ca^{++} saline containing 10^{-5} M physostigmine, orthodromic repetitive stimulation (10 Hz, 40 stimuli) produced two kinds of depolarizations, both of which result from augmented Ach action. These depolarizations lasted over 1 min and were usually followed by a hyperpolarization (up to 10 mV) lasting over 3 min. The slow hyperpolarization was enhanced markedly by a short application of d-TC (10^{-4} M) (up to 20-30 mV). Atropine (5×10^{-5} M) prevented the hyperpolarization but dihydroergotamine (10^{-5} M) did not. Perfusion with K^{+} -free saline did not abolish the hyperpolarization and prolonged its duration. These results indicate that the slow hyperpolarization in submandibular ganglion cell of hamster results from activation of muscarinic receptor.

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REFLEXLY INDUCED Cl^- CONCENTRATION CHANGES IN THE MUCUS ON THE EPIGLOTTIS OF THE RABBIT. SHINGAI, T. AND IKUNO, H. Dept. of Physiol., Niigata Univ. Sch. of Dent., Niigata.

Measurements of Cl^- concentration of the mucus secreted from the mucous glands on the laryngeal face of the epiglottis were carried out using glass ion microelectrodes constructed with a liquid ion exchanger for Cl^- . The tip diameters of the electrodes were 10-20 μm . The sensitivity of the electrode exhibited an approximately theoretical response. Electromotive force was stable within ± 1 mV, and the response time was less than 1 sec. The epiglottis was cut at the midline and held apart by threads. Cl^- concentrations of the mucus on the epiglottis were 80-120 mM at the resting state. The Cl^- concentration of the mucus on a half of the epiglottis was markedly reduced by water application to the surface of the other half of it within a few minutes. NaCl solutions of 500 mM or 1 M failed to change Cl^- concentration. An orthodromic electrical stimulation applied to the contralateral superior laryngeal nerve reduced Cl^- concentration. Perhaps the reflexly induced Cl^- concentration change is mediated by water fibers in the superior laryngeal nerve.

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FACILITATORY EFFECT OF EXOGENOUS PROSTAGLANDIN, NORADRENALINE AND SUSTAINED SYMPATHETIC NERVE STIMULATION ON PROTEIN PERMEABILITY THROUGH BLOOD-AQUEOUS BARRIER IN THE RABBIT EYE. YAMAMOTO, S. and ITOH, Y. Dept. Physiol., Sch. Med., Nagoya University, Nagoya.

Since the discovery of PG in the plasmoid aqueous (Ambache, 1964), its contribution to protein permeation through BAB has been proposed by many workers (Eakins et al, 1970). In this report, facilitatory effect of exogenous PGs on protein permeability and its modulatory effect on sympathetic neuro-effector mechanism were studied in the rabbit eye. After intravenous injection of ^{131}I -labeled serum albumin (RISA), posterior-anterior chamber perfusion with saline solution containing ^{59}Fe - β -globulin was carried out to measure albumin flux rate and bulk flow rate of aqueous humor. Albumin permeability was estimated graphically by the tangent of bulk flow-albumin flux curves. Intracameral application of PG E_2 (3 $\mu\text{g}/\text{ml}$) or noradrenaline (1 $\mu\text{g}/\text{ml}$) in the perfusing saline solution caused remarkable increase in albumin permeability. Sustained electrical stimulation on cervical sympathetic trunk (10V, 0.1 msec, 10 Hz, 15-25 min) also caused an increase in protein permeability. However, application of isoproterenol (0.1 mg/ml), phentolamine (0.05 mg/ml), propranolol (0.01 mg/ml) and PG $\text{F}_{2\alpha}$ (5 $\mu\text{g}/\text{ml}$) did not cause such facilitatory effect. From those results, modulatory effects of PGs on sympathetic neuro-effector mechanism were discussed.

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EXCITATORY AND INHIBITORY NEURONAL RESPONSES OF THE PONTINE DEFECATION REFLEX CENTER TO STIMULATION OF THE CEREBRAL CORTEX IN THE DOG. H. FUKUDA. Dep. of Physiol., Kawasaki Med. Sch., Kurashiki, Japan

Five neuron groups (G1-5) in the pontine defecation reflex center (PDC) were identified by their responding types to stimulation (RBS) of rectal branches of the pelvic nerve: type I, a short burst of spikes with a short latency; II, spikes as type I followed by a delayed long lasting train of spikes; III, a delayed long lasting train of spikes; IV, an inhibition of spontaneous spikes; V, an inhibition followed by a rebound discharges. Responses of G1-5 to stimulation (CS) of the cerebral cortex were studied in chloralose-anesthetized dogs. Nine points in the cortical regions received sensory inputs from the colon were stimulated. Responses of PDC neurons to CS were classified into six types: the same type I-V as those in responses to RBS and type VI, a short burst of spikes followed by an inhibition. Responding types to CS and percentages of responding neurons were different among G1-5. Latencies of type I and VI responses in G1 neurons were shorter than those in G2-5. No remarkable differences were observed among the 9 points of CS, in types and latencies of responses, and in percentages of responding neurons.

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INHIBITION OF SYMPATHETIC NERVE ACTIVITY DURING THE TRIGEMINAL DEPRESSOR RESPONSE

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Stimulation of the spinal trigeminal tract and its nucleus (TSC) of the rabbit anesthetized with urethane results in decreases in arterial pressure and heart rate. We termed this the trigeminal depressor response (TDR). This study demonstrates that the fall in arterial pressure in the TDR is due to inhibition of sympathetic vasoconstrictor discharges. Sympathetic pre- or postganglionic discharges were recorded from the white ramus of the L₁ or the ranal nerve, the latter consisting almost exclusively of the sympathetic vasoconstrictor fiber. The tonic sympathetic discharge was completely inhibited by a single shock given to the TSC. Inhibition of the evoked sympathetic discharge was demonstrated by obtaining the inhibitory curve for the TDR. The conditioning stimulus was given to the TSC, whereas the test stimulus was applied to the following sites; the medullary pressor area, nucleus fastigii, central gray substance and the somatic afferent nerve. Inhibition was observed in all tests except for the short latency response elicited from the somatic afferent. We thus concluded that the TDR inhibits both tonic and evoked sympathetic discharges and that this inhibition involves the supraspinal brain structure.

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RELATIONS BETWEEN GASTRIC MOTILITY CHANGES EVOKED BY STIMULATION OF VAGAL AND SPLANCHNIC NERVES AND THE RESPONSIBLE FIBER TYPES IN RATS

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This experiment was undertaken to determine the relation between gastric motility changes evoked by electrical stimulation of centrally transected vagal or splanchnic nerves and the responsible efferent fiber types in anesthetized rats. Gastric motility was slightly facilitated by repetitive electrical stimulation of vagal B fibers. Repetitive stimulation of vagal C fibers produced either slight gastric facilitation or slight inhibition during stimulation, but large gastric facilitation always followed shortly after stimulation. Splanchnic C fiber stimulation inhibited gastric motility, but the B fiber contribution to inhibition was much greater.

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RECEPTIVE AREAS AND DISCHARGE PATTERNS OF GASTRIC MECHANORECEPTOR NEURONS IN NODOSE GANGLION. M. SATO, K. YOSHIZAKI, J. IWAMOTO, H. KOYANO.

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The discharge pattern of the most gastric mechanoreceptor neurons was regularly grouping. These neurons responded to the mechanical stimuli applied from the serosal side to the stomach. Each neuron has a various threshold that may partly depend on the different receptor layers.

To clarify this problem, the distribution of the radioactive material coming into the gastric wall through an axonal flow has been studied with obtaining specific radioactivity (dpm/tissue wet wt.) of the respective gastric layers. And light microscopic autoradiography has been adopted to search for the afferent terminals of nodosal neurons in the gastric wall.

Radioactivity above background has been detected in all the layers, and the highest specific activity was found in the circular muscle layer. In autoradiograph, silver grains were predominantly located on the cell layers above laminae muscularis mucosae and were appeared to be diffused in the circular muscle layer.

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CARDIAC SYMPATHETIC NERVE: SUPRASPINAL NUCLEUS AND DESCENDING PATHWAY RELATED WITH CARDIOACCELERATION. MIURA, M., KITAMURA, T., OKADA, J.
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By HRP technique, supraspinal nuclei sending inputs to cardioacceleratory sites in nucl. intermediolateralis (ILN) of T2 segment were surveyed in rats. HRP labeled neurons were found bilaterally in: (1) nucl. paramedial reticularis, nucl. medullae oblongatae centralis subnucl. vent. et dors., nucl. gigantocellularis, nucl. raphe pallidus and around nucl. lateralis reticularis in medulla; (2) nucl. locus coeruleus in rostral pons; (3) nucl. paraventricularis and nucl. lateralis in posterior hypothalamus. This fact suggests the presence of multiple inputs to ILN.

By electrophysiological technique, location of spinal descending tracts from bilateral hypothalamic pressor areas, fastigial pressor areas and carotid chemoreceptor fibers to cardiac nerve were surveyed in cats. Before and after lesions in spinal cord, averaged evoked responses in cardiac nerve were monitored to repetitive stimulation of these sympathetic sources. Descending tracts were localized bilaterally in dorso-lateral funiculus. No differential distribution was found in the pathways from different sympathetic sources.

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Distribution of vagal cardioinhibitory preganglionic neurons in rat brain stem.
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Locations of vagal cardioinhibitory preganglionic neurons (VCIN) were determined in rat brain stem with functional and histological approaches. 1. In chloralose-urethane anesthetized rats, with the spinal cord transected at the C₁, electrical stimulus was given to various points of the brain stem. Loci eliciting vagal bradycardia were found in the vicinity of the nucleus dorsalis (ND) and in the region of the nucleus ambiguus (NA). These areas showed a greater responsiveness to a given suprathreshold stimulus. 2. HRP was administered iontophoretically through an HRP-containing glass capillary electrode into the functionally identified cardiac branch of the vagus. HRP-labeled cells were found in the ND, in the region around the NA and in the intermediary region in between the two nuclei. 3. When the cardiac branch of the vagus was electrically stimulated, antidromic unitary responses could be recorded in the same three regions where HRP-positive cells had been localized. Latencies of antidromic responses of the units of the ND were comparable to conduction time of C fibers whereas those of the other two areas, to conduction time of B fibers. In conclusion, the VCIN in rats are not confined to any single nucleus as previously conceived, but are distributed in the three areas, the ND, the region around the NA and the intermediary zone in between the two nuclei.

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CATECHOLAMINE-INDUCED REGULATION OF CYCLIC MP RESPONSE IN RAT PAROTID GLAND.
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Hokkaido University School of Dentistry, Kitaku, Sapporo

Rat parotid slices exposed to norepinephrine (NE) become refractory to subsequent NE stimulation in the formation of cyclic AMP. The degree of refractoriness depended on a time of exposure to NE. It was evident within 10 min., but it required about 60 min. to obtain almost complete refractoriness. The degree of refractoriness depended on the concentration of NE. It was significant at 0.4 μ M with the maximum effect being attained at 10 μ M. Recovery from refractoriness was observed by removing NE from the medium. It was significant at 15 min. and almost complete at 60 min. Both the development of refractoriness and recovery from it were temperature-dependent process. Although parallel changes were observed between the increase in cyclic AMP and the degree of refractoriness by NE, refractoriness was not mediated by the formation of cyclic AMP. Preincubation of slices with NE markedly decreased the stimulatory effect of NE on the activity of adenylate cyclase of the membrane fraction prepared from the corresponding slices and this decrease was almost comparable to the decrease of the effect of NE plus 3-isobutyl-1-methylxanthine on the level of cyclic AMP. These results suggest that refractoriness of parotid cyclic AMP response is mediated by regulating the process of activation of adenylate cyclase.

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ACTION OF HISTAMINE ON THE MOTOR ACTIVITY OF THE ANTRAL CIRCULAR MUSCLE IN THE DOG'S STOMACH. FUJII, K. & TAKASUGI, S.* Dept. of Physiol. & Dept. of Surg.*, Hiroshima Univ. School of Med., 1-2-3 Kasumi Hiroshima.

The purpose of this experiment is to investigate the role of histamine on the mechanism of the gastric motor excitatory response obtained by stimulation of vagal and splanchnic nerves.

The influences of administration of histamine, Chlorpheniramine (CPM), Cepharanthine (CR), atropine and TTX on the motor activity of the antral circular muscle in the dog were examined.

(1) Histamine augmented height of the contraction of the antral circular muscle induced by the vagal stimulation. (2) CPM (Histamine H_1 -receptor antagonist) inhibited the contraction of the antral circular muscle produced by administration of histamine and gastrin. (3) CR (Inhibitor of histamine release) inhibited the contraction of the antral circular muscle produced by administration of gastrin. However, no influences of CR were observed on the contraction of the antral circular muscle produced by histamine. (4) No influences of atropine & TTX were observed on the contraction of the antral circular muscle produced by histamine.

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EFFECT OF BLOOD GLUCOSE IN THE PORTAL VEIN ON EXOCRINE PANCREATIC SECRETION. T. HIRANO, T. SAKAGUCHI, A. FUKUDA, A. WARASHINA and A. NIIJIMA Dept. of Physiol., Niigata Univ. Sch. Med., Asahimachi, Niigata

We have reported that the hepatic gluco-sensitive mechanism affects the secretion of gastric acid and efferent activity of the gastric vagus nerve. It has been shown that there was an inverse linear relationship between pancreatic secretion and systemic level of blood glucose after glucose infusion. The experiment was designed to clarify whether change in the glucose level of the portal blood influences on the secretion of pancreatic juice.

Conscious rats with chronic pancreatic fistulae were used 2-5 days after the operation. Plasma glucose in portal blood was altered by intraduodenal infusions of 20% glucose (400mg/kg) or physiological saline 2 ml in 2 min. The secretion of pancreatic juice was inversely correlated with the glucose level in portal blood.

Thus it was suggested that the gluco-sensitive mechanism of the liver may affect the secretion of pancreatic juice.

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STUDIES ON VASOMOTOR NERVES Y. NISIMARU, M. KATO. Dep. of Physiol., Hiroshima Jogakuin College, Hiroshima

Since Stricker (1876) reported that hindlimb vessels are dilated by stimulating the dorsal roots of the spinal cord, many such experiments have been presented. Bayliss (1901), after performing the degeneration test, which is the cutting of the nerve between the spinal cord and the posterior root ganglion, considered that the vasodilatation was brought about via afferent nerve fibers. According to this, Langley termed the vasodilatation "antidromic action." On the other hand, Kure (1937) attributed it to parasympathetic nerve fibers, because medullated nerve fibers remained after the same degeneration test. Further, Kozuka (1962) regarded the action as being caused via sympathetic nerve fibers. We have obtained the following results from our experimentation since 1961 on the frog and toad: 1) Acetylcholine-like substances are released by the hindlimb vessels by stimulating the dorsal roots of the spinal cord, while adrenalin-like substances, by stimulating the anterior roots. 2) Dilatations and constrictions of the hindlimb vessels occur by stimulating the medulla oblongata. 3) Action potential can be measured at the dorsal and anterior roots of the spinal cord by stimulating the medulla oblongata.

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CENTRAL NEURAL MECHANISM OF THE CEREBRAL ISCHEMIC RESPONSE. M. KUMADA and N. TERUI Inst. Basic Med. Sciences, Univ. Tsukuba, Ibaraki-ken

We sought to determine whether or not the hypertension in the cerebral ischemic response (CIR) is a consequence of excitation of reticular neurons within the medullary pressor area (MPA). The lower brainstem was explored in anesthetized and paralyzed rabbits for recording activity of the medullary reticular unit and its response to the CIR. Of 265 medullary units observed, 102 units (38.5%) responded to the CIR by increasing their discharge rate (E unit), whereas in 151 units (57.5%) the CIR diminished the discharge rate (I unit). Within the MPA the ratio (# of E unit/# of I unit) was significantly greater ($P < 0.005$; Chi-square test) than within the rest of the medullary reticular formation. Electrical stimulation of the MPA is known to evoke potentials in the splanchnic nerve with the shortest latency between the medulla and that nerve. These findings indicate that hypertension in the CIR is a consequence of excitation of reticular neurons within the MPA.

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FACILITATORY INTERACTION BETWEEN CAROTID SINUS BARORECEPTOR REFLEX SYSTEM AND VAGALLY MEDIATED REFLEX SYSTEM IN ARTERIAL PRESSURE RESTORATION
HIROSHI HOSOMI, Dep. of Physiol., Div. II, Kobe Univ. Sch. of Med., Ikuta-Ku Kobe

The manner of summation between the carotid sinus baroreceptor reflex system and the vagally mediated reflex system was studied as they attempt to restore mean arterial pressure after 10% quick hemorrhage in splenectomized conscious dogs chronically instrumented with catheters for pressure measurement and hemorrhage. The hemorrhage experiment was repeated under nerve intact condition (INTACT), with cold block of the vagi ((V)), after carotid sinus denervation (CS), and CS plus (V) situations. Mean arterial pressure falls at 1.5 min after the hemorrhage were 7.2 in INTACT, 24.7 in (V), 36.0 in CS, and 67.6 in CS+(V) mm Hg. When we calculated the open-loop gains of both reflex systems assuming a simply additive summation between them, a self contradiction occurred. To avoid this contradiction, it was necessary to assume that both reflex systems interact in a facilitatory manner. Mean open-loop gains calculated under this assumption were 1.64 for the carotid sinus baroreceptor reflex system alone, 0.89 for the vagally mediated reflex system alone, and 6.59 for the facilitatory interacting component between both reflex systems. These results forced us to conclude that the interacting component between both reflex systems plays the most important role in arterial pressure restoration after the hemorrhage. (This study was performed in cooperation with K. SAGAWA at Johns Hopkins U.)

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PATHOGENESIS OF LOCAL CIRCULATORY INSUFFICIENCY INDUCED BY VIBRATORY STIMULATION., T. AZUMA, T. OHHASHI, M. SAKAGUCHI*, Dep. of Physiol., Shinshu Univ. Med. Sch., Matsumoto, *Dep. of Elec. Eng., Nagano Tech. Coll. Nagano

We have reported the effects of in vitro and in vivo vibratory stimulations on dose-response relationships of excised femoral artery to noradrenaline. The responsiveness to noradrenaline was reduced during and enhanced after application of the stimulation. The present study was undertaken to investigate whether the vibration-induced hyperresponsiveness of arterial smooth muscle to noradrenaline could also be recognized in intact hind paw vascular bed of dogs. The results obtained were as follows. (1) Blood flow resistance in hindlimb vascular beds was lowered by vibratory stimulations. (2) The increase in blood flow resistance by noradrenaline at the first hour after a vibratory stimulation was significantly higher than that before the stimulation. (3) The interdigital temperature of a hindlimb rose gradually during the application of vibratory stimulations. The amount of temperature drop by noradrenaline reduced during and increased after the stimulations. (4) The degree of reactive hyperemia was reduced during and increased significantly after the stimulations.

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BLOOD PRESSURE MEASUREMENT WITH STRAIN GAUGE FORCEPS. Y. HAYASHI, N. MUTSUGA, T. MIZUTANI, N. KAGEYAMA, Dep. of Neurosurg. Nagoya Univ. Sch. Med. Showaku, Nagoya. K. Sugita, Dep. of Neurosurg. Shinshu Univ. Sch. Med. Matsumoto. Y. MIZUNO, Y. GOTO, Tokai Rika Corp. Shinkawa-cho, Aichi-Pref.

the measurement of

The possibility of intraarterial blood pressure (BP) without cannulation was already reported using our designed strain gauge forceps by completely obstructing an artery. Furthermore, BP could be measured using this kind of new forceps without completely obstructing an artery. Based on the force (Fgm) to compress an artery against its tension and the outer diameter (OD) of the vessel during compression, both of which are affected by BP and elasticity of the arterial wall, the theoretical formula was made to calculate BP as the functions of various factors: force change ΔF , OD change ΔOD , initial OD with no compression, width of forceps and fundamental tension of arterial wall. This formula was proved to be well correlated with the BP measured by cannulation method on dog experiments with an error of + 20%. Thus, it is possible to measure BP even without completely obstructing a vessel by the strain gauge forceps. Clinical application of method will be possible in neurovascular surgery.

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ARTERIAL AND VENOUS PRESSURES PRODUCING EFFECT ON HEART RATE O. OKAI, A. WATANABE*, M. SAITO*. (Dept. of Physiol., Kyorin Univ. Sch. of Med., Mitaka-shi, Tokyo 181; *Inst. of Med. Elec., Fac. of Med., Univ. of Tokyo, Hongo, Bunkyo-ku, Tokyo 113)

Experiments were performed on dogs under the condition induced by intravenous infusion with noradrenaline, isoproterenol and acetylcholine. After measuring hemodynamic variables from each dog, normalizing these by the control values, we got heart rate H, cardiac output F, mean arterial pressure P and mean venous pressure V. From these data such equation was established by the least square method as $H = a(\log F + b)^2 + c + dP + eV$ --- (1). Here pressure-driven value is defined as $PDV = c + dP + eV$. Rewriting eq. (1), we obtained cardiac output: $F = \exp((PDV - H)^{1/2}/a - b)$. These equations mean that 1) cardiac output increases with increasing heart rate, 2) standard deviation of output PDV are smaller than that of input P and V, 3) according as pressure is greater or lower than control pressure, PDV is smaller or greater than control value; after all, it seems possible that venous and arterial pressure both produce effect on heart rate for arterial pressure to remain constant; PDV cooperate in suppressing heart rate above the control pressure while PDV does so in quickening heart rate below the control pressure.

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ANALYSIS OF TRANSVASCULAR FLUID SHIFT BY MEANS OF CONTINUOUS BLOOD VOLUME DETERMINATION. T. MORIMOTO, K. MIKI & Y. TANAKA Dept. of Physiol., Kyoto Pref. Univ. of Med., Kamigyoku, Kyoto.

On splenectomized dogs, 15 % of circulating blood was shed or reinfused and the changes in circulating blood volume, hematocrit, colloid osmotic pressure were determined continuously. Based on the results, transvascular fluid shift was simulated by an equivalent circuit which enabled to determine the effective intravascular capacitance (C_1), interstitial capacitance (C_2) and transvascular filtration coefficient (FC) of whole body tissue.

The results obtained were as follows: For blood shedding, C_1 was 3.58 ± 0.82 ml/kg·mmHg, C_2 was 3.73 ± 1.50 ml/kg·mmHg and FC was 0.619 ± 0.361 ml/min·kg·mmHg. When the blood was reinfused, the values became higher and C_1 was 4.21 ± 1.48 ml/kg·mmHg, C_2 was 4.88 ± 2.33 ml/kg·mmHg and FC was 0.764 ± 0.501 ml/min·kg·mmHg. Statistically significant difference was not found in any of the values between blood shedding and reinfusion. The value of FC is inbetween of the reported values of FC for dog muscle (0.104) and dog intestine (0.8-4.4).

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MODEL EXPERIMENTS ON THE FLOW PATTERN IN THE ABDOMINAL AORTA., T. FUKUSHIMA, T. AZUMA. Dep. of Physiol., Shinshu Univ. Med. Sch., Matsumoto

The focal nature of atherosclerosis may well be ascribed to local fluid dynamic events. This work was undertaken to investigate flow patterns in the model of the abdominal aorta and to relate them with the development of atheromatous plaques. Complicated secondary flows were induced in the aorta as a result of vortex-sink flows at the orifices of branch vessels. The presence of sink flows into the celiac and superior mesenteric arteries resulted in flow separation at the opposite wall to the branching sites of the arteries. A part of wall surface just distal to an orifice of a branch may be subjected to a relatively high shearing stress due to impingement of central core flow. The concentration of streamlines was observed at the wall short distance upstream of every branch orifice, which has been known as a predilection site of atherosclerotic plaques. The turbulent flow appeared downstream of the branching site of the renal arteries may exert shearing stresses to endothelial surface which are unstable in direction and in magnitude. Exposure to these unstable stresses for long time seems to facilitate the development of atherosclerotic changes.

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EVALUATION OF CAPILLARY BLOOD FLOW FROM OXYGEN UTILITY RATIO Masakazu Fukuoka, Osamu Okai, Tomiko Ishikawa, Hiroshi Ito, and Chosetsu Nagashima. Dept. of Physiol., Kyorin Univ. School of Med., Mitaka-shi Tokyo.

Using a simple model simulating microcirculation, a theory to measure the ratio of capillary blood flow (F_c) to arterial blood flow (F) in an organ ($\alpha \equiv F_c/F$) was proposed. This model is a parallel circuit composed of a true capillary in which gas exchange occurs and a thoroughfare channel (an A-V anastomosis) in which oxygen is not considered to diffuse into the surrounding tissue. On this model the ratio is expressed as $\alpha = (C_a - C_v)/(C_a - C_c)$. If C_c is negligibly small with respect to C_a , we can determine the ratio α from the relation between the oxygen utility ratio ($U \equiv (C_a - C_v)/C_a$) and the arterial flow. This theory is applied for measuring the ratio α in the hindlegs of anesthetized dogs. The results are as follows: (1) In normal dogs the ratio α was about 70-80 %; (2) The ratio α is 65-70 % for papaverine (i.v. administrated), 75-80 % for atropine, and about 85 % for norepinephrine; and (3) During the sciatic nerve stimulation (10 Hz) the ratio increased up to more than 90 %. These results suggest that this method seems to be useful for evaluation of the relative blood flow in the true capillary.

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RECIPROCITY OF BLOOD FLOW IN THE PERFUSED CANINE CEREBRAL CIRCULATION. M. SHIRATAKA, Y. NARA, T. SATO, N. IKEDA Depts. Physiol., Int Medicine, and Information Sci., School of Medicine, Kitasato Univ., Sagami-hara-shi Kanagawa

In order to quantify the reciprocal relationships in the blood flows of arteries flowing into the brain, right and left, internal, external carotid and vertebral arteries were isolated to pump-perfuse the brain tissue of the dogs with autologous blood. Blood flow rates were measured with EM-flowmeter. Pressures of the systemic, perfusion arteries, circle of Willis and venous pressure in the cranium were measured with pressure-transducers. Isolation of the cerebral circulation was confirmed roentgenologically with contrast materials after the experiment.

Clamping of one or more arteries resulted in increase of blood flow rates in others, although total cerebral blood flow was not completely recovered by the reciprocal response. A mathematical analysis of pressure-flow relationships under the various conditions of the clamping has shown that mechanism of the reciprocity can be attributable to the invariant mechanical parameters of the blood vessels in the sense of Poiseuille's law, and that any biological regulations may not be involved.

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AUTOREGULATION OF WALL SHEAR RATE BY AN ADAPTIVE RESPONSE IN A CANINE ARTERY. A. KAMIYA. Inst. Med. & Dent. Engng, Tokyo Med. & D'ent. Univ. Chiyoda-ku, Tokyo

To quantify the adaptive vascular responses to the flow load, an anastomosis between the common carotid artery and the external jugular vein was constructed in 12 dogs and more than 6 months after the operation, the blood flow rate and the internal diameter of the artery proximal to the anastomosis were measured. The increased flow rate associated the increased diameter and vice versa. Calculated wall shear rates were found to return almost exactly to the control level. An autoregulatory mechanism of wall shear rate including the adaptive response was suspected.

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THE EFFECT OF HEMATOCRIT INCREASE ON PULMONALY ARTERY HYPERTENSION. G. UEDA, A. SAKAI. Inst. of Adapt. Med., Shinshu Univ., Matsumoto

Healthy humans and animals living at high altitude for long periods reveal some degree of right ventricular hypertrophy associated with pulmonary artery hypertension even at rest. Although the explanation for the mechanism had been controversial so far, we obtained some experimental evidence to suggest that hematocrit(Ht) increase was an important contributing factor.

First, when the flow in simulated model experiments was kept at a constant level and the Ht-values were altered from 25 to 82 %, the pressures corresponding to aortic and pulmonary portions increased respectively as Ht-values increased. From these data, simulated cardiac works were calculated. Then, the ratios, right ventricular work / left one, were obtained. The results were, for example, 0.09 for 37 % -Ht, 0.13 for 49 % -Ht, and 0.17 for 82 % -Ht.

Secondly, the femoral-artery pressure(FP) and the right-ventricular pressure(RP) were measured continuously for dogs anesthetized. In a typical case, it was shown that the FP increased from 103 to 110 mmHg when Ht-values were altered from 49 to 84 %, while the RP changed from 30.0 to 45.7 mmHg. Consequently, the ratio, RP/FP, increased considerably from 0.29 to 0.42 after the artificial increase of Ht-value. The similar tendency was confirmed in 4 among 6 cases.

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LYMPH TRANSPORT AND ITS REGULATORY FACTORS., T. OHHASHI, T. AZUMA, M. SAKAGUCHI*, Dep. of Physiol., Shinshu Univ. Med. Sch., Matsumoto, *Dep. of Elec. Eng., Nagano Tech. College, Nagano.

We have reported spontaneous electrical and mechanical activities of bovine mesenteric lymphatics, and discussed a structural feature, on the basis of which the activities were developed. The present study was undertaken to investigate mechanical characteristics and responses to several physiological vasoactive substances of the isolated canine thoracic duct for the purpose of comparison. The results obtained were as follows. (1) Pressure-radius relationships of the both lymphatic ducts were similar in pattern to those of the vein. By the use of Oka-Azuma's equation, Young's moduli of the mesenteric lymphatics and the thoracic duct in circumferential direction at a physiological intraluminal pressure were estimated to be 0.4 and 2.0×10^5 dynes/cm², respectively. (2) Endurance limits of the valves involved in the lymphatics and the duct of about 3 mm in outer diameter were 69.1 ± 7.6 and 48.4 ± 12.8 cm H₂O, respectively. (3) Contractions of smooth muscle in the canine thoracic duct were induced by histamine, noradrenaline, 5-hydroxytryptamine, dopamine, and prostaglandin F_{2α}.

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PO₂ AND PLASMA OSMOLALITY CHANGE IN VENOUS OUTFLOW FROM THE RABBIT HINDLIMB DURING A 30-MIN MUSCLE EXERCISE. TAKEMIYA, T. HIGUCHI, Y. MATSUKURA, H. ITO, H. NAGASHIMA, Ch. Dep. of Physiol., Kyorin Univ. Sch. Med., Mitaka-shi Tokyo

Venous outflow, Po₂ and plasma crystalloid osmolality were studied in the rabbit hindlimbs during and following prolonged exercise. Muscle exercise for 30 min was induced by interval stimulation (30 sec per min) of the sectioned sciatic nerve at the frequency which was modulated sinusoidally in the range of 1 to 10 Hz.

Microvascular resistance (PRU) decreased rapidly to 45.3% (n=13, P<0.01) of the control and was kept approximately constant during 30 min exercise. Maximal tension force developed in the initial stage of exercise decreased to 60% at the end of 30 min exercise. The maximal venous osmolality to the control was 106.7% (n=13, P<0.01) at 5 min after onset of exercise, and then gradually decreased to 104.1% at 10 min, 101.8% at 20 min and 101.3% at 30 min. Venous Hct and plasma protein were parallel with these changes. Venous Po₂ decreased to 74.2% (n=7, P<0.01) at 2 min after the start of exercise. A few minutes later, the level reached 67.7% and was kept approximately constant until the end of exercise. (n=4, P<0.01).

The mechanism of long lasting hyperemia has been discussed from the point of mechanical mode of exercise and dual blood flow.

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STUDIES ON THE LOCAL REGULATORY MECHANISM OF MICROCIRCULATION WITHIN RABBIT EAR CHAMBER. (8) COMPARISON OF MICROCIRCULATORY EFFECTS OF CUTANEOUS WARMING AND ADRENERGIC ALPHA-RECEPTOR BLOCKADE WITH PHENTOLAMINE. M. ASANO, C. OHKUBO, K. SAWANOBORI. Dep. of Physiol. Hyg., the Inst. of Publ. Health, Minato-ku Tokyo

Under normal conditions, at ambient temperature of 20°C, whole body or local warming of ear lobe of the rabbit by heated air up to 40°C induced a persistent microvascular dilatation after a certain latency at all vessel levels within the ear chamber. The dilating state, in which vasomotion became hardly recognizable and increased blood flow was rapid and pulsatile, subsided quickly following cessation of warming. Under the same conditions, α-adrenergic blockade with phentolamine (5-10 mg/kg i.v.) promptly induced a marked and transient microvascular dilatation. Thereafter, the vasodilating state changed into a persistent constricting one in which vasomotion was obscure and capillary flow was very much reduced and retarded. Both warming and α-adrenergic blockade brought about a similar marked and persistent increase in macrocirculatory flow of the central artery and marginal vein of ear lobe installed the chamber throughout periods during which the treatments were effective.

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HEMODYNAMICS OF THE PULMONARY CIRCULATION DURING A BLOOD PRESSURE OSCILLATION IN RABBITS M. HAYASHI, K. MIYAKAWA The 2nd Dep. of Physiol. Faculty of Medicine Shinshu Univ. Matsumoto

Stepwise elevation of the systemic arterial blood pressure (S.A.P.) superimposed by oscillation was produced by graded restrictions of cerebral blood flow. The pulmonary blood flow (P.F.), aortic blood flow (A.F.), central venous pressure (C.V.P.) and left atrial pressure (L.A.P.) were simultaneously recorded during the change of S.A.P.

The exertion of moderate side pressure elicited a S.A.P. oscillation (S.A.P.O.) around an elevated level. In this stage L.A.P. undulated a little behind S.A.P.O. P.F. undulation was almost in the same phase of S.A.P.O. A.F. decreased with each rise of S.A.P.O., turned to increase a little before the top of it and attained the maximum in the middle of the descending phase of it. C.V.P. undulated almost reversed to phase with S.A.P.O. During the course of stepwise elevation of side pressure, L.A.P. level exponentially increased with the rise of S.A.P. level. Dissociation between P.F. and A.F. became greater as S.A.P. level increased. On the other hand, C.V.P. level indicated a gradual decrease with the increase of S.A.P. level, but turned to increase at about 140 mmHg of the S.A.P. level.

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ANALYSIS OF PERIPHERAL VASCULAR SYSTEM BY MEANS OF FLUCTUATION OF FREQUENCY CHARACTERISTICS STUDIED IN MANDIBULAR PERIOSTEUM OF RABBIT. MORITA, M. Dep. of Physiol., Tokyo Dental College, Chiyoda-ku, Tokyo

The comparison of impedance plethysmogram from peripheral tissue (IMP) and blood pressure from influent artery (BP) must give informations about peripheral vascular system (PVS). Frequency analysis was applied to IMP and BP, and harmonics of each were compared for the measurement of frequency characteristics of PVS. The fluctuation of it mirrors the change of PVS. PVS was analogued by 3 components model, consisting of inflow, outflow resistance (R_i), (R_o), and compliance (C). Characteristics of PVS approximated to those of analogue model roughly in animal studies. Therefore if the suppositions mentioned below are held, R_i can be analyzed as follows.

- (1) IMP reflects the fluctuation of blood volume proportionally.
 - (2) PVS of study approximates to the analogue model.
 - (3) PVS is constant during the sampling time for frequency analysis.
- $$R_i = \frac{1}{\sqrt{3}} \cdot \frac{1}{\omega} \cdot \frac{\left(\frac{P_{2\omega}}{Q_{2\omega}} \right)^2 - \left(\frac{P_{\omega}}{Q_{\omega}} \right)^2}{\left(\frac{P_{2\omega}}{Q_{2\omega}} \right)^2 + \left(\frac{P_{\omega}}{Q_{\omega}} \right)^2}, \quad \omega = 2\pi f$$
- $P_{\omega}, P_{2\omega}$, Amplitude of 1st and 2nd harmonic of BP.
 $Q_{\omega}, Q_{2\omega}$, Amplitude of 1st and 2nd harmonic of IMP.
- Different fluctuation was recorded after injection of Nor or IsP, with the result that R_i changed as follows, Cont. 100, Nor: to 137+19, IsP: to 82+10.

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UNIT ACTIVITY IN BRAIN STEM CORRELATING TO SYMPATHETIC DISCHARGE. Nishikawa, Y., Miyakawa, M. and Hukuhara, T., Jr., Dep. of Pharmacol. II, Jikei Univ. Sch. Med., Minatoku, Tokyo

In aiming to find the more reasonable method for identification of brain stem vasomotor neurons relating to the central vasomotor control mechanisms, the present experiments were performed in vagotomized, paralyzed cats with local anesthesia maintained by artificial ventilation under monitoring end-tidal O_2 and CO_2 levels. The efferent discharge of the renal sympathetic and splanchnic nerves was quantitatively evaluated by means of power spectrum analysis as well as non-leaky integration procedure. Vasomotor neurons were identified on the basis of either the recognizable coordination between the spontaneous and/or experimentally evoked changes in unitary discharge frequency and the sympathetic nerve activities or the value of correlation coefficient of cross-correlation between the neuronal and nerve activities and the both criteria. These neurons were scattered in the bulbar reticular formation. Four types of sporadic, tonic and bursting background neuronal discharge patterns were discerned. Two types of vasomotor neurons were differentiated on the basis of the direction of the frequency change of unitary discharge in response to alterations of arterial blood pressure induced experimentally. Furthermore, confirming by cross-correlation analysis, some vasomotor neurons exhibited a rather longer periodicity than the respiratory cycle in synchronization with that of the sympathetic nerve activity.

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THE HEAD ELECTROCAPACITOGRAPHY AND BRAIN CIRCULATION.

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Electrocapacitography, a very sensitive electrical method for measuring volume changes of organs (Hatakeyama, I.: Jap. J. Physiol., 9: 387, 1959) was applied for investigation of cerebral circulation. Electrocapacitogram (ECPG) of rabbit head bears pulsatile variation with respiratory undulation. Pulsatile component has a resemblance to central arterial pulse wave, although the former is more complex. The amplitude as well as the configuration of pulsatile changes varied with the location of ECPG electrodes. ECPG obtained at the region containing hypothalamus showed marked pulsatile change but relatively small respiratory undulation. Occlusion of both carotid arteries little influenced on pulsatile component but respiratory undulation was markedly decreased at the region containing diencephalon. The drop of ECPG level, which means decrease of vascular volume, was produced by stimulation of cervical sympathetic nerve. By carotid occlusion the effect was slightly decreased, although considerable deterioration of the effect was observed in several cases. It is suggested that cerebral circulation is considerably regulated by sympathetic nerve.

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MEASUREMENT OF CARDIAC OUTPUT IN CONSCIOUS RATS. J. IRIUCHIJIMA, Y. NUMAO

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In conscious rats cardiac output was continuously observed by means of an electromagnetic flowmeter probe chronically implanted at the ascending aorta. Replacement of the rat to a new box from an accustomed one invariably induced a cardiovascular response complex (new box response, NBR), comprising increases in heart rate, minute volume, maximum aortic flow velocity, and cardiac work. Despite these cardiac changes arterial pressure remained almost unchanged and total peripheral resistance decreased. After beta adrenoreceptor blockade with propranolol, 1mg/kg, the above changes ascribable to an excitation of cardiac beta receptors disappeared but arterial pressure and total peripheral resistance increased in NBR. It is suggested that a general vasodilation due to beta receptor excitation is included in NBR. It is possible that the vasodilation is induced by an activity of the adrenal medulla and that, in the rat, the role played by the cholinergic sympathetic vasodilators in other animals is fulfilled by this mechanism.

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A MULTICHANNEL TELEMETER FOR RECODING CARDIOVASCULAR NEURAL SIGNALS. Y. YONEZAWA and I. NINOMIYA. Department of Electrical Engineering, Hiroshima Institute of Technology, Itukaichi, Hiroshima and Department of Cardiac Physiology, Research Institute, National Cardiovascular Center, Suita, Osaka.

A multichannel telemetry system was developed for use with both chronic and unrestrained small animals. This system can simultaneously record: efferent and afferent cardiovascular neural signals; bioelectrical noise arising near the electrode recording the neural signals; EEG; ECG; and a standard calibration signals.

The miniature (18 cm³), lightweight (24 g) telemeter is powered by two small 120 mA hr silver oxide cells; it has an indoor transmission range of 10 meters, and can operate for 48 hours.

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BARORECEPTOR RESPONSE TO PRESSURE DECREASE AROUND THE NECK. OGASAHARA, Y., KURODA, E. and FUJII, K., Dept. of Elect. Engrg., Osaka Univ., Suita, Osaka, Japan

Carotid arterial baroreceptors were stimulated in man by applying subatmospheric pressures to a box enclosing the neck, and the cardiovascular responses to this stimulation were observed. At each cardiac period, the heart rate, arterial pressure and stroke volume were measured in order that the transient cardiovascular behavior might be observed. The pressure in the box was gradually decreased and was then maintained at a constant level. Results obtained are as follows: (1) The heart rate decreases proportionately to the pressure in the box as the pressure is gradually decreased. After the pressure attains the constant level, the heart rate recovers slightly. These imply that the control mechanism of the heart rate including baroreceptors has differential characteristics. (2) Cardiac output and arterial pressure decrease soon after the pressure decreases. After the pressure reaches the constant level, cardiac output returns to the control value, whereas the arterial pressure hardly changes. This would suggest that the total peripheral vascular resistance decreases when the pressure decreases. Further, the experiments were simulated by using a mathematical model of the whole vascular control mechanism which the authors had proposed. The simulated results were compared with the experimental ones. The comparison supports the implication described above about the characteristics of the baroreceptors.

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BLOOD FLOW REDISTRIBUTION IN MICROCIRCULATORY BEDS OF THE STRIATED MUSCLE OF DOG'S HIND LIMBS. INFLUENCES OF ACUTE VENOUS CONGESTION AND HEMORRHAGIC HYPOTENSION.

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We measured the diffusion capacity (PS, the permeability-surface-area-product) for Na^{22} or Rb^{86} during acute venous congestion and during hemorrhagic hypotension, using the "indicator diffusion" method. PS for Na^{22} or Rb^{86} was decreased by about 30-40%.

In another series of experiments, the Capillary/Fiber ratio, studied employing low-viscosity silicone rubber injection method was significantly decreased only during hemorrhagic hypotension.

It is concluded that, during acute venous congestion, blood flow shifts mainly to non-exchange vessels without any "closure" of exchange vessels. In contrast, during acute hemorrhagic hypotension, blood flow shifts to non-exchange vessels with an approximately 20% "closure" of "capillary" blood vessels.

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EFFECT OF BLOOD pH ON THE PHOSPHOLIPIDS OF THE ERYTHROCYTES IN RATS. SHIRAKI, K., SAGAWA, S., Dept. of Physiol., Sch. of Med., Univ. Occup. & Environ. Hlth., Kitakyushu

pH of the blood compartment which passes relatively slowly through the red pulp of spleen is reported to be very low (approximately 6.8). Previously we reported that a lowered pH environment made the erythrocytes spherical and reduced membrane lipids. Present study was designed to examine the effect of blood pH on the changes in water content of the erythrocytes and lipid composition of the cells and plasma. When the erythrocytes were incubated in the plasma of low pH (6.6), their water content increased by 4.7% ($p < 0.001$) and phospholipids and cholesterol decreased by 10.8% ($p < 0.001$) and 8.9% ($p < 0.01$), respectively. At the same time phospholipids and cholesterol in the plasma increased by 9.7% ($p < 0.001$) and 13.6% ($p < 0.001$), respectively. This observation suggested that water was shifted into the cells from the plasma and conversely, lipids of the cell membrane moved to the plasma. Recovery of water and lipid contents of the erythrocytes was observed by the restoration of pH to normal value. By lowering blood pH, a significant reduction of phosphatidyl ethanolamine, and lecithin, and a significant increase in lysolecithin in the erythrocytes were observed. At the same time increase in lecithin and lysolecithin were observed in the plasma. These results showed the rapid exchange of erythrocyte phospholipids with phospholipids of plasma and the degeneration of lecithin by lowering blood pH.

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CHANGES IN ERYTHROCYTE SPECIFIC GRAVITY AND OSMOTIC FRAGILITY WITH THE GROWTH OF RATS.

KOGAWA, H. and SUDO, K. (Dept. of Health Science, Osaka Kyoiku Uni., Hirano-ku, Osaka)

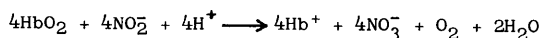
The osmotic fragility curves of erythrocytes were recorded by the coil planet centrifuge (C.P.C.) system. The specific gravity distribution of erythrocytes was determined by the method of Sudo (Osaka City Med. J., 1976). The erythrocyte osmotic fragility curves of one-week-old rats are quite different from those of four-week-old ones. The former blood contains both fragile and resistant erythrocytes in the osmolarity, while the fragile erythrocytes disappear completely in the latter blood. The density distribution curves of erythrocytes obtained from one-week-old rats reveal specific gravity ranging from 1.082 to 1.093 and higher density erythrocytes increase with the growth of rats.

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STOICHIOMETRY OF THE REACTION OF OXYHEMOGLOBIN WITH NITRITE

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Although nitrite has long been used as a reagent for the oxidation of hemoglobin to methemoglobin, the stoichiometry of the reaction is still uncertain. First, we investigated the binding of NO_2^- with methemoglobin. The binding was non-cooperative with a binding constant of 600, 440, 340, and 240 M^{-1} at pH 6.0, 7.0, 7.4, and 7.7, respectively. When oxyhemoglobin (240 or 360 μM) was reacted with nitrite (480 or 720 μM , respectively) at pH 7.4 or 7.7, respectively, the fraction of methemoglobin nitrite present in the final product was about 0.07 for both sets of experimental conditions as calculated from the binding constant. The rate of NO_2^- consumption and NO_3^- production exactly coincided with the rate of methemoglobin formation, and one mole of NO_2^- was consumed and one mole of NO_3^- was produced to yield one mole of metheme. 0.25 mole of O_2 was produced to yield one mole of metheme. The slope of the pH vs. $\log k$ plot, where k denotes autocatalytic rate constant according to Jung and Kahl (1969), was unity. From above results the stoichiometry for the overall reaction can be described as;



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EFFECT OF PYRIDOXAL PHOSPHATE ON THE OXYGEN TRANSPORT FUNCTION OF ACD-STORED BLOOD. N. MAEDA, K. KON, T. SUDA, and T. SHIGA. Dept. of Physiol., Sch. of Med., Ehime Univ., Ehime.

The effectiveness of pyridoxal 5'-phosphate (PLP) for improving the decreased oxygen transport function of ACD-stored blood was investigated.

(1) Incorporation of PLP : (i) More PLP were incorporated into stored (2,3-DPG-depleted) red cells, as increasing the amounts of PLP added, as decreasing the hematocrit, and as lowering the pH in the medium. (ii) Serum proteins did not impede the PLP uptake. (iii) Inorganic phosphate did not affect the PLP uptake, suggesting that the phosphate channel did not participate the uptake, but was effective for the preservation of ATP. (iv) When more PLP were incorporated, more ATP decreased. (v) Based on the analysis of the initial velocity of PLP uptake, PLP must be incorporated by the passive diffusion, and by the active transport partly.

(2) Improvement of the oxygen transport function : (i) The oxygen affinity of stored red cells with the intracellular PLP concentration of 5~6 mM was same as that of fresh cells (with 5~6 mM 2,3-DPG). (ii) The Hill's coefficient was lowered to 2.1~2.4, depending on the amounts of PLP incorporated.

In conclusion, the oxygen transport function of 2,3-DPG-depleted red cells can be improved by PLP, and the rejuvenated cells may be applicable for the clinical use.

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ON THE NATURE OF ERYTHROPOIETIC ENHANCING FACTOR FROM IRRADIATED RAT'S SPLEEN H. KODAMA, S. KASAI, T. TERASAWA, Dep. of Physiol., Tohoku Dental Univ., Koriyama Fukushima.

We have already shown that erythropoietin(Ep)-dependent erythroid colony formation could be considerably enhanced by the addition of spleen extract from ⁶⁰Co irradiated rats (IRSE) to the cultures. Recently, we have developed a modification of the plasma clot method, called fibrin clot method that yielded substantially higher plating efficiencies. By using this method, the enhancing activity of IRSE was assessed at various Ep concentrations. The IRSE shifted the Ep dose-response curve to 5-10 fold lower concentration and also increased the number of colonies by about 1.5 fold in the presence of a plateau concentration of Ep. A good correlation between the number and the size distribution of the colonies was generally observed under various conditions. It seems that the sensitivity of erythroid progenitor cells to Ep is markedly increased and more immature progenitors are subsequently recruited into the Ep-responsive population within 48 hours with the presence of IRSE.

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NATURAL INHIBITOR OF PLATELET AGGREGATION IN HUMAN AND RABBIT BLOOD. Y. FUNAHARA, M. MIKI. Dept. of Physiol., Kobe Univ. Sch. Med., Ikuta-ku, Kobe

A patient of primary thrombocythemia having antiplatelet aggregating activity in his plasma was found by Funahara et al. (Jap. J. Clin. Haemat. 20 Suppl. 1 p219). In order to know whether or not an increase of production of the inhibitor was accompanied by thrombocythemia, an antiplatelet aggregating activity in blood from healthy subjects was examined. Aggregation was measured by changes of residual free platelets which were counted by a Coulter Counter. One fifth volume of platelet rich plasma was added to a platelet suspension medium as a platelet source. Maximum decreasing rates of residual free platelets by 1 μ M ADP in calcium free Tyrode solution and in platelet poor plasma (PPP) were 90% and 45% respectively, indicating an activity to inhibit aggregation existed in citrated PPP. Sephadex G25 fractionation of citrated PPP showed that the activity resided in the same fraction as that of serum or heat treated native PPP, indicating sodium citrate used as an anticoagulant was not a cause of the activity. The activity in serum fraction was lower than in plasma.

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DYNAMIC CHANGES OF HEMOSTATIC AND FIBRINOLYTIC ACTIVATION IN HUMAN PLASMA.
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To clarify the dynamic changes of coagulation and fibrinolysis, enzyme activities of human plasma such as plasma kallikrein, thrombin and plasmin activated by intrinsic and/or extrinsic activation were studied. Three type of chromogenic synthetic peptid-substrate (S-2302, S-2251, S-2238) were applied for the measurement of three kinds of plasma enzyme respectively. Dextran sulphate (MW 5×10^5) was used for intrinsic activation and Streptokinase and Urokinase as fibrinolytic agent and Simplastin as hemostatic agent were used for extrinsic activation. In the experiment of DS-activation, the activity of plasma kallikrein was appeared dominantly at early time and followed then the activities of plasmin and thrombin were appeared. In the activation by SK, the high activities of plasma kallikrein and plasmin were observed at early time. From these results, it is suggested that induced plasmin by intrinsic activation differed from that by extrinsic activation and could not caused fibrinolysis because activity of plasmin was very low.

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THE ACTION OF BILE ACIDS ON PLASMIN ACTIVITY
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The present investigation deals with the mode of action of bile acids on plasmin activity. The bile acids employed were taurocholate (TC), taurochenodeoxycholate (TCDC), and taurodeoxycholate (TDC), which represent principal components of human bile acids. The plasmin employed was a preparation from KABI. The results obtained were as follows: 1) TC, TCDC and TDC clearly inhibited the fibrinolytic activity of plasmin at 0.01 - 0.05 M. TC, however, exhibited an enhancing action, in contrast to TCDC and TDC, at 0.1 M. 2) TCDC and TDC demonstrated an inhibitory action on the amidolytic activity of plasmin towards the synthetic chromogenic substrate, S-2251, while TC exhibited an enhancing action. 3) On basis of the above results, it appears that the action of bile acids on plasmin activity depends on their chemical structure, that is, whether they have a di- or tri-hydroxyl group.

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STUDIES ON THE PLASMINOGEN-ACTIVATOR (GALACTOKINASE) IN BOVINE COLOSTRUM
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Previous finding that human colostrum contained high activity of plasminogen-activator (galactokinase) enabled us to investigate the basic properties of the activator.

At present study, bovine colostrum (1-6days samples after deliveries) was found to contain considerable amount of galactokinase, though the activity was always concealed with the inhibitors. The presence of galactokinase in bovine milk was first revealed by gelfiltration using Sephacryl S-200 column, indicating one peak of activator in void volume and two peaks of the plasmin inhibitors. The activator fraction were precipitated by acidification, applied to the Sephadex G-150 column and eluted in the fraction of lower molecular weight, which was estimated as approx. 70,000. The activator separated from the most of the inhibitors showed relatively high thermostability (stable at 50°C for 120min, but rapidly lost its activity at 65°C). The activator was also stable in a wide range of pH at 37°C. Results thus obtained from bovine galactokinase fairly well coincided with the human galactokinase.

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DOG RENAL TISSUE pO_2 AND CREATININE EXCRETION. Yasuo TANAKA, Shige-yuki NAKAYA and Ryoh-ko HONJO, Dept. of Physiol., Med. Schl. of IWATE Med. Univ., Morioka, JAPAN.

In order to take a correlation of renal tissue pO_2 with excretion rate of endogenous creatinine, using 8 dogs each of which was of about 10 kg in weight and anesthetized with thiopental, the left kidney was prepared for Yagi's oxygen electrodes of enamelled Cu-wire 275 micrometer thick each to be placed into renal parenchyma to the depth of 3, 5 (the cortical), 10, 15 (the medullary) and 35 mm (the pelvic) radially from the lateral border, and also the left ureter for a catheter to remove urine which was examined on the volume, the refractive index and the concentrations of chemical constituents. The urine was removed exactly at a time interval of 60 minutes during which the depolarizing currents of each oxygen electrode were integrated with an ensemble of the integrator Ando's ADAC180 and the digital voltmeter YEW's VD-51A into figures of volts/hour as the integrated pO_2 .

The higher was the excretion rate of creatinine, the renal tissue pO_2 in the integrated figure was the larger at the cortical part 5 mm deep but the smaller at the medullary part 10 mm deep.

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STUDIES ON DIURETIC ACTION OF DEMECLOCYCLINE IN MAN S. YUASA. Renal Disease Center, Osaka Prefectural Hospital, Sumiyoshi-ku, Osaka

Diuretic action of demeclocycline(DMC) which is known to interfere with ADH action was evaluated. In five normal subjects receiving DMC (900mg per day) for ten days, impairment of urinary concentrating ability was found without any changes in plasma ADH. Maximal urinary osmolality, free water reabsorption and urinary cyclic AMP excretion significantly decreased. The abilities in these subjects to excrete solute-free water were also impaired during water diuresis, and the ratio of $C_{H_2O}/C_{H_2O}+C_{Na}$, indicating the fractional sodium reabsorption in the distal tubule, significantly decreased. DMC did not affect phosphate and potassium excretion. Defects of urinary concentrating ability completely restored three weeks after the agent was stopped. Furthermore, diuretic effects of DMC were found in 10 out of 13 patients with liver cirrhosis, nephrotic syndrome, chronic glomerulonephritis or idiopathic edema. Increase in sodium excretion was also observed in some patients.

These results suggest that DMC inhibits both ADH action in the collecting tubule and sodium reabsorption in the distal tubule, and that DMC could be useful in treating edematous patients.

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AN APPLICATION OF NEEDLE TYPE COLLOID OSMOMETER

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To assess over-all bodily osmotic fluid flow between blood and tissues, arterial blood oncotic pressure of anesthetized dogs during and after intravenous loading of albumin, dextran, glucose, mannitol, $NaHCO_3$ or NaCl was continuously measured with a needle type colloid osmometer. Estimation of osmotic fluid flow was based on plasma volume changes which were directly reflected on blood oncotic pressure changes.

Small solute (sugars and salts) loads resulted in transient osmotic flows (8.5 ± 2.2 ml/g of solute per Kg of animal by NaCl, and 1.7 ± 0.4 by glucose). Large solutes also induced fluid flow (1.3 ± 0.4 by albumin, and 2.2 ± 0.7 by dextran). The amount of osmotic flows well correlated to van't Hoff's force. Filtration rate of fluid exchange barriers was estimated from the oncotic pressure curves to be 0.014 ± 0.004 ml/min per mmHg per 100 g tissues. Statistical comparison of paired plasma volume changes estimated independently from oncotic pressure changes and hematocrit changes predicted appreciable changes in red blood cell volume during small solute loads.

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A STUDY ON THE ACTIVE SITE OF THROMBIN USING SYNTHETIC INHIBITORS

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Our studies on about 800 kinds of synthetic arginine derivatives, which include very active and highly selective thrombin inhibitors, indicated the following requirements for the competitive inhibitors.

The skeleton of the inhibitors is L-arginine, which can not be replaced by D-arginine or lysine. In the case that α -NH₂ group and α -COOH group of L-arginine are respectively covered with R₁ (such as dansyl, α - and β -naphthalenesulfonyl and quinoxalinesulfonyl group) and R₂ (such as the structure having the length equal to several carbons chain), the inhibitory activity for thrombin is extremely potent and highly selective.

Assuming that the active site would take a replica structure of the inhibitor, the stereogeometry of the active site of thrombin would be documented in the present report.

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CHANGE OF PULMONARY WATER DISTRIBUTION AT VARIOUS POSITIONS

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The CT value of lung tissue means average water content of the lung. So, we attempted to study change of pulmonary water distribution at various positions by computed tomography. CT values of lung tissue in normal subjects and cardiac patients were determined by "JEOL, dynamic scanner".

In normal subjects in the supine position, no difference was noted in the CT value between levels of intercostal spaces as well as between right and left lung fields. CT values were greater in posterior lung fields than in anterior lung fields. However, when the patient was turned to the prone position, they were greater in anterior lung fields than in posterior lung fields. We thought this change was attributed to differential blood flow influenced by gravity. CT values in patients with congestive heart failure, myocardial infarction and intracardiac shunt were greater than in normal subjects. Significant increase in the CT value was occurred in congestive heart failure.

This method was particularly useful for study of pulmonary water distribution and cardiac function.

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EFFECT OF ENVIRONMENTAL GAS MIXTURE ON THE ARTERIAL PRESSURE AND HEART RATE OF THE

INCUBATED EGG. TAZAWA, H. Dept. of Physiol., Yamagata University School of Medicine, Yamagata 990-23.

Because the respiration of the incubated avian egg takes place by only diffusion, the egg is a simple biological model for studying the diffusive gas exchange. In the present report, we investigated the effect of environmental gas on the heart rate and arterial pressure of the chicken egg. The egg whose allantoic artery was catheterized with a 26-G needle was vented at 38 °C with the various gas mixtures, and the arterial pressure and heart rate were measured. Hypoxia lowered markedly both the heart rate (HR) and blood pressure (BP), but hyperoxia, even pure oxygen, effects no changes in these circulatory parameters. The HR has a negative linear correlation with hypercapnia and the maximum pressure seems to increase with CO₂ concentration. The combined effect of hypoxia and hypercapnia on HR appeared to be strengthened. The severe effect of the hypoxia on HR was moderated significantly by replacing N₂ with He in the hypoxic gas mixture. The hypercapnia in He atmosphere showed a similar effect to that in N₂ despite of the anticipation that it would strengthen the decrease in HR. However, the combined effect of hypoxia and hypercapnia was almost identical between N₂ and He, indicating that the hypercapnia in He has an effect to decrease the HR. The effect of He agreed with that expected from the Fick's law in the diffusive gas exchange system.

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FLUCTUATIONS OF VENTILATORY RESPONSE TO CO₂ DURING THE MENSTRUAL CYCLE.N. TAKANO. Dept. Physiol., Sch. Med., and Dept. Sch. Health Sci., Fac. Educ., Kanazawa Univ., Kanazawa

The following respiratory and metabolic parameters were measured in 8 women with regard to the menstrual cycle: (1) resting $\dot{V}_A$, P_{ACO_2} and $\dot{V}CO_2$, (2) ventilatory response to CO₂ expressed as parameters S and B of a response curve $\dot{V}_A = S(P_{ACO_2} - B)$, and (3) overall "gain" (G) of the respiratory control system ($G = S/S'$, where S' is the slope of metabolic hyperbola). Throughout the follicular phase, each of the parameters studied held fairly constant. In the period between the 3rd and 9th days of the luteal phase lasting for 14 days, resting P_{ACO_2} dropped 4 mmHg while resting $\dot{V}_A$ and $\dot{V}CO_2$ increased 20% and 7%, respectively, compared with those in the follicular phase. Parameter S did not change significantly while parameter B and G decreased 5.8 mmHg and 30%, respectively, as well. The present study suggests that hyperventilation during the luteal phase is produced partly by a lowering of the set point of the respiratory chemoreceptors to CO₂ stimulus and yet excessive decrease in P_{ACO_2} due to hyperventilation is prevented by a blunting of the sensitivity of the overall CO₂ control system.

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REGIONAL DISTRIBUTION OF LUNG GAS VOLUME MEASURED BY AN IMPEDANCE PLETHYSMOGRAPHY.

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Regional distribution of transthoracic impedance in the healthy lungs was studied in seated and supine men each at three different lung regions. The absolute impedance (Z_0) obtained from FRC level was found to be maximal at apical and minimum at basilar regions of seated subjects, while the regional difference became insignificant in supine subjects. The subjects with higher Broca index gave always higher Z_0 values than others regardless of the regional and postural changes. In the subjects with standard somatotype, the relative impedance change for a unit change of over-all lung volume ($\Delta Z/\Delta V$) was maximum at the xiphoid level and became progressively small toward the apex. In obese subjects, the $\Delta Z/\Delta V$ was found significantly lower than others, regional difference thereof being also less pronounced. The impedance curves for a quasi-static expiration measured in seated subjects gave significant characteristics that might be caused by the closing volume phenomenon at the range near residual volume. The relationships between over-all and regional lung volume changes estimated from the impedance study were in good accordance with the published results determined by labeled gas dilution techniques.

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Comparison of steady state and transient ventilatory responses to mild hypoxia with hypercapnia stimulation

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Hypoxia-hypercapnia interaction in ventilatory responses was studied in twelve healthy males to elucidate its origin: peripheral chemoreceptors and/or central neural mechanisms. In an attempt to avoid distortion effect due to hypoxic depression reported by recent investigators, the experiment was conducted in mild hypoxia, P_{aO_2} 54.0 ± 3.6 mmHg and P_{ET,O_2} 54.0 ± 1.5 mmHg and hypercapnia P_{ET,CO_2} 45.9 ± 1.8 mmHg. 1) Maximal depression in ventilation ($\Delta \dot{V}_w$) in response to two breaths of O_2 during hypoxic hypercapnia (Withdrawal response) were mostly at 3rd to 6th breaths and about 10 - 15 sec after O_2 switch. The distribution of the $\Delta \dot{V}_w$'s in their time profiles was observed well within the period to induce peripheral chemoreceptor block only. 2) The differences in steady state response between hypoxia and hyperoxia with the same degree of hypercapnia ($\Delta \dot{V}_s$) were also obtained. The differences between $\Delta \dot{V}_s$'s and $\Delta \dot{V}_w$'s were not statistically significant, suggesting no central multiplication in hypoxia-hypercapnia stimulation. 3) Despite the use of mild hypoxia, possibility of hypoxic depression was still suggested in one out of 12 subjects.

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REFLEXIVE MODULATIONS ON THE RESPIRATORY-AND CIRCULATORY SYSTEMS BY THE THIN-FIBER AFFERENTS OF THE MUSCLE. KUMAZAWA, T., TADAKI, E., MIZUMURA, K., KIM, K.

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The majority of the thin-fiber afferents have been shown to originate from the polymodal receptors of the muscle in dogs (J. Physiol. 273: 179, 1977). Chemical stimulation of the muscle produced both an augmentation of ventilation in spontaneous ventilated dogs and excitation of polymodal C fibers; the latency and relative magnitude of both responses were similar (Br. Res. 109: 402, 1976).

In anesthetized, artificially ventilated, bilaterally vagotomized, and carotid sinus deafferented dogs, electrical stimulation of the muscular afferents caused an augmentation of ventilation and a depressor response followed by pressor response depending on the intensity of the stimulation. It was very often found that the effect of a stimulation lasted for a long period after the end of stimulation and subsequent respiratory and circulatory responses to the same stimulus concomitantly altered much. Naloxone, a specific opiate antagonist, (0.1-2 mg/kg i.v.) caused a significant rise ($p < 0.001$) of mean blood pressure by an average of 11 mmHg and of the pressor component of reflex response by an average of 5 mmHg. Endogenous opiate seems to participate in the circulatory responses of muscular afferents. However, neither the level of ventilation nor respiratory reflex response changed significantly.

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RESPIRATORY RHYTHMICITY IN THE ADULT ARCTIC LAMPREY, *ENTOSPHENUS JAPONICUS*. R. KAWASAKI. Col. Bio-Med. Tech. Niigata Univ. Niigata.

The whole body of the animal was fixed by the specially designed holder. Recording the branchial movement, the brain lesion was performed and the neural activities were recorded externally from the medulla. Transecting the medulla equally into three (rostral, medial and caudal) parts revealed that the respiratory rhythm-generators are basically located in the medial part. After midline sectioning the brain-stem, both of two halves functioned independently with their own rhythm at the same time for 2hr or more, as if indicating the one half acting as an original pacemaker, the other half as a follower (latent pacemaker). From the medial part of the medulla, respiratory discharges were recorded, correlating exclusively to the branchial contraction, preceded, in some cases, by the 'diastolic slow depolarization', which resemble in their shape to those in pacemaker cells in the crustacean heart ganglion. Possible respiratory rhythm-generators in the lamprey may be pacemaker neurons of such a bursting type as seen in the neurogenic heart ganglion. Supposedly, reciprocal inhibition network is not necessary for breathing rhythm-generation in the lamprey.

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RESPONSES OF RESPIRATORY MOTONEURONS TO SEGMENTAL NERVE STIMULATION IN THE DRAGONFLY LARVAE, *ANAX PARTHENOPE*.

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Rhythmic motor discharges were recorded in the abdomen from the segmental nerve, n2A, innervating the dorso-ventral muscles and from the median nerve, sn, innervating the transverse muscles. Burst activity in n2A coincided expiration and that in sn did inspiration. Electrical stimulation of the segmental nerve, n1A, during inspiratory period inhibited inspiratory discharges of sn and evoked expiratory discharges in n2A, and the respiratory rhythm was reset.

Intracellular recordings were made from respiratory motoneurons of the abdominal ganglion. Expiratory motoneurons showed e.p.s.p.'s during expiration and i.p.s.p.'s during inspiratory period. Inspiratory motoneurons showed i.p.s.p.'s during expiratory period. No motoneurons appeared to have an intrinsic rhythmicity. Stimulation of n2A evoked a depolarizing response in expiratory motoneurons and a hyperpolarizing response in inspiratory motoneurons.

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ROLE OF THE PERIPHERAL MOTOR NEURONES FOR THE BULLFROG RESPIRATION

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The phasic characteristics of the Vth, the VIIth, the IXth, the Xth and the XIIth cranial nerves were investigated in the adult bullfrog under anaesthesia. Except for the Xth, all other nerves showed their activities both in oscillation and in pulmonary ventilation. The Vth and the XIIth showed diphasic activities in the oscillation. One of the XIIth activities was evaluated to contribute for elevating lung pressure just before expiration without inducing particular change in buccal pressure. The pulmonary ventilation is consisted of three phases. The second one in which gas is pumped into the lung corresponded to each greatest activities of all respiratory nerves. Next experiment was conducted to quantify the effect of denervation of these respiratory neurones on performance of ventilatory movements. When the bilateral Vth, or the bilateral XIIth were cut firstly, ventilation depletion was $76.2 \pm 3.6\%$ (mean $\pm$ S.E. in 7 frogs), or $53.5 \pm 6.8\%$ (in 5 frogs), respectively. From above results it was assumed that the Vth as well as the XIIth are the major respiratory motor neurones and that there is interaction between them to augment each other.

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INSPIRATORY-INHIBITORY REFLEX PROVOKED BY CHEST WALL VIBRATION IN MAN.

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Vibration-induced effect on respiration in man was studied. 14 healthy adult subjects (18-37 years old) would begin their breathing into a closed-chamber spirometer and continue until their tidal volume reached about 2 liters. The volume signal was recorded on a chart recorder and tidal volume, inspiratory time and expiratory time were measured. Two cylinder type's vibrators, frequency 100Hz, were applied on bilateral 7th to 10th intercostal spaces anterior to mid-axillary regions. Vibrators applied in this region had not only reinforced the underlying intercostal muscle activity, but also inhibited the diaphragm muscle activity.

When vibrators were triggered to be applied in inspiratory phase, both tidal volumes and inspiratory times were decreased. In the re-breathing experiment, relationship between tidal volume and inspiratory time in the vibrated breath was shifted to left and down from that in control breath.

Both control and vibrated breath had linear relation in inspiratory and expiratory times.

These results suggest the existence of intercostal-phrenic inhibitory reflex through central pattern generator in man.

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EFFECT OF LUNG INFLATION ON THE FLOW VELOCITY IN THE PULMONARY MICROVESSELS OF BULLFROG

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Flow velocity in the pulmonary microvessels on the exposed lung surface of anesthetized bullfrogs was measured during positive lung inflation by means of a laser Doppler microscope. Since velocity was measured together with a beat signal analyzing system and a time sharing circuit triggered by the R wave of ECG, the velocity contour could be obtained in response to cardiac cycles. Mean flow velocity and pulsatile amplitude (difference between maximum and minimum velocity) were obtained from the velocity contour as a function of transpulmonary pressure (TPP). Both the mean velocity and the pulsatile amplitude in arterioles and venules increased during the moderate lung inflation of TPP range 1 to 4 cmH₂O and rapidly decreased on further inflation. At excessively high TPP, arrest of blood flow was frequently observed in the alveolar microvessels including capillaries. Subsequent TPP decrease in steps caused a gradual increase of the mean velocity and the pulsatile amplitude curve prior to attaining their maximum values and succeeding decrease in the lower range of TPP. Hysteresis was present on both curves. The mean velocity during inflation was greater than during deflation over the wide range of TPP. The changes of the mean velocity against TPP was consistent with those of the pulmonary vascular conductance described by previous authors.

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RELATIONSHIP OF THRESHOLD P_{CO_2} FOR RESPIRATORY SYSTEM TO ARTERIAL HYDROGEN ION CONCENTRATION.

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By recording phrenic nerve discharge as an indicator of the respiratory activity, the threshold values of P_{CO_2} ($P_{T\ CO_2}$) as ventilatory stimulus were examined at varying arterial hydrogen ion concentrations ($[H^+]$) in anesthetized cats with and without peripheral chemoreceptors. After vagotomy, cat was paralyzed and artificially ventilated. As ventilation increased successively, phrenic nerve activity decreased. When the phrenic discharge disappeared, alveolar P_{CO_2} was decided to be the $P_{T\ CO_2}$. Arterial pH was altered between 7.0 and 7.6 by 0.5N-HCl or 1.0M-NaHCO₃ intravenous infusion. The $P_{T\ CO_2}$ lowered linearly with increasing arterial $[H^+]$ in the carotid sinus nerve (CSN) intact cats. This inverse relationship between $P_{T\ CO_2}$ and $[H^+]$ was observed even after denervation of CSN. However, the mean regression slope of 0.37 in the intact CSN reduced to 0.18 after denervation of CSN. On the basis of these findings, we concluded; 1) Arterial H^+ acts as a respiratory stimulus in the cat without peripheral chemoreceptors. 2) The threshold activity of respiratory system is determined by the simple algebraic sum of arterial P_{CO_2} and H^+ in any levels of acid-base status.

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COMPARISON BETWEEN OXYGENATED MIXED VENOUS CO_2 PRESSURES ESTIMATED IN NORMOCAPNIA AND HYPERCAPNIA BY DEFARES' METHOD. M. MOCHIZUKI, K. NIIZEKI, M. TAMURA. Dep. of Physiol., Yamagata Univ. Sch. of Med., 990-23 Yamagata

Oxygenated mixed venous Pco_2 was estimated in normo- and hypercapnia by using the Defares' extrapolation method, revealing that the venous Pco_2 estimate (Peq) in hypercapnia was higher than that in normocapnia. The above difference was obviously greater in normoxia than in hypoxia. Referring to oxygenation and CO_2 dehydration rates so far obtained as well as O_2 - and CO_2 -dissociation curves of red blood cells (RBC), the CO_2 profile along the capillary was calculated. In hypercapnia RBC- Pco_2 was certainly lower at the initial stage than alveolar Pco_2 , but throughout the subsequent contact time the former remained higher than the latter due to the Haldane effect. While CO_2 efflux out of RBC persists, the CO_2 influx into plasma originating from hydration reaction in RBC is arrested, resulting in an increase of Peq in hypercapnia. The theoretical difference between Peq 's in normo- and hypercapnia coincided well with the experimental data quantitatively, suggesting that the positive alveolar to mixed venous Pco_2 difference depends on the Haldane effect.

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EFFECT OF ISOPROTERENOL ON SALIVARY GLAND CHOLESTEROL METABOLISM. H. NAKAMURA, E. NEZU.* Dep. of Oral Physiol., HIGASHI NIPPON Univ. Sch. Dent., *Dep. of Oral Physiol., Hokkaido Univ. Sch. Dent., Hokkaido

The present investigation was conducted to determine the effects of isoproterenol (IP) administration on the cholesterol metabolism of salivary glands (submandibular, parotid and sublingual gland) of mice. Male ICR -JCL mice were injected with IP (25 mg/Kg body weight) once a day for 7 days. Incorporation of acetate- ^{14}C and mevalonic acid- ^3H into cholesterol was measured. Further, after a single administration of cholesterol-4- ^{14}C and IP administration as described above simultaneously, incorporation of cholesterol-4- ^{14}C into salivary glands was measured.

Results are as follows : IP treatment resulted in salivary gland hypertrophy; decreased cholesterol content and uptake of cholesterol- ^{14}C ; and increased cholesterol biosynthesis and HMG CoA reductase activity.

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STUDIES ON THE SECRETION OF SALIVA FROM HUMAN PAROTID GLAND AND THE VARIATION OF ITS POTENTIAL. INOMATA, K., TAKAMATSU, T.* AND NAKAMURA, H.** Dep. of Physiol., Sch. of Dent., Higashi Nippon Univ.. Dep. of Oralphysiol., Sch. of Dent., Iwate Med. Univ.* Dept. of Oralphysiol., Sch. of Dent., Higashi Nippon Univ.**

The studies for the secretion of saliva from parotid gland were reported in several journals. In these reports, the volume of secretion of saliva was usually measured by manual method, then, continuously measuring for an increase in secretion was very difficult. But continuously measuring is necessary for the studies on the secretion saliva. Recently, Inomata reported on this measuring method. According his report, the time course for total volume and volume in unit time of secretion were recorded simultaneously. But the electrical change in parotid gland is not measured by his method, so that, we tried to record the three phenomena simultaneously, it is total volume and volume in unit time and electrical phenomenon. Thereby we know an intimate relation between secretion and electrical phenomenon. And we believe this method is very useful for the studies on external secretory organs.

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STUDIES ON PENETRATION PHENOMENA THROUGH INTESTINAL MEMBRANE. S.NAKANO, T.YOSHIOKA, M.NARUSAWA AND K.NAGAMI. Dept. of Physiol., The Tokai Univ. Sch. of Med., Isehara, Kanagawa.

By use of our devised apparatus of intestinal circulation, we have investigated a series of experiments on penetration of insulin as active polypeptides, L-tryptophane and its related active transport of glucose through everted intestine of a rat. In the present study, also using the above apparatus, intestinal penetration phenomena were investigated under each following condition. The obtained experimental results are as follows: 1) In pretreatment of brush border cell membrane with 0.1N HCl, insulin and L-tryptophane penetration were hardly influenced, but its related glucose transport was inhibitory. Furthermore, ATPase and Adenylatekinase activity of brush border membrane were decreased. 2) In pretreatment with 0.1N NaOH, insulin and L-tryptophane penetration were enhanced, but glucose transport was slightly inhibited. 3) In high hydrostatic pressure of serosal to mucosal side caused by make use of our apparatus, insulin, L-tryptophane penetration and glucose transport all had unchanging tendency, to the extent of 80 cmH $_2$ O. 4) In hydrostatic pressure of 115 cmH $_2$ O, had no defined change of those substances penetration. On the other hand, histochemical findings were observed transformation of brush border cell membrane.

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GLYCYL-L-LEUCINE TRANSPORT IN THE GUINEA PIG ILEUM

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Initial influx of glycyl-L-leucine was measured by isotope tracer ($[1-^{14}\text{C}]$ glycyl-L-leucine and glycyl-L- $[U-^{14}\text{C}]$ leucine) in the guinea pig ileum in vitro.

It was found that the rate of uptake of leucine moiety was about 2 times faster than that of glycine moiety when uptake from glycyl-L-leucine (5mM) was examined. The difference of uptake rate was due to superficial membrane hydrolysis following amino acid (L-leucine) uptake. The uptake of glycine moiety was considered to be intact peptide entry. The intact peptide entry was independent of medium Na^+ ion.

Both residues of glycyl-L-leucine were not inhibited by glycylglycine; on the other hand, the influx of glycylglycine was inhibited by glycyl-L-leucine. Kinetically, inhibitory action of glycyl-L-leucine was mixed type.

This kind of interaction suggest that this binding site for the two dipeptides are very closely located or on the same protein molecule.

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EVALUATION OF BILIARY TRANSPORT PATHWAY FOR ORGANIC COMPOUNDS

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The biliary transport pathway for sulfobromophthalein (BSP) has been classified as specific one for organic anions. It has been postulated that there are additional two separate pathways for organic cations and neutral compounds. In order to study whether this classification can be applied to all xenobiotics, the biliary excretion of ^{14}C -taurocholate, ^{35}S -BSP, $^{99\text{m}}\text{Tc}$ -Pi (pyridoxylidene isoleucine), and $^{99\text{m}}\text{Tc}$ -HIDA (N-dimethylphenyl carbamoylmethyl iminodiacetic acid) were compared in control rats and in rats made in a BSP Tm state by a continuous infusion of BSP (0.25 mg/100 g/min). There was no significant difference in the biliary excretion of ^{14}C -taurocholate between control and BSP Tm rats. On the other hand, ^{35}S -BSP excretion was considerably delayed in BSP Tm rats (biliary recovery, (% of dose) control rats (n=8) 25.1 ± 3.1 in the first 5 min, 91.4 ± 4.0 , for 60 min, BSP Tm rats (n=8) 3.8 ± 0.8 in the first 5 min, 76.4 ± 6.1 for 60 min). Similarly, the biliary recovery of two $^{99\text{m}}\text{Tc}$ -compounds were considerably depressed in BSP Tm rats compared with control rats. Since $^{99\text{m}}\text{Tc}$ -Pi was reported to be a neutral compound, and $^{99\text{m}}\text{Tc}$ -HIDA, a cationic compound respectively, the results of the present study suggest that the specificity of BSP pathway for organic anion needs a reevaluation.

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RELEASE OF DIGESTIVE ENZYME FROM THE ISOLATED RAT PANCREAS DEPENDS ON EXTERNAL

CALCIUM ION. Y. HABARA AND T. KANNO, Dept. of Physiol., Faculty of Vet. Med., Hokkaido Univ., Kita-Ku, Sapporo 060.

Continuous stimulation with 3×10^{-7} M acetylcholine caused a large output of pancreatic enzyme at the beginning of the stimulation, but the output declined gradually during the stimulation. The first rapid increase in output was slightly reduced and the second declining phase was markedly accelerated when the standard perfusing solution was replaced with a Ca-deficient solution. In the standard solution, the continuous stimulation with 5×10^{-8} M ACh caused a first rapid increase in enzyme output followed by a plateau phase during the stimulation. These two phases of enzyme output were markedly and evenly inhibited in the Ca-deficient environment. A quantitative relation was found between the amount of enzyme output induced by 5×10^{-8} M ACh and the concentration of Ca in the perfusing solution at values below the normal 2.5 mM Ca. These findings show that the entry of Ca induced by ACh may be mediated by a Ca carrier in the membrane of acinar cell.

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INFLUENCE OF CAROTID AND AORTIC BARORECEPTORS ON NEUROSECRETORY NEURONS IN SUPRAOPTIC NUCLEI. H. YAMASHITA AND K. Koizumi*. Dep. of Physiol., Univ. of Occup. Environ. Health Sch. Med. Kitakyushu, * SUNY Downstate Med. Center Brooklyn N. Y.

The effects of arterial baroreceptor stimulation on the activity of identified neuro-secretory cells in supraoptic nuclei (SON) of the hypothalamus were investigated in Nembutal (30mg/kg) anesthetized cats. Stimulation of baroreceptors by distension of an isolated carotid sinus greatly inhibited SON activity. A linear relationship was found to exist between stimulus intensity and the degree of inhibition of SON neuron activity. The inhibitory effect of baroreceptors on SON neuron activity was most pronounced in the first 5 sec during stimulation and the effect became less when the stimulus lasted for a long period. At the end of stimulation there was a transient reversal of the response. The excitation of aortic baroreceptors by occluding descending aorta strongly inhibited SON neuron activity. Occlusion of carotid arteries augmented the SON neuron activity. Electrical stimulation of the sinus nerve caused an excitation or an inhibition of SON neurons, depending on the stimulus intensities. Combination of chemo- and baroreceptor stimulations revealed that the excitatory effect exerted by chemoreceptor stimulation on SON neurons was reversed or blocked by baroreceptor activation, indicating the powerful inhibitory influence of baroreceptors.

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PHYSIOLOGICAL SIGNIFICANCE OF ANGIOTENSIN II (AII) ON ADH RELEASE UNDER DEHYDRATION. K. YAMAGUCHI, T. SAKAGUCHI, H. NEGORO and S. KOBAYASI. Dep. of Physiol., Niigata Univ. Sch. Med., Niigata

To evaluate a physiological significance of AII on ADH release, the effects of intraventricular (IVT) injection of Sar¹-Ala²-AII (a specific antagonist of AII) on ADH release induced by IVT injection of AII and by dehydration (46 hr) were examined in conscious male rats with a chronic cannula in the third cerebral ventricle. Blood samplings were made by decapitation and plasma (p) level of ADH was determined by radioimmunoassay. Twenty-five, 50 or 100 ng of AII produced significant ($p < 0.05$) increase in p ADH level 90 sec after the injection. The effect of 50 ng of AII on ADH release was suppressed significantly ($p < 0.05$) at least with 100 ng of AIIA given 2 min before the injection of AII. The dehydrated rats (n=10) to which 1000 ng of AIIA was given 5 min before decapitation showed the significantly ($p < 0.05$) lower median ADH level (4.4 μ U/ml) than that of the dehydrated controls (10.8 μ U/ml; n=10). No significant difference in p osmolality was noted between them. These results suggest that p ADH response to IVT AII is produced via AII receptors in the brain and that AII is a mediator to induce ADH secretion under dehydration.

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ADRENAL SECRETION OF ALDOSTERONE IN ANAPHYLACTIC SHOCK. T. AIKAWA, I. MATSUMOTO, T. HIROSE, T. SUZUKI, Dept. of Physiol., Nagasaki Univ. Sch. Med., 12-4 Sakamoto-machi Nagasaki

The adrenal secretion of aldosterone in response to anaphylactic shock was examined in intact and hypophysectomized-nephrectomized dogs which were sensitized by s.c. injection of horse serum 3.5 weeks before experiment. On the day of experiment, dogs were injected i.v. with horse serum. After injection of horse serum, the adrenal secretion of aldosterone in intact and hypophysectomized-nephrectomized dogs increased from 1.32 ± 0.55 (mean $\pm$ S.E.M.) to 8.43 ± 1.99 ng/kg/min and from 0.25 ± 0.13 to 2.73 ± 0.77 ng/kg/min, respectively. Plasma potassium and sodium concentrations increased slightly after injection of horse serum in hypophysectomized-nephrectomized dogs. The results suggested that in anaphylactic shock, histamine or some unknown factors other than renin-angiotensin system (kidney), pituitary factors, plasma sodium and potassium stimulate the adrenal secretion of aldosterone. The adrenal secretion of cortisol and corticosterone also increased slightly in hypophysectomized-nephrectomized dogs, whereas it increased markedly in intact dogs.

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INFLUENCE OF INTRACEREBROVENTRICULARLY INJECTED TRH ON THYROID BLOOD FLOW. T. TONOUE, T. NOMOTO. Dept. of Pharmacol., Tokyo Women's Medical Coll., Shinjuku-ku, Tokyo

The thyroid blood flow in the pentobarbital anesthetized rat was assessed before and after an icv injection of TRH (2 nmoles/100g) from the hydrogen desaturation curve in the tissue. The hydrogen desaturation curve consisted of the heterogeneous exponential decay. The initiating fast component was not affected by an icv TRH. On the other hand, the half-time of the late slowest component which seemed to reflect the micro-circulation in the tissue was shortened markedly within 2 min after icv TRH. An icv methionine-enkephalin (ENK, 2 nmoles/100g) or an iv TSH (200 mu) did not exert any effect on the thyroid blood flow. The micro-circulation of adrenal cortex was also augmented by either TRH or ENK but the response (28%) was less than that of thyroid (100 %). TRH was not effective on the blood flow of renal cortex. Vagotomy abolished the response in thyroidal blood flow to TRH but it was not blocked by supracervical ganglion destruction. The results indicated that TRH in CNS is likely to stimulate selectively the specific vagal efferents involved in the regulation of thyroidal micro-circulation. Since TRH is neuroactive and the TRH-TSH-thyroid function may represent a relatively late evolutionary development in vertebrates, the vagus mediated effect on thyroid of TRH may be a possible moment in the development of the hormonal action.

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ARGININE-VASOTOCIN INHIBITION OF THE PITUITARY RESPONSE TO LUTEINIZING HORMONE RELEASING HORMONE. K. YAMASHITA, M. MIENO AND ER. YAMASHITA, Dept. of Pathophysiol., Atom. Dis. Inst., Nagasaki Univ. Sch. Med., Nagasaki

The concentrations of 17-oxosteroids in the spermatic venous blood of anesthetized dogs were used as an index of LH release. When injected into the carotid artery, arginine-vasotocin (1.0 µg/kg) caused no significant alterations in the testicular output of 17-oxosteroids. The administration of luteinizing hormone releasing hormone (LH-RH; 5 µg/kg, a standard dose) into the carotid artery produced typical stimulation of testicular 17-oxosteroid secretion. Administration of arginine-vasotocin (0.01, 0.1 or 1.0 µg/kg) into the carotid artery 3 h before the administration of a standard dose of LH-RH inhibited the testicular secretion of 17-oxosteroids normally induced by LH-RH. However, pretreatment with arginine-vasotocin (1.0 µg/kg) did not affect the testicular response to i.v. administration of HCG (5 i.u./kg).

These results indicate that in the dog, arginine-vasotocin inhibits the LH-RH-induced release of LH by acting directly on the anterior pituitary gland.

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FUNCTIONAL SEGREGATION OF THE AREAS IN THE ANTERIOR HYPOTHALAMIC AREA (AHA) ON THE CONTROL OF FSH SECRETION. S. VISESSUVAN, M. KAWAKAMI. Dept. Physiol., Sch. of Med., Yokohama City Univ., Yokohama.

Serum FSH was determined in hemispayed (H-spayed) rats bearing estradiol benzoate implant (EB imp.) in the anterior (A-) or the middle (M-) part of the AHA for 30 days and also determined in the A-AHA or M-AHA deafferented H-spayed rats at 0 till 96 hrs post surgery. A-AHA EB imp. effected transient changes of serum FSH with compensatory ovarian hypertrophy. M-AHA EB imp. suppressed serum FSH with ovarian atrophy. Ovarian histology demarcated several corpora lutea in the former group but cystic atrophic follicles in the latter. Deafferentation damaging the A-AHA did not prevent serum FSH elevation at 5 hrs after H-spaying while that damaging the M-AHA prohibited this rising trend, and serum FSH remained at 0 hr level.

Thus, the more potent estrogen sensitive area in the AHA for the modulation of FSH secretion is suggestively located at the M-AHA than at the A-AHA, damaging of the area diminished the responsiveness of the AHA to H-spaying induced decrease blood estrogen level.

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EFFECTS OF TESTOSTERONE AND ESTROGEN ON UNIT ACTIVITIES OF THE BRAIN
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Neuronal sensitivity for testosterone was studied and compared with that of estrogen, prolactin, betamethasone etc. Testosterone was applied directly by microelectrophoresis to 200 single units near the hypothalamus of urethane-anesthetized male Wistar rats. Testosterone activated 13 neurons and showed no effect on the other 187 units. The testosterone-sensitive units were distributed in the septal nucleus and hypothalamus. These units did not respond to the application of estrogen. The data showed the different central effects between testosterone and estrogen. Estrogen showed only inhibition when applied microelectrophoretically. But with this microelectrophoretic method the estrogen concentration around the tip of micropipette is not clear. Therefore the estrogen effect was studied with brain slices by changing the medium composition around the slices with female guinea pigs. Any neurons of the hypothalamus, hippocampus and cerebral cortex did not show any spontaneous firing in the slices. Conjugated estrogen inhibited the activity of spontaneous firing Purkinje cells with the concentration of $400 \mu\text{g/ml}$.

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REGULATION OF GLUCAGON AND INSULIN SECRETION BY THE CENTRAL NERVOUS SYSTEM.
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It has been recognized that the ventromedial hypothalamic nucleus (VMH) is involved in central nervous control of glucagon and insulin secretion from the pancreas. To develop further studies on the regulatory function of the VMH in pancreatic hormone secretion, we selectively stimulated neurons of the VMH with local applications of the different neurotransmitters (5×10^{-8} mole/ $1 \mu\text{l}$ saline) and measured the plasma levels of glucagon and insulin. Microinjection of epinephrine into the VMH of rabbits caused rapid rises in the plasma levels of both glucagon and insulin. Focal application of acetylcholine also induced a rapid rise in plasma glucagon, without change in plasma insulin. This latter response of plasma glucagon was almost completely blocked by previous treatment of the VMH neurons with hexamethonium (a nicotinic blocker), but not by previous application of atropine (a muscarinic blocker). However, similar applications of other neurotransmitters, such as norepinephrine, dopamine, serotonin, and GABA, did not affect appreciably the plasma levels of the both hormones. It is concluded that adrenergic stimulation of the VMH leads to rapid release of glucagon and insulin from the pancreas, whereas nicotinic cholinergic stimulation of the same region causes release of glucagon only.

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NEUROCHEMICAL STUDIES ON PITUITARY DWARF MICE (dw).
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The pituitary glands of dwarf mice (dw) have been shown to be almost entirely devoid of growth hormone and to contain reduced amounts of TSH and ACTH. In the cerebrum of adult animal, the amounts of S-100 protein and thy-1 antigen, and the activity of 2',3'-cyclic nucleotide 3'-phosphohydrolase were found to be reduced. This finding revealed that the cerebral development, especially in myelination, of dwarf mouse was retarded. The administration of 10mg/kg of bovine growth hormone from the day of birth to the 40th day could repair the biochemical retardation of brain development. In 24-hour changes in spontaneous locomotion activity of the three types of mice, whereas the controls had a well-marked diurnal periodicity of spontaneous locomotion activity, the Snell dwarfs exhibited a strikingly reduced level of activity with an indistinct rhythm. In contrast, the treated dwarf mice showed higher level of activity than that of the dwarf controls and kept clear diurnal periodicity which was almost identical to the normal control mice.

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GROWTH HORMONE (GH) SECRETION RELATED TO THE SLEEP-WAKE RHYTHM IN DOGS. YASURO TAKAHASHI, KIYOHISA TAKAHASHI. Depts. of Psychology and Medical Chemistry, Tokyo Metropolitan Institute for Neurosciences, Musashidai, Fuchu City, Tokyo.

Twenty-four h variation of plasma GH and cortisol concomitant with sleep stages were examined in dogs. Blood was drawn at 15-30 min intervals through an indwelling catheter. Spontaneous, episodic GH release had no apparent relationship with sleep or time of day in 10 dogs when they were left without interference. In 5 dogs, forced wakefulness (FW) of 3, 6 and 12 h was automatically performed at intervals of 3, 6 and 12 h, respectively, during which the dogs were allowed to sleep. In 28 of 40 recovery sleep periods, a plasma GH peak with a mean of $6.0\text{ng/ml} \pm 0.5(\text{SE})$ occurred soon after the onset of recovery sleep and was always associated with delta wave sleep. The incidence of these sleep-related GH peaks increased with the length of prior FW. The occurrence of these GH peaks depended on sleep, but not on time of day or light-dark cycle. The mean GH level was significantly higher during the total 12-h recovery period than during the total 12-h FW period in each FW study, whereas the mean cortisol level was significantly lower. No circadian variation of plasma cortisol was detected in each dog under the baseline condition or under the forced sleep-wake cycles. This sleep-related GH release in dogs is considered to be regarded as a model of that in man. The importance of sustained wakefulness prior to sleep onset has been emphasized as related to sleep-related GH secretion.

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POSTNATAL DEVELOPMENT OF THE CIRCADIAN ADRENOCORTICAL RHYTHM IN THE RAT K. TAKAHASHI and Y. TAKAHASHI, Depts. of Medical Chemistry and Psychology, Tokyo Metropolitan Institute for Neurosciences, Fuchu-city, Tokyo

A micromethod for determination of individual 24 or 48 h patterns of blood corticosterone levels has been developed in our laboratory using microsampling (20 μl of blood) and microassay methods. With this method it was possible to determine the 48 h patterns at 4 h interval even in infants 2 weeks of age.

To evaluate the significance of light for the development of the adrenocortical rhythm, 48 h patterns of blood corticosterone levels were measured in blinded pups (optically enucleated within 24 h after birth). They manifested an overt circadian rhythm at 4-week-old. Their rhythm free-ran during the observation periods of following 3 weeks, indicating that the rhythm was endogenous. When blinded pups were raised by foster mothers, which had a reversed rhythm of the original ones, the observed rhythm in pups appeared to be entrained by the foster mothers. This finding suggested the important role of mother for the development of the circadian adrenocortical rhythm in the rat.

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THYROTROPIN RELEASING HORMONE (TRH) ENHANCES INITIATION OF Ca SPIKE IN THE RAT CLONAL PITUITARY CELL (GH₃). S. OZAWA and N. KIMURA* (Dep. of Physiol., Jichi Med. Sch., and Dep. of Med. Chem., Tokyo Metropolitan Institute for Neurosciences*.)

The clonal pituitary cell GH₃ is capable of generating action potentials due partly to Ca^{2+} . This voltage-dependent Ca^{2+} -influx has been suggested to be involved in stimulus-secretion coupling. Since TRH stimulates release of both prolactin and growth hormone from GH₃ cells and this effect is dependent on the extracellular Ca^{2+} , we investigated effects of TRH on the electrical excitability of these cells. Application of TRH induced a sustained burst of action potentials preceded by a short-lasting membrane hyperpolarization. The spike burst was also evoked in Na^{+} -free solution. Since the critical membrane potential level for initiation of the Ca^{2+} spike was occasionally shifted to more negative range by application of TRH, it is likely that TRH may act on the voltage-dependent Ca^{2+} and/or K^{+} channels. Addition of 2 mM Co^{2+} , which blocked Ca^{2+} spike, abolished the stimulatory effect of TRH on the hormone secretion. These findings indicate that TRH exerts its effect on hormone secretion by augmenting initiation of the action potentials in GH₃ cells.

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PLASMA PROLACTIN LEVELS IN MONKEYS. HAYASHI, M and OSHIMA, K. Dept. of Physiol., Primate Res. Inst., Kyoto Univ., Inuyama

Monkey plasma prolactin was determined by a homologous radioimmunoassay system for human prolactin. In this system, human pituitary prolactin and plasma of pregnant macaques showed similar inhibition in shape and slope. The concentration of plasma prolactin during pregnancy was determined in one Japanese and four rhesus monkeys. Prolactin levels increased during the last week before parturitions and reached a maximum (10-20 fold) at delivery and then declined gradually. The effect of TRH injection (10 µg/kg) on the prolactin levels was examined in five female Japanese monkeys. Prolactin increased with about thirty fold value at maximum 10 to 15 minutes after injection and returned to the resting levels at 2 hr. The pattern of prolactin release and half life of prolactin (24 min) were closely similar to those of human. In an attempt to clarify whether the adrenergic pathway is involved in the regulation of prolactin secretion, the effects of α - and β -adrenergic blockers on the plasma prolactin levels were studied. Intravenous injection of α -adrenergic blockers, chlorpromazine and haloperidol, at a dose of 1 mg/kg triggered a prolactin release, while β -adrenergic blocker, propranolol, at a dose of 1 mg/kg was inert on the levels of prolactin. These results suggest that α -adrenergic and dopaminergic neural system may be involved in the regulation of prolactin secretions in monkeys.

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PARTICIPATION OF THE ORGANUM VASculosum OF THE LAMINA TERMINALIS (OVLt) IN ACTIVATION OF PARAVENTRICULAR (PV) AND SUPRAOPTIC (SO) UNIT ACTIVITY INDUCED BY INTRAVENTRICULAR INJECTION OF ANGIOTENSIN II.
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Angiotensin II (10 ng) injected into the third cerebral ventricle activated PV and SO unit discharges in urethane-anesthetized rats. To search for the site of action of angiotensin II in the brain, the response of the neurosecretory cell to angiotensin II injected into the third ventricle was examined in the rats bearing a lesion in the OVLt, subfornical organ (SFO) or subcommissural organ (SCO). After lesioning the OVLt or SFO, PV and SO units responsive to angiotensin II significantly reduced, while lesioning the SCO did not elicit a significant change in the response. When angiotensin II was applied to the OVLt, PV unit was excited by only 1/100-1/1,000 of the dose for intraventricular injection. Electrical stimulation of the OVLt evoked action potentials of the neurosecretory cells. These findings indicate that the OVLt is a sensor for angiotensin II and participates in neurohypophyseal hormone secretion.

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Ca^{++} -INDEPENDENT RELEASE OF CATECHOLAMINES FROM THE PERFUSED ADRENAL GLAND: SECRETION BY EXOCYTOSIS?

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Secretory stimulus somehow promote the Ca^{++} influx and a prompt rise in the intracellular Ca^{++} induces exocytotic secretion of catecholamines. In light of Ca hypothesis, some investigator considered the intracellular Ca bound to the membranes to be essential for secretion, which persists in the absence of extracellular Ca^{++} . Little evidence, however, is obtained supporting the exocytotic mechanism for this secretion. Adrenal glands were perfused, and catecholamines (CA), dopamine- β -hydroxylase (DBH) and phenylethanolamine-N-methyltransferase (PNMT) in the effluents were measured after stimulation with some agents. The release of CA was observed in the absence of Ca^{++} (containing EGTA) by chlorpromazine, isotonic NH_4^+ , X 537A and acetaldehyde. The release after the two former agents was always accompanied by that of PNMT and DBH, suggesting that these agents have toxic effects on the plasma membrane. X 537A showed the similar effects in some cases, but in most cases, the release was not accompanied by that of DBH, showing that this agent acts on the granules as an aminophore. Acetaldehyde repeatedly released CA without concomitant release of DBH and PNMT suggesting the direct action on the granule. On the other hand, exocytotic secretion was obtained when Na^+ was completely replaced with sucrose.

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CONTROL OF RAT GROWTH HORMONE SECRETION BY THYROID HORMONE. M. SUZUKI, A. TAKEUCHI, AND T. KAKEGAWA. Dep. of Physiol., Inst. of Endocrinol., Gunma Univ. Maebashi

To analyse the action of thyroid hormone to restore the secretion profiles of growth hormone, corticosterone and thyrotropin of thyroidectomized rats, clonidine (15 µg/100 g body weight), an α-adrenergic stimulant in CNS was iv injected to normal, thyroidectomized, and thyroxine-supplemented rats previously treated with α-methyl-p-tyrosine. Clonidine stimulated so markedly growth hormone secretion of normal rats, which was lowered by the drug pretreatment, as the ultradian burst but induced no change in the hormone secretion of thyroidectomized rats. Thyroxine supplement restored the responsiveness, although it was slow. Alfa-methyl-p-tyrosine increased plasma corticosterone level of normal rats as high as 400 to 600 ng/ml, while thyroidectomy blunted the increase below the half of the normal level. Thyroxine administration recovered the response nearly to the normal level. Clonidine decreased abruptly the corticosterone levels of all these groups. The thyrotropin concentrations of normal and thyroidectomized rats were further increased significantly by clonidine but the α-adrenergic stimulant failed to stimulate thyrotropin secretion of thyroxine-supplemented group. These results suggest that thyroxine caused the ultradian burst of growth hormone secretion through a probable mechanism(s) after the level of α-adrenergic receptor, while the responsiveness of the adrenal cortex was maintained by the hormone.

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DEVELOPMENT AND SEX DIFFERENTIATION OF THE LIMBIC-PREOPTIC-HYPOTHALAMIC NEURO-AXIS IN IMMATURE RATS. T. AKEMA, M. KAWAKAMI. Dep. of Physiol., Yokohama City Univ. Sch. of Med., Urafune-cho, Minami-ku, Yokohama, Japan.

Single hypothalamic arcuate (ARC) unit responses to the medial preoptic (MPO) stimulation, and MPO unit responses to the medial amygdala (AMYG) or the dorsal hippocampus (HPC) stimulation were examined in immature rats of 21-40 days of age by means of post-stimulus time histograms. Either percentages of ARC neurons responding to the MPO stimulation or thresholds of the MPO stimulation were not different between both sexes nor during development. Percentages of MPO units facilitated by the AMYG stimulation were decreased during maturation in male rats, while the changes in percentage in females were not obvious. Significant developmental changes were observed in the percentage of MPO units responding to the HPC stimulation in both sexes. The number of MPO units responding to the HPC stimulation was different between intact males and females, between neonatally gonadectomized males and females, and between intact and neonatally gonadectomized males. Thresholds of the AMYG stimulation were lowered and those of the HPC stimulation elevated during development. These developmental changes were influenced by gonadectomy or gonadal steroid injection. These results suggested the existence of sex differences and developmental changes which might be under the control of gonads in the limbic-preoptic systems rather than the hypothalamus in immature rats.

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INTRACEREBRAL ADRENALINE (AD) FACILITATION OF ESTROGEN SENSITIVITY FOR INDUCING LORDOSIS BEHAVIOR IN THE OVARIECTOMIZED RAT. M. YANASE & N. MURAKAMI. Dep. of Physiol. Yamaguchi Univ. Sch. of Med. Ube. Yamaguchi

The author has reported previously that adrenaline (AD) i.p. but not noradrenaline (NA) facilitates estradiol benzoate (EB) induction of lordosis behavior in the ovariectomized rat, only when given during 4h after EB. Effects of intracerebral AD and related agents on EB sensitivity of lordosis mechanism with an index of lordosis quotient (LQ: No. of females lordosis responses x 100 / male's mounts) were examined. Results were as follow: (1) Lordosis facilitation after AD i.p. together with 2 µg EB was abolished when 20 µg of dibenziline or nderal was pretreated into the 3rd ventricle through the chronically implanted cannula. (2) Microinjection of 5 µg AD/5 µg saline or a similar dose of isoprotelenol into the POA-AH but not NA in the POA-AH or AD in the caudate putamen caused an increase in LQ in the 2µg EB and 0.5 mg P primed ovariectomized rat 48 h later, when it was given 0.5 h after EB. Results suggest brain AD mechanism sensitizes lordosis mechanism to EB.

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UNIT ACTIVITY IN HYPOTHALAMIC ISLAND AFTER LONG-TERMED DEAFFERENTATION

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This experiment was designed to study the changes of unit activity in the hypothalamic island of female rats after several months of the deafferentation. The experimental results were summarized as follows. (1) The pattern of interspike interval histogram in the hypothalamic island indicated the gamma distribution as same as the intact rat. (2) The long-termed fluctuation of the mean frequency was observed in the hypothalamic island, this phenomena was also appeared in that of intact rat. (3) On the other hand, the leukocyte in vagina smear was observed just after the cut around the basal medial hypothalamus (BMH), neucleated epithelium cell in vagina smear was observed three months after the cut of BMH, and this condition was continued.

From the above mentioned results, it might be suggested that the neurosecretic function in the hypothalamic island were recovered about half year after the cut around BMH.

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CONTROL PATTERN OF MYOELECTRIC DISCHARGES ON SYNCHRONIZATION AND ALIGNMENT MOVEMENT BETWEEN THE AGONIST AND ANTAGONIST OF MUSCLES — BY COMPARISON WITH CROSS-POWER SPECTRA OF SURFACE ELECTROMYOGRAM.

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Surface electromyogram was recorded during static contraction of skeletal muscles (M.Deltoides, M.Biceps Brachii and M.Triceps Brachii). Motor control of these signals were analyzed to get Fourier Transform and Power Spectra pattern statistically. Intervals(frequency) and amplitude(gain) of myoelectric discharges were obtained quantitatively during synchronization and alignment movement of the fore-arm, adopting the digital computer.

Assuming these muscular movement to the close loop system of model, Bode charts were written by the auto-control theory in according to the pattern of the cross-power spectra, and characteristics of motor control were shown as follows. Function of low-frequency components(about 15 Hz) of these myoelectric discharges, which were propagated with small gain and fast phase, were contributed to tonic control of movement. High-frequency components were appeared as bands of 40-60 Hz remarkably, in which both muscles functioned during phasic control of movement synchronizably.

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APPEARANCE TIMES OF MUSCULAR ACTIVITY OF LOWER LIMB DURING CONTROLLED FALL IN MAN. T.YONEDA AND A.ISHIDA. Dept. of Physiol. Sch. of Physical Edu. Juntendo Univ. Fujisaki, Narashino, Chiba.

It has been well known that electromyographic responses of M.Gastrocnemius and M.Tibialis ant. appeared within 100 msec after onset of unexpected free fall. This early muscle discharge was postulated, startle response and Otolith-spinal reflex. In order to investigate the effect of various fall speeds to amplitude and appearance time of muscle activity, parachute falls released electromagnetically from 30 cm height were performed, which speeds were controlled by method of loading in opposite to falls.

As results, discharge amplitude of muscles in common tended to decrease gradually as falling speed were relative slow. And appearance times of M.Gastr. were in about 100 msec in the speeds range of 65-150 cm/sec speeds. However, the times of M.Tibia. delayed with slowing speed as drawing near the landing time. The results suggested that early discharges of both muscles may due to motor mechanisms which elicit different activities between flexor and extensor by stimulus of speed.

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THE OSMOTIC FRAGILITY OF ERYTHROCYTES AND LIPID PATTERN
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The sports anemia is characterized by the increase in osmotic fragility of erythrocytes to a hypotonic salt solution.

In the present study, the subjects exercised on a treadmill for 3 minutes with the speed of 250 m. per minute. Results obtained are as follow:

- 1) After the exercise, the concentration of blood lactate markedly increased and attained to the level of 95 mg/dl in average. This high concentration of lactate returned to the control level of 6-10 mg/dl in one hour. Almost the same content of lactate was found after keeping the blood in vitro for 3-4 hours at a high room temperature (30-32°C), that is attributed to the glycolysis.
- 2) The osmotic fragility of erythrocytes increased parallel with the elevation of lactate content in the blood.
- 3) After the exercise, the contents of free cholesterol (C) and total phospholipids(P) were changed in the red blood cells, and the ratio of C/P decreased.

In conclusion, lactic acid may contribute to the modifications in the lipid profile and to the increased fragility of the erythrocytes.

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CATECOLAMINES METABOLISM DURING PHYSICAL EXERCISES (3)

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The purpose of this study was to follow the adrenaline(Ad.) and noradrenaline(Norad.) levels in blood plasma in related to the graded work load, and to find the correlation between catecholamines and cyclic AMP(c-AMP) levels after each work load exercise.

The subjects of this study were six healthy males with a mean age of 25.5 years.

The levels of Ad., Norad. and c-AMP in blood plasma at rest were 0.035 ± 0.025 ng/ml(mean $\pm$ SD), 0.200 ± 0.009 ng/ml and 23.8 ± 3.9 pmole/ml respectively.

Increments of catecholamines after exercises correlated to the per cent of the individual's maximal oxygen uptake that represents the work load ($r=0.7656$, $p < 0.001$). The Norad. and c-AMP levels increased slowly, up to about 70 % of the maximal oxygen uptake, and thereafter rapidly. The increments of Norad. concentration after exercises were 0.883 ± 0.407 ng/ml at 82.5 % and 1.223 ± 0.433 ng/ml at 100 % of maximal oxygen uptake respectively. Cyclic AMP concentration increased 25.3 ± 10.3 pmole/ml at submaximal(82.5 % VO_2 max.), 33.0 ± 8.6 pmole/ml at maximal work load, respectively.

The changes of Ad. concentration after exercises were slight compared with Norad.. There was significant correlation between Norad. and c-AMP levels in the plasma in exercises.

SEXUAL DIFFERENCE OF SODIUM AND POTASSIUM CONCENTRATION IN SKELETAL MUSCLE FIBERS. K. KIKUCHI. Dep. of Health and Physical Edu., Fac. of Integrated Arts and Sci., Hiroshima Univ., Hiroshima-city, Hiroshima

Sodium and potassium contained in M.gastrocnemius and M.tibialis ant. were determined to evaluate differences between male and female rats. Twelve male and female albino rats of an inbred Wistar strain, 4-6 weeks of age, were used in this experiment. Ultra-micro-flamephotometer was used to measure the concentration of sodium and potassium. The results obtained were as follows; 1) Each weight of M.gastrocnemius and M.tibialis ant. in male was heavier than that in female. 2) No apparent difference between male and female was found in water content of M.gastrocnemius and M.tibialis ant.. 3) In sodium concentration of M.gastrocnemius and M.tibialis ant., no apparent difference was found in male and female. 4) Potassium concentration of M.gastrocnemius and M.tibialis ant. in male was larger than that in female. 5) The concentration ratio of potassium to sodium was found no distinguishable difference in male and female.

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EFFECTS OF THYROXINE ADMINISTRATION AND EXERCISE ON RAT CARDIAC MUSCLE.

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The hearts were isolated from control rats, L-thyroxine administrated rats (T_4 , $15 \mu\text{g}/100\text{g}$ body weight/day for 3 weeks), and endurance-exercised rats (at 70-80% of VO_2 max daily for 30 min. throughout 2 months). Lactate dehydrogenase (LDH) was prepared from atria, right and left ventricles. Contractile protein was obtained from left ventricle.

Present investigation demonstrated that: (1) T_4 and exercise induced the increased heart wet weight. (2) LDH specific activity of ventricle decreased in T_4 administrated rats and the muscle-type LDH isoenzyme increased in them. (3) Myosin Ca^{2+} -ATPase activity ($0.6 \text{ M } \text{KCl}$) increased slightly in T_4 administrated animals. (4) Myosin K^+ -EDTA ATPase activity ($0.6 \text{ M } \text{KCl}$) and actomyosin Mg^{2+} -ATPase activity did not change by T_4 and exercise. (5) There was no difference on the amount of SH and pH dependency of myosin between 3 groups. (6) Electrophoretic pattern of contractile proteins was same in every group.

The difference between the effects of T_4 and exercise on heart, which may induce the hyperfunction of it, is discussed.

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STUDIES ON THE RELATIONSHIP BETWEEN THE PHYSICAL STRENGTH, THE BODY TYPE AND THE CHARACTER.

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We studied the relationship between the physical strength, the body type and the character on 61 sportsmen.

Indicators of physical strength are back strength, side step test and etc., that of body type, body height, body weight and breadth of breast, length of leg and etc., that of character are version quotient of SG extraversion-intraversion test.

Result:

I. We classified the body type into the following four groups, that is type of very tall person, working type, running type and type of average person,

II. Person's coefficient of the relation between the physical strength and the body type is small,

III. Those who have wide shoulders seem to be of extraversive characters.

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STUDY FROM THE VIEW POINT OF EXERCISE PHYSIOLOGY ON THE BEARD, NAILS AND HAIRS OF A SUBJECT DURING 20 YEARS.

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From 38 years old the 57 years old daily beard growth, the number of depilated hair and quantity and quality of the scurf which was collected by shampooing every five days of my own were measured. From 48 years old to 57 years old fingernails and toenails par-day-growth were estimated.

Daily running training has been done from 50 years. No significant influence of the running training were observed on the number of depilated hair and others but beard growth. From 50 years to 53 years the rate of beard growth per day was almost same the one obtained from 46 years old to 49 years old. After 54 years the rate of beard growth were decreased clearly. It seemed to me that the cause of beard growth decrease maybe hard running training. Because when premature contraction was observed after the running frequently the beard growth rate was decreased remarkably and when any abnormal phenomenon didn't observed after the running the beard growth rate was same as standard value.

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Adaptive changes in the serum LDH isozymes during chronic exposure to simulated high altitude.

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Three Japanese monkeys weighing 7.5-12.0 kg and ten male rabbits weighing 3.3 kg in average were continuously exposed to simulated altitude of 18,000 ft (ca 1/2 ata) for 30 days in a large, adequately ventilated low pressure chamber maintained at $24 \pm 1^\circ\text{C}$. Total serum lactic dehydrogenase (LDH) activity and isozyme distribution were determined at intervals of 7 to 10 days pre-, during and post-exposure period.

Total LDH levels in both animals were significantly increased during the initial two weeks of exposure and then returned gradually to the pre-exposure control level. Percentage distribution of isozymes, designated as LDH-1, -2, -3, -4 and -5, were found to be more specifically, decrease in LDH-1 and -2 and increase in LDH-3, -4 and -5, during the acute adaptation period of the initial two weeks of exposure. These isozyme changes are suggestive of a metabolic adaptation to hypoxia and may be resulted in effective oxygen consumption at the aerobic tissues, such as heart or lung, and saving oxygen at the anaerobic tissues, such as liver or skeletal muscle, during the period of oxygen deficiency before the time when the complete acclimatization will be achieved.

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CARDIAC RESPONSES AT REST AND DURING SUBMAXIMAL EXERCISE IN CHILDREN.

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The characteristics of the cardiac responses at rest and during submaximal pedalling exercise using Monark ergometer were studied in 176 healthy children (male 86, female 90) from 5 to 18 year of age. Stroke volume and systolic time intervals were determined by impedance cardiograph and mechanocardiograph. Stroke volume at rest gradually increased with age in both sexes. PEP, QZ and QS₂ at rest gradually increased with age, while LVET showed almost constant. Therefore, PEP/LVET ratio increased with age. In the response of stroke volume at exercise, significant differences were found at between below 11 year and after 12 year in male, below 10 year and after 11 year in female. Significant negative correlations were found between stroke volume index and PEP/LVET ratio at each age in both sexes. PEP/LVET ratio at exercise showed low values in young age and increased with age. The decrease rate of PEP/LVET ratio with increasing of heart rate showed progressively increase after 12 year of age. From these results, it may be concluded that the children of 10 to 12 years have the turning point in development of the cardiac functions.

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BLOOD FLOW OF THE IPSILATERAL AND CONTRALATERAL LOWER LIMBS AFTER ISOMETRIC CONTRACTION

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Calf and thigh blood flows both of right and left lower limbs were determined simultaneously by means of venous occlusion plethysmography before and after isometric contraction of the right thigh. The isometric contraction was performed for 15 second at about 50 % of maximal voluntary contraction. The blood flow in the active limbs immediately after isometric contraction of the right thigh was increased in all subjects. On the other hand, the blood flow in the inactive ipsilateral and contralateral lower limbs immediately after isometric contraction decreased as compared with the resting level. These results are suggested that the blood flow in the ipsilateral and contralateral lower limbs may be controlled independently each other.

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ON THE PERIODIC OXYGEN CONSUMPTION IN MAN.

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The oxygen consumption in fifty college normal female subjects was measured with a electrometabolator (type BMS-600, Fukuda) and a Benedict-Roth respirometer (13.5 liter). The average oxygen consumption was at rate of about 150 ml per minute. The periodic increase in oxygen consumption was observed at interval of 2-4 minutes in a large number of subjects. The amounts of the periodic increase in oxygen consumption were 20-25% of the resting oxygen consumption level and 35-40% of the post exercise level. The mechanism that generates the periodic oxygen consumption is still incompletely understood.

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EFFECTS OF K^+ OR ADRENALINE ON OXYGEN UPTAKE IN RAT SUBMANDIBULAR GLAND.

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TSUBOI, M., KOMABAYASHI, T., SAKAMOTO, S. and KOFUNE, K. Dep. of Physiol., Tokyo College of Pharmacy, Hachioji-shi, Tokyo

This investigation was undertaken to clarify the mechanism of stimulated respiration caused by K^+ or adrenaline in rat submandibular gland. 1. The addition of 20-30 mM K^+ stimulated remarkably oxygen uptake in rat submandibular gland, and similiary adrenaline (0.5-1.0 μ g/ml) caused a marked stimulation. 2. K^+ and adrenaline-induced oxygen uptake were decreased considerably when a Ca^{2+} -deficient tissue was incubated in Ca^{2+} -free medium, and was recovered by an addition of 5 mM Ca^{2+} . 3. Mn^{2+} (3 mM) or La^{3+} (6 mM) inhibited slightly oxygen uptake due to K^+ and adrenaline. 4. K^+ -induced oxygen uptake was inhibited considerably by 0.1 mM ouabain, but adrenaline-induced oxygen uptake was unaffected.

These positive results suggest thst K^+ and adrenaline-induced oxygen uptake are dependent on the presence of Ca^{2+}

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EXCITATION-METABOLISM COUPLING IN RAT SUBMANDIBULAR GLAND. TSUBOI, M., KOMABAYASHI, T., SAKAMOTO, S. and ENDO, S. Dep. of Physiol., Tokyo College of Pharmacy, Hachioji-shi, Tokyo

This investigation was undertaken to clarify the excitation-metabolism coupling in rat submandibular gland slices. Adrenaline (DL and L), noradrenaline (DL and L), isoproterenol and acetylcholine considerably stimulated the oxygen uptake, but dopa (DL and L) and serotonin did not. L-adrenaline-induced oxygen uptake was inhibited by phenoxybenzamine and propranolol, and isoproterenol-induced oxygen uptake was considerably inhibited by propranolol. Acetylcholine-induced oxygen uptake was remarkably blocked by atropine. L-adrenaline, DL-noradrenaline and isoproterenol increased the amylase output. L-adrenaline-stimulated amylase output was blocked by propranolol, but was not blocked by phenoxybenzamine. Also, isoproterenol-stimulated amylase output was strongly inhibited by propranolol. These positive results suggest that the oxygen uptake in submandibular gland is stimulated following activation of muscarinic or adrenergic receptors, and that the increase of oxygen uptake caused by adrenergic agonists is mediated by α - and β -receptors and the amylase output is evoked through the stimulation of β -receptors.

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RESYNCHRONIZATION OF CIRCADIAN RHYTHM FOLLOWING PHASE SHIFT. T.SASAKI, R.KOGA, S.TSUZUKI, Dept. of Physiol., Inst. of Constitutional Med., Kumamoto Univ., Kumamoto and T.H.TSAI, Dept. of Anat., Univ. of Arkansas for Med. Sci., Little Rock, Ark., U.S.A.

Progress of synchronization of circadian rhythm in hamsters following a phase shift of LD 12:12 by 10 hours (delay or advance) was observed. The period for synchronization after the phase delay (westbound travel simulation) was generally less by two days than the phase advance.

Circadian rhythm follows the daily shift of 1 hour for ten days (1x10) without delay, and on the tenth day the synchronization was complete. But by 1.5x7, the synchronization was attained on the 11-12th day; and by 2x5, on the 14-15th day.

In the case of three-step shifts as in 4+3+3 or 5+3+2, as well as two-step shifts as in 7+3 or 3+7, the synchronization was complete on the 16-17th day, while by a step change of 10 hours, on the 10-14th day.

Accordingly the minimum period for synchronization was attained by a single step shift or by daily shift of less than 1.5 hours, and two- or three-step shift was found to be of little value.

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IMPORTANCE OF CORE TEMPERATURE TO INCREASE COLD RESISTANCE FOLLOWING REPETITIVE ADMINISTRATIONS OF NE AND SWIMMING HIRATA,K. SUGANO,Y. SHIBATA,H. NAGASAKA,T. Dept. of Physiol., Kanazawa Univ.Sch.Med., Takaramachi 13-1, Kanazawa

Male rats were forced to swim for 3-hr daily for 4 weeks at 1)38.5°C, 2)36°C and 3) 32°C of water temperature (Tw). Body temperatures while swimming were 40°C, 38°C, and 34°C respectively. ISBAT and heart were larger in Tw 32°C-swimming rats than in other 2 groups. In unanesthetized rats, the calorogenic response to infused norepinephrine (NE) was prominent only in Tw 36°C-swimming group. The cold resistance measured by immersion of the animals in cold water (Tw=18°C) was higher in Tw 36°C-swimming group. In all rats, injection of NE caused an elevation of mean arterial pressure (MAP) with a marked bradycardia. In anesthetized rats (with urethane-chloralose), the results were different. Heart rate and MAP increased greatly following NE injection in all groups. The grade of tachycardia and change in heart rate were larger and the calorogenic response to NE was also greatest on Tw 32°C-swimming rats. In general, a marked bradycardia suggests a reduction of cardiac output. In spite of having an increased mass of BAT, heat production rose only a small amount following NE injection in unanesthetized Tw 32°C-swimming rats. The results suggest that core temperature is important to maintain blood flow to the calorogenic tissues such as BAT, which may function to modulate calorogenic response to NE. The effects of repetitive injections of NE were also studied.

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PHYSIOLOGICAL RESPONSES OF ANIMAL BODY TO ABNORMAL MAGNETIC FIELD EXPOSURE SUDOH,M. NAKAYA,M. ABE,M. SAIKI,H. Space Medicine Lab., Jikei Univ. Sch. Med., Minato-ku, Tokyo

Experimental results on the attitude of the physiological function of rats and mice during and after exposure to low magnetic field (LMF) about 1% intensity of geomagnetic field (GMF) by active shielding under hypokinetic conditions, were reported. The results obtained were as follows : 1) Increase of the urinary excretion value of K and Na during the hypokinetic period was more remarkable in the GMF group than in the LMF group. And return to the pre-exposure control level was faster in the LMF group than in the GMF group. 2) The fluctuation of K and Na excretion rate of rats during 5-weeks and 3-weeks hypokinetic exposure and ambulatory life after the exposure, shows recovery to control value preceding hypokinetic exposure is more readily accomplished, when release from the hypokinetic exposure is after 5-weeks than after 3-weeks exposure. 3) Healing process of the wounds inflicted with a punch to the dorsum of mice under hypokinetic field, during GMF and LMF exposure showed the significantly better healing effects of GMF than LMF exposure. 4) Swimming capacity of mice showed that the detrimental effects of hypokinetics were attenuated by LMF. From the results 1),2), it is possible to consider that one of the characteristics of adaptation to hypokinetics is their readaptability is dependent on the process of the adaptation. And all those results 1)-4), suggest the suppressive effects of LMF on the responses by hypokinetics.

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ENDOCRINE RESPONSES TO LOW ATMOSPHERIC PRESSURE BEFORE AND AFTER SHORT-TERM MOUNTAIN CLIMBING IN MEN. Y. TAMURA, N. MATSUI. Dep. of Endocrinol. and Metab., The Research Institute of Environmental Medicine, Nagoya University, Chikusa-ku Nagoya

Responses of several hypophyseal, thyroidal and adrenal hormones to low atmospheric pressure were examined in men. Low pressure experiments were performed in a decompression chamber with 2 hr decompression to 4,000 m or 5,000 m simulated altitude, 2 hr maintenance and 2 hr restoration. Results of these responses were compared with results in the 2nd experiment after 3 days mountain climbing which gave continued low pressure stimuli to the subjects.

Increases in levels of blood LH, prolactin, ACTH and cortisol, increased excretions of 17-OHCS and epinephrine in urine, decreases in blood level and in urinary excretion of aldosterone were observed after exposure to the low atmospheric pressure. Levels of blood FSH, TSH, T_3 and T_4 showed small fluctuations, but the level of GH remained unchanged. Increments in adrenal cortical and medullary hormones in response to the low pressure were reduced to a certain degree in the 2nd experiment. The meaning of this reduction of responses is still to be investigated.

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THE EFFECT OF ONE HAND IMMERSION IN COLD WATER ON THE FINGER TIP TEMPERATURE, HEART RATE AND BLOOD PRESSURE IN THE NORMAL AND IN THE VIBRATION EXPOSED SUBJECTS.

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1. Influence of one hand immersion in 5°C, 10°C and 15°C water for 10 min on the finger tip skin temperature was studied in 6 same male subjects in Aug., Oct., Feb. and May. CIVD (cold induced vasodilation) occurred more often and stronger in lower water-bath temperature (T_w) in both Aug. and May. At T_w of 15°C, MST (mean skin temperature during the end 5 min of immersion) was nearly T_w and the rewarming response during the recovery period reached a minimum in Oct. and Feb. This chiefly vasoconstrictive T_w was higher in summer.

2. At T_w of 5°C, 116 vibration exposed subjects (VES) were examined. MST was lower and the recovery was far slower in VES than in the control subjects. This may be due to low chiefly vasoconstrictive T_w in VES.

3. Increases of heart rate, systolic and diastolic pressures during the early phase of immersion were greater in the control subjects than in VES. In students, increases of them were greater in summer than in winter. These results indicate that the sympathetic response normally observed when extremities are exposed cold decreases in autumn and winter, especially in VES.

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THE EFFECT OF ADAPTATION FOR LOCAL WARMING OR COOLING UPON THE COLD VASOREACTION OF RABBIT'S EARLOBES. G. UEDA, M. TAKEOKA, Y. KOSHIHARA. Inst. of Adapt. Med., Shinshu Univ., Matsumoto

[Purpose] The difference of vasoreactions induced by -7°C local stimulation for rabbit's earlobe was investigated under warm- and cold-adapted conditions.

[Method] Six normal adult rabbit's were investigated in the artificial climatic chamber. On the central artery and marginal veins, thermistors were placed and the continuous recording of the temperatures was performed with the precision of 0.01°C. The local cooling (0°C) or warming (42°C) was applied to the peripheral one-third of the earlobe for one hour × two times per day during 3 weeks. The waves were analyzed at the data station connected to the Tokyo University Computer Center.

[Result] After the completion of 3 weeks' stimulation, cold vasooscillations for the warm-adapted and cold-adapted earlobes were compared. It was thus shown that as for the coefficients of variation of the amplitudes (CVX), CVX of the warm-adapted group, 0.545, was significantly larger than that of the cold-adapted group, 0.433. Next, two weeks after the completion of the stimulation, it was shown that the mean amplitude of the cold group was higher than that of the warm group, the mean period of the cold group was shorter than that of the warm group, and the mean underlying fluctuation of the cold group was less than that of the warm group.

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FUNCTION OF GLUCOCORTICOIDS IN METABOLIC ACCLIMATION TO COLD-EXPOSURE.
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The participant period of glucocorticoids in metabolic acclimation of rats exposed to cold environment (4°C) was investigated. The results obtained were as follows. 1) The plasma levels of corticosterone showed a major increase during 5 days of cold-exposure and decreased thereafter. 2) Adrenalectomized rats exposed to cold were unable to maintain the normal levels of plasma glucose and free fatty acids (FFA), and died in less than 17 hr. 3) When the rats exposed to cold for 5 days were bilaterally adrenalectomized, their plasma glucose and FFA levels were maintained at levels near normal during subsequent cold-exposure. 4) In adrenalectomized rats treated with a dose of dexamethasone sulfate (1.5 mg/Kg s.c.) daily for 5 days on cold-exposure, plasma levels of glucose and FFA during subsequent cold-exposure were maintained at levels near normal. 5) Even when plasma glucose levels in adrenalectomized rats were maintained at normal range on cold-exposure, hepatic glycogen levels were markedly lower than those of normal rats.

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CIRCADIAN RHYTHM OF RESISTANCE TO COLD, M. TOHORI, Y. KAKUTANI, S. KIMURA, H. YOSHIMURA*, Dept. of Nutritional Physiology and Physical Fitness, Kobe Women's College, Sumaku, Kobe; *Dept. of Physiol., Hyogo College of Medicine.

About 20 Wistar rats of about 200g were fed laboratory stock diet ad libitum in the day time, and divided into three groups (A, B and C). After 24 h. fasting, A group were placed in a cold chamber of -20 °C at 10 o'clock, A at 14, and C at 18 for 60 minutes respectively. Falls of rectal temperature of the rats were measured with thermister and it was found that the extent of fall was significantly the less with C group, while the largest with A group. Measuring the glycogen content in liver, it was the highest in A and gradually decreased from B to C. The fact is well known as a circadian rhythm of liver glycogen and is explained by circadian change of activity of rate limiting enzyme of glycogen synthesis as well as degradation respectively. By making the animal fast for 6 days, the circadian rhythm of liver glycogen disappeared. At this stage, three groups divided as above, were exposed to the cold of -20 °C, and the fall of rectal temperature was compared among the three groups. Difference among the falling rate of rectal temperature among three groups disappeared. Thus the resistance to cold exposure shows a circadian rhythm, and the rhythm is presumed to be due to the circadian rhythm of catabolism of caloric nutrients to protect the fall of body temperature.

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THE ROLE OF VENTROMEDIAL HYPOTHALAMUS IN THE METABOLIC ADAPTATION OF GLUCOSE TO THE COLD AND HEAT EXPOSURE K. SETO, H. SAITO, M. FUJITA, A. USHIKOSHI, E. UCHIDA Dep. of Physiol., Kochi Medical School, Nankoku-shi Kochi-ken R. HAYASHI, M. KAWAKAMI Dep. of Physiol., Yokohama City University School of Medicine, Minami-ku Yokohama

There were many influences of cold and heat exposures on the glucose metabolism in the liver slices of control rabbits. These influences of cold and heat exposures on the glucose metabolism in the rabbit's liver were changed by the lesion of ventromedial hypothalamus (VMH). In both the control rabbits and VMH lesioned ones, these actions of cold and heat exposures on the glucose metabolism were disappeared by the repeated exposures.

From above mentioned results, it might be suggested that the VMH played some important role in the actions of cold and heat exposures on the glucose metabolism, but the VMH did not play any role in the establishment of metabolic adaptation of glucose to the repeated exposures of cold and heat.

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INFLUENCE OF EXTERNAL TEMPERATURE ON THE ACTIVITY OF SINGLE MOTOR UNITS.
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The influence of external temperature on the discharge threshold of a single motor unit (MU) during voluntary knee extension was studied by electromyographic recordings made from the right *m. vastus medialis* in five subjects. External cooling resulted in an increase and decrease in excitability of units in all parts of the muscle. In the former, especially cold-sensitive units were observed. Since recovery from excitability in MU was very fast with a slight external warming, it was not directly related to the rise of skin temperature. Transient spontaneous discharges were appeared in these units during shivering. These units showed almost no change in excitability by external warming.

The conduction velocity of MU was lineally decreased in external cooling, but this relation between conduction velocity and cooling grade was not changed even in shivering period.

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THERMOREGULATORY RESPONSES TO THERMAL STIMULATION OF SPINAL CORD IN RABBIT. M. KOSAKA, T. INOMOTO, N. OHWATARI. Dep. of Epidemiol., Inst. for Tropical Medicine, Nagasaki Univ., Sakamoto-machi Nagasaki

In rabbits, thermoregulatory responses to the spinal cord and cutaneous thermal stimuli as well as to LPS-pyrogen administration have been investigated at ambient temperature of 28°C. Heat production and heat conservation responses induced by cooling of the spinal cord closely resembled those following the cutaneous cold stimulation and LPS-pyrogen administration. While, heat loss mechanism was activated by heating of the spinal cord and skin as well as by intravenous injection of sulpyrine. In this study, blood flow of the cerebral tissue (PO/AH area) was measured with a hydrogen monitor based on the Hydrogen-clearance method in addition to the measurement of blood flow of the common carotid artery. An average amount of the cerebral blood flow calculated was 0.36ml/g/min at resting condition and it was not significantly changed if the spinal cord was thermally stimulated, though there existed marked changes in the blood flow of the common carotid artery. The physiological significance of these homeostatic reactions was discussed from the view-point of the central mechanism of the temperature regulation.

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THE EFFECT OF SELECTIVE COOLING OF LUMBOSACRAL CORD ON THE AUTONOMIC FUNCTIONS IN RATS
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It was already reported that selective cooling of thoracic cord increased the gastric motility and decreased the colonic motility while the selective cooling of lumbosacral cord decreased the gastric motility and increased the colonic motility (Proceed. IUPS Vol. XIII, 1977, Tsuchiya & Iriki). From above results, a mutual inhibitory relationship was proposed between sympathetic neurones in thoracic and lumbar cords which regulated the gastrointestinal motility. To investigate the same relationship between thoracic and lumbar sympathetic neurones concerning the spinal vasomotor mechanism, lumbosacral cord was cooled selectively in urethane or thiopental anesthetized rats. Selective cooling of lumbosacral cord increased heart rate in 11 and decreased in 12 examples. The changes of heart rate during the stimulation could not be abolished by preliminary spinal-transection in cervical level or by bilateral vagotomy. Skin temperature in ear and in tail were decreased during the stimulation in spinal-intact rats. Gastric motility was decreased during the stimulation. This results may suggest a functional connection from lumbar sympathetic neurones to the spinal vasomotor mechanism in the thoracic cord.

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THE INFLUENCES OF TEMPERATURE CHANGES OF ANTERIOR HYPOTHALAMUS ON THE FUSIMOTOR ACTIVITY
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In anesthetized cats, the responses of spindle primary and secondary endings to a ramp- and hold stretch of the soleus muscle, applied repetitively (3/min.), were recorded during cooling or warming of anterior hypothalamus to the various levels (32-42°C) by using a water perfused thermode, under the condition of a constant temperature. In each response to stretch of the muscle, the peak frequency and the static frequency at 0.5 sec. after completion of stretch were measured, calculating the dynamic index. The hypothalamic cooling only by a few degrees below the normal body temperature sharply increased the responsibility of the primary endings as well as the secondary endings to stretch with an occurrence of the background firing, while the sequential warming reduced it profoundly. The values of the static frequencies in the range of 32-35°C were significantly higher (up to 215%) than those (100%) in the range of 36-38°C in the most of the endings studied. Approximate 80% of 146 responses of an increase or decrease in the static frequency to a stepwise shifting of temperature by several degrees performed in the range of 32-38°C were found to be 'reverse' in a directional relationship between stimulus and response. The analysis on the response pattern of spindle primary and secondary endings to stretch revealed that the dynamic fusimotor as well as the static fusimotor system were activated by cooling of anterior hypothalamus.

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A WORKING HYPOTHESIS ON THE CENTRAL CONTROL OF BODY TEMPERATURE IN REFERENCE TO CIRCADIAN VARIATION. T. NAKAYAMA, S. ARAI AND K. YAMAMOTO.
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Normal rats entrained to a 12 hr light 12 hr dark cycle were exposed to heat and cold at noon and at midnight. Thermoregulation was performed more effectively at night than in the day. Blinded rats were subjected to the same heat and cold exposures 2-4 hr before the acrophase and the nadir of body temperature. In blinded rats, the temperature change differences in two circadian phases were not statistically significant for either heat or cold exposure. In blinded rats free of time cues, the circadian change of set-point is most likely caused by a parallel shift of temperature characteristic curves of both warm- and cold-sensitive neurons of the hypothalamus. In normal rats, the slopes of the temperature characteristic lines might be reduced during the light phase in addition to the parallel shifts. The circadian temperature range was reduced in blinded rats. The range was $1.8 \pm 0.3^\circ\text{C}$ in normal rats and $1.4 \pm 0.1^\circ\text{C}$ in blinded rats. The 24 hr mean temperature was the same in normal and blinded rats.

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POWER SPECTRUM ANALYSIS OF DYNAMIC PROPERTIES OF SWEATING ACTIVITY. M. ASAYAMA, T. OGAWA, M. ITO, T. MIYAGAWA. Dep. of Physiol., Aichi Med. Univ., Nagakute, Aichi

The present study concerns possible factors affecting the dynamic property of sweating activity by power spectrum analysis of sweat rate and skin temperature records.

Experiments were performed on seven male subjects in Winter, at room temperature of 37°C with relative humidity of 40% in most of cases. Sweat rate (Sw) and skin temperature (Ts) at a forearm area were recorded continuously on data recorder for a period of 90 minutes. Power spectrum density and correlation coefficient were calculated and examined for relationship between changes in Sw and Ts and for mode of sweat response to a cyclic radiant heat stimulus. Significant negative correlation ($r = -0.6 \sim -0.7$) between changes in Sw and Ts were observed in all experiments. Pattern of power spectrum density of Sw and that of Ts were also similar with each other. However, local periodic radiant heat of 2 min cycle applied to the test area failed to cause synchronized sweat response. Sweat response to a periodic radiant heat stimulus applied to the back of the trunk was highly synchronized with irradiation cycle of 2 min in the rest, but it was less synchronized during physical exercise. The results indicate that less dependency of sweat rate upon skin temperature during exercise can be clearly demonstrated by power spectrum analysis of dynamic properties of sweating activity.

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EFFECT OF TEMPERATE CLIMATE ON SWEATING REACTION OF MEN BORN AND RAISED IN OKINAWA., J. TSUJITA, M. MAYUZUMI, N. TANAKA, K. B. ITOH AND S. HORI., Dept. of Physiology., Hyogo College of Medicine, Nishinomiya, Hyogo.

Sweat tests were made on 20 young men who were born and raised in Okinawa but move to the Japan main islands in less than three years (group S) and 12 young male migrants of Japanese from Okinawa who have lived in the Japan main islands more than 10 years (group L). Sweat tests were performed at around 3 p.m. Sweating was induced in a climatic chamber of 30 °C and 70 % R.H. by immersion of both legs up to the knees in the stirring water bath of 42 °C for 30 min. after stairing in the room for 30 min. Sweat samples from the chest and back were collected for a 15 min. period using the filter paper method. There was no difference in rise of oral temperature between two groups during heat exposure. Group L showed significantly smaller sweat volume than group S. We already reported that sweat volume of subtropical natives is smaller and Na concentration in sweat is lower when compared with those of temperate natives. Sweat volume in group L was approximately same as that of temperate natives though Na concentration in sweat tended to be lower in group L than in temperate natives.

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INFLUENCE OF REGIONAL BLOOD FLOW RATE TO THE DEEP TISSUE TEMPERATURE IN THE DOG HINDLIMBS. T. TAMURA*, T. NEMOTO*, A. KAMIYA*, T. TOGAWA*, M. TANAKA**, K. KAWAKAMI***. *Inst. for Med. & Dent. Eng., Tokyo Med. & Dent. U., **Showa U., ***Jikei U..

Deep tissue temperature change for the change of the blood flow rate was analyzed theoretically and experimentally in the dog hindlimbs. Thigh and paw deep tissue temperature and regional blood flow rate were measured. After obtaining blood flow rates in a steady state, the abdominal aorta was occluded and regional temperature changes were recorded. It was found that the rate of deep tissue temperature drop was about five times larger in the paw than in the thigh. This fact was explained theoretically by applying the compartment model and it was shown that there were at least three main factors that contributed to increasing temperature change in the paw for the regional blood flow rate: 1) thermal capacitance of the paw is about 50% smaller than that of the thigh. 2) regional blood flow for a unit tissue weight in the paw is about 50% larger than that in the thigh. 3) temperature difference between the tissue and the arterial blood in the paw is about two times larger than in the thigh.

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COMPARISON OF COLD TOLERANCE AND PERIPHERAL VASCULAR REACTION BETWEEN YOUNG MEN BORN AND RAISED IN OKINAWA AND THOSE BORN AND RAISED IN MAIN ISLANDS., S. HORI, N. TANAKA, M. MAYUZUMI, K. B. ITOH AND J. TSUJITA., Dept. of Physiol., Hyogo College of Medicine, Nishinomiya, Hyogo.

Cold tolerance test and peripheral cold tolerance test were made on 5 young men born and raised in Okinawa but move to the Japan main islands in less than three years (group O) and 10 men born and raised in Japan main islands (group M). Cold tolerance test was performed on the subjects clothed with 1.8 clo in the supine position in a room of 10 °C with 70 % R.H. Changes in metabolic rate and skin temperature during cold exposure were observed for 60 min. Peripheral cold tolerance test was made by dipping left middle finger with a thermocouple attached to the nail bed into ice water for 30 min. In cold tolerance test, group O showed higher skin temperature, higher metabolic rate and greater frequency of shivering than group M. These results indicate cold tolerance of group O was inferior to that of group M. In peripheral cold tolerance test, the mean value of time for first temperature rise of the vascular reaction of finger was significantly greater in group O than in group M. Thus, it might be said that the vascular reaction of finger in the cold for group O was smaller than that for group M.

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FACTORS AFFECTING REGIONAL DIFFERENCES IN APPEARANCE OF THERMAL SWEATING. T. OGAWA, M. ITO, T. MIYAGAWA, M. ASAYAMA. Dep. of Physiol., Aichi Med. Univ., Nagakute, Aichi

Kuno(1956) maintains that thermal sweating appears almost simultaneously over the general body surface, whereas Randall and Hertzman (1953) assert that it first appears on the dorsal surface of the foot and extends progressively craniad. We demonstrated that this discrepancy was caused by the difference in posture of the subject. In a standing or sitting subject sweating appears almost simultaneously on various skin areas, while in a supine position appearance of sweating over the upper half of the body was delayed considerably, and in a subject lying on one side it preceded over the contralateral side of the body. Such effects were undoubtedly exerted by the sweat-inhibitory reflex induced by pressure applied to specified skin areas. Pressure applied to a small area over a rib of various heights caused inhibition of sweating in a fairly wide but restricted area on the ipsilateral side. It is considered that the pressure-sweating reflex is a kind of somato-sympathetic spinal reflex, and the extent of the sweat inhibitory effect is determined by the level of sensory dermatomes where the pressure is applied and sympathetic dermatomes which show considerable overlap.

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CHANGES IN SWEATING ACTIVITIES IN THE RATS INTOXICATED WITH METHYLMERCURIC CHLORIDE. FUJIOKA, Setsuyo, ABE, K. and TANAKA, I. Dept. of Physiol., Kumamoto Univ. Med. School, Kumamoto

In the Wistar-strain rats treated with methylmercuric chloride (MMC), spontaneous sweating and evoked sweating by local administrations of mecholyl (MCL) or epinephrine (EP) were examined at the sweat glands located at palmar and plantar pads. The rats were given MMC (5 mg/kg body weight, s.c.) twice a week. Sweating spots were visualized by an iodine-starch method of Wada & Takagaki.

The first change was a decreased excitability to MCL at total MMC doses of 40 mg/kg. The second was a decreased spontaneous sweating at 60 mg/kg. These changes preceded loss of body weight (at more than 60 mg/kg) and a neurological symptom of crossing phenomena in the hind limbs (at 90 mg/kg). In the excitability to EP, no consistent changes were found except a tendency to increase at the early stages and decrease at the late stages of dosing. When MMC dosing was discontinued at 40 mg/kg, the excitability to MCL well recovered within 10 weeks, but did not in 17 weeks when discontinued at 90 mg/kg.

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EFFECTS OF COLD-EXPOSURE ON L.P.L. ACTIVITY IN BAT OF MICE
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A prominent increase of L.P.L. activity was observed in BAT of cold-exposed (at 4°C) C57BL/6J mice. The increase was showed already initially on first 3 hours and reached to maximal activity at 15 hours in cold exposure, which showed 10-fold higher than that of housed at room temperature group, and also, that of the cold-exposed tissue surface did more prominent increase. Furthermore, with intraperitoneal administration of heparin (200U/body), the decrease of L.P.L. activity was observed in BAT of cold-exposed group, whereas it was not so obvious in normal group. The L.P.L. activity in heart of cold-exposed mice showed a little increase, but that of epididymal fat didn't. PHLA of cold-exposed mice showed about 2-fold higher than that of normal mice. Therefore, it is a conceivable idea that a large amount of the increased activity may come from the L.P.L. of BAT, which may present in releasable or surface type of L.P.L..

Plasma insulin level was not changed under the cold exposure.

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OXYGEN CONSUMPTION OF DEHYDROEPIANDROSTERONE TREATED RATS AT VARIOUS AMBIENT TEMPERATURE. M. MOHRI, Y. SUGANO AND T. NAGASAKA. Dept. of Physiol., Kanazawa Univ. Sch. Med., Kanazawa.

Thermogenic response of dehydroepiandrosterone in new born rats was investigated. The oxygen consumption was measured by means of a closed circuit system. In control rats, the thermal neutral range was, before the weaning period, at 35°C, and after the weaning period at 30°C. On the other hand, in DHA-treated rats, the thermal neutral range was at 35°C before and after the weaning period, though the oxygen consumption obtained at 30°C was not significantly different from that obtained at 35°C. Therefore, the DHA-treated animals are thought to acquire larger cold resistance.

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A DOUBT ON THE CONCEPT THAT HEAT PRODUCTION AND HEAT LOSS MUST BE SO EQUALLY BALANCED AS SHOWN BY PIONEERS. Suteyo YAGI, Dept. of Physiol., Med. Schl. of IWATE Med. Univ., Morioka, JAPAN.

In 33 experiments using 4 male human adults of normal activities there were found the gains in difference between those values obtained by indirect and direct calorimetry. The gains corresponded to the amounts of work with different loads. Some of the gains remained positive even without load, but most of the negative were obtained at rest after meal. From extrapolation of those figures above-mentioned, at such a low rate as the basal metabolism there may be found any gain lost.

The Heat Loss by Direct Calorimetry was estimated about a) temperature changes in 3 layers of Cu-plate each built up to a set of 3 boxes, of which in the innermost was kept the subject sitting at rest and then sometime with different loads, b) the amounts of water by evaporation, c) changes in the body temperature and the body weight, and d) the temperature change in the bronze body of valve connecting to Knipping's spirometer with which the Heat Production by Indirect Calorimetry was estimated from O₂ -uptake of the subject.

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CARBOHYDRATE METABOLISM OF RABBIT AORTA DURING CONTRACTION S. MASUMURA, M. HASHIMOTO, Y. TSURUMOTO and I. SATO. Dep. of Physiol., Shimane Medical Univ. Izumo, Shimane

Using rabbit aorta, we previously estimated the activities of glycogen phosphorylase and glycolytic enzymes and found higher activities of these enzymes in the aortic arch than in the thoracic and abdominal aorta. Since carbohydrates of arteries are mainly utilized for the energy production, we also checked the enzymatic levels during contraction. Throughout our experiments, rabbit aortic strips were subjected to a load of 1 gm of tension and mounted in an organ bath medium at 37°C, aerated with 5 % CO₂ and 95 % O₂. Adrenalin (1.0 μM) was added to the bath medium to contract these strips. In the aortic strips (the aortic arch and the thoracic aorta), activation of glycogen phosphorylase a and glycolytic enzymes were observed during contraction. For instance, glycogen phosphorylase a activity of the aortic arch was increased by 31 % of the control activity, while the increase in the enzymatic activity of the thoracic aorta was 28 %. However, the activity of the abdominal aorta was unchanged during contraction. Of the glycolytic enzymes, the activation of phosphofructokinase (PFK) was the most prominent. The increase in the activity of PFK was 220 % in the aortic arch and 150 % in the thoracic aorta. From these findings, it appears that glycogenolysis and glycolysis in the aortic arch and thoracic aorta are stimulated during contraction.

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EFFECTS OF LIVER-HYDROLYSATE OR AMINO ACIDS IN DIETS ON RATS OCCURRING FAT ACCUMULATION BY FEEDING OF LOW AMINO ACID MIXTURE DIETS. Y. KATAYAMA, AND C. SHIMOSHIMA*, Dep. of Food & Nutr., Faculty of the Sci. of Living, Osaka City Univ. and Mukogawa Women's Univ.*

The rats occurring fatty liver by feeding Wheat-pattern amino acid mixture diet at 5% were further given similar diet supplemented with liver-hydrolysate or amino acid mixture which have similar composition to that of liver-hydrolysate for 4 weeks. The effects of supplementations of these substances were investigated through determinations of lipids in the sera and the livers. Recovery diets were as follows; control group: diet consisting of Wheat-pattern amino acid mixture at 5%, W-L group: diet supplemented with liver-hydrolysate to the control diet, W-L-A group: diet supplemented with amino acid mixture which have similar composition to that of liver-hydrolysate to control diet, W-L-S₂ group: diet further supplemented with Lys & Thr to W-L-A diet. In recovery period, food intake of W-L-S₂ group was significantly larger than that of control. Body weight gain of W-L-A and W-L-S₂ groups were significantly higher than that of control. Serum TG of W-L-S₂ group showed significant increase. Contents of total hepatic lipids were the order of Control > W-L > W-L-A > W-L-S₂. W-L-S₂ group was significantly less than control. Hepatic TG were the order of control > W-L > W-L-A > W-L-S₂. The latter two groups were significantly lower than that of control. There were no significant difference in total cholesterol or conjugated lipids in the liver among all the experimental groups.

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THERMOSENSITIVITY OF PREOPTIC NEURONS IN THE CAPSAICIN-DESENSITIZED RAT.

Tetsuro HORI and Shuji TSUZUKI. Dept. Physiol., Saga Medical School, Nabeshima, Saga 840-01; and Dept. Physiol., Inst. Const. Med., Kumamoto Univ., Kumamoto 862.

Capsaicin influences thermoregulation by its stimulating and subsequent desensitizing action on warm-detectors responsible for thermoregulation. The capsaicin-desensitized animal has a permanent loss of autonomic and behavioral thermoregulation to heat. Unit activities were recorded from neurons in the preoptic area (POA) of capsaicin-desensitized rat during POA thermal stimulation. The rats were injected with 50mg capsaicin and were unable to withstand overheating. In a total of 290 units studied, 28 units (9.7%) increased the firing rate to a rise in preoptic temperature (warm-units) and 8 units (2.8%) were cold-sensitive. These numbers of thermo-sensitive units in the total population of POA neurons are very few in comparison with those of POA thermo-sensitive neurons of normal rats previously studied in the same laboratory. Some thermo-sensitive units in the desensitized rat failed to respond to temperature with repeated thermal stimulation and most had low thermosensitivities. The result adds further evidence that the POA thermo-sensitive neuron has a role in thermoregulation. The reduced number of cold-units, along with warm-units, supports the view that POA cold-neurons have no direct thermosensitivity and are interneurons inhibited by warm-neurons.

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DAILY VARIATION OF THERMAL TOLERANCE IN RATS

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Effects of photoperiod on thermal tolerance were studied in rats for their survival time in a hot environment of 42.5 °C. Prior to the experiments, individual rats were exposed to the same heat environment at a definite time of the day, and the predicted survival time was calculated in according to their responses in rectal temperatures in the heat. (*) They were divided in 8 groups (each group n=9), so as the intergroups homogeneity to be ensured regarding to their predicted survival time. After each groups were reared under the different lighting condition for 28 days, they were exposed to heat at a different time of the day. It was found that the heat tolerance varied with the time of the day, in relation to the photoperiod of the group. In the groups kept under the normal light-dark cycle (L, 07:00-19:00; D, 19:00-07:00) heat tolerance at day-time were observed significantly higher than those at night. Lethal body temperature was not correlated with the heat tolerance. Reversal of light-dark cycle (L, 19:00-07:00; D, 07:00-19:00) resulted in a phase shift of the diurnal variation of the body temperature. In this lighting condition, also, the heat tolerance was found slightly higher (though not significant) in the night than in the morning.

* Ohara, K., Furuyama, F., Isobe, Y. : J. Appl. Physiol. 38, 724 (1975)

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EFFECTS OF PYROGEN ADMINISTRATION ON BLOOD FLOW OF COMMON CAROTID ARTERY AND CEREBRAL TISSUE IN RABBITS. M.KOSAKA, N.OHWATARI, T.INOMOTO. Dep. of Epidemiol., Inst. for Tropical Medicine, Nagasaki Univ., Sakamoto-machi Nagasaki

In rabbits, LPS-pyrogen was administered intravenously and then sulpyrine was given intravenously during the first or second phase of LPS-pyrogen induced fever. The rectal temperature, the hypothalamic temperature, the ear skin temperature, respiratory rate, EMG, oxygen consumption and cortical EEG were recorded. Blood flow of the common carotid artery (F.C.A.) was measured with an electromagnetic flowmeter and, in addition, blood flow of the cerebral tissue near or in the PO/AH was calculated by using a hydrogen monitor. The F.C.A. and the ear blood flow calculated from the equation after Stitt (1973) were decreased by cooling of the skin and spinal cord and LPS-pyrogen administration. By heating of the skin and spinal cord and sulpyrine administration, the change reverse to the above was observed. Both the F.C.A. and the ear blood flow were increased or decreased with a fall or rise in the hypothalamic temperature, respectively. However, the cerebral blood flow was not changed significantly during these temperature changes in the cerebral thermo-sensitive tissues.

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SEXUAL DIFFERENCE IN THERMOREGULATORY RESPONSES TO COLD AND HEAT IN RATS. K.DOI, A. KUROSHIMA. Dept. of Physiol., Asahikawa Medical College, Nishikagura, Asahikawa.

A marked sex difference in the thermoregulatory responses to cold (5°C , 90 min) was observed in rats older than 40 days of age, characterized by significantly smaller increase in cold-induced shivering as well as oxygen consumption in females than in males despite the same extent in the fall of colonic temperatures in both sexes. Nonshivering thermogenesis tested by norepinephrine was significantly smaller in females than in males in both warm- and cold acclimated rats. Ovariectomy increased cold- and norepinephrine-induced heat production in females. This result suggests that female gonadal hormones are responsible for the manifestation of sex difference of thermogenic responses. The fall of skin temperature after cold exposure was greater and more rapid in females than in males, although skin fold thickness on the back was the same for both sexes. Therefore, greater insulation in females through vasomotor function seems to be involved in the sex difference in the thermoregulatory responses to cold. There was also observed less increase of heat production after exposure to heat (35°C , 90 min) in females than that in males. These findings suggest that females respond to thermal stress more efficiently, namely with less heat production and higher body insulation than males.

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SEX EDUCATION FOR INFANTS--3~6 YRS

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While the first gleam of self-consciousness may appear at the stage of this age, no curiosity would be noted for sex life. However, as a link for building a good human character in the future, right guidance related to sex at this stage will greatly influence in the later years.

Of late, a common question to all a question is raised on the issue, "What is birth?" On this issue, the role of mother may be easier to play her part through herself in giving understanding of the issue. But on the other hand, what role can the father play in the situation? This presents a very important theme.

Here, the role of father is the practice of the parental love first by the physical intercourse with the mother to be and give birth to children and rear them. Then, there he must work and earn and sustain living with bread and butter. This would not suffice by all means. The father must give mental food to his children. What is the mental food? Its expression is rather hard. It is said in this connection that "man cannot live by bread alone." This leads us to the realm of the spiritual phase of human life which must be nurtured.. In this regard the Japanese people especially lack in the supply of spiritual food. If this spiritual food is amply given at the infant stage.

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STUDIES OF SAFETY OF SALINOMYCIN IN CHICKENS (1st report)

K.KOASE, T.KADOYA, M.FUKUI, H.OHTA, N.YUYAMA, AND S.SEKI

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Following the previous report, the 4 items cited below were physiologically studied. Chickens (white Leghorn strain) were allowed free access to salinomycin for 60 days; 10 males and 10 females were randomly extracted from each group, and sacrificed by blood depletion through the carotid artery; the organs were grossly examined, weighed, and then fixed in a formaldehyde solution for histopathologic study.

- 1) The gross examination revealed no abnormalities, except for a decoloration of the liver and the lungs filled with blood due to inhalation of blood at blood depletion in the group on the high dose.
- 2) There was a significant difference in the weight of many an organ between both the male and female birds of each treated group and the counterparts of the control group: the weights of organs in the group treated with 80 ppm of salinomycin were greater, and those in the group treated with 160 ppm and the group treated with 320 ppm were smaller, than those in the control group, or the weights of organs were mostly parallel with the body weights of the birds.

S1

CENTRAL MECHANISMS OF MOTOR CONTROL: INTRODUCTION. SHIMAZU, H.
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The basic concept of the elementary reflex and its integration established by Sherrington has long been exerting leading influences on studies of the central mechanisms of motor control. Recently it has become accepted that simple patterns of movement such as stepping or flying may be centrally formed. Knowledge of the interaction between peripheral feedback and central patterning appears to be essential to understand the control mechanisms of movement. A few previous studies related to the following four presentations will briefly be reviewed.

Evarts (1965, 1966, 1968) described three major findings on the relation of activity of pyramidal tract neurons (PTNs) to voluntary arm movement in moving monkeys. First, PTNs with high axonal conduction velocities tended to be phasically active in relation to movement, whereas PTNs with low conduction velocities had regular tonic discharge in the absence of movement and showed both an increase and a decrease in discharge frequency when movement occurred. Second, many PTNs showed responses prior to the peripheral EMG activity associated with extension of the wrist, indicating that these PTN responses were not consequent upon the feedback associated with the movement. Third, for the majority of PTNs discharge frequency was related primarily to the force (F) and dF/dt exerted by the moving part. These results are important backgrounds related to the works of Kubota presented in this symposium.

The organization of certain ascending paths in the spinal cord suggests that they monitor activity in lower motor centers rather than peripheral events (Oscarsson, 1973). They carry information about activity in pools of interneurons that are simultaneously links in descending motor paths, thus forming an internal feedback system. The notion of internal feedback is also evident as to the function of the abundant connections between the cerebral cortex and the cerebellum. The command signals from the cerebral cortex may be monitored by the cerebellum and compared with the activity of lower motor centers reaching the cerebellum. On the basis of this comparison corrections may already have begun before the initiation of movement. The works done by Oka have been directed towards anatomical and electrophysiological analyses of neuronal organization of basic circuitry in the cerebrocerebellar communication systems.

The basic pattern of stepping has been suggested to be centrally programmed at the spinal cord level without reflex influences (Brown, 1911; Engberg and Lunberg, 1969). The arrangement of the spinal stepping generator would consist of reciprocal inhibitory connections between interneurons which activate flexor motoneurons and those which activate extensor motoneurons (Jankowska et al., 1967). Moscow group (Shik et al., 1966) was able to induce almost normal locomotion in mesencephalic cats by repetitive electrical stimulation of discrete area immediately beneath the inferior colliculus, after setting the limb in motion on a treadmill. By using this preparation it is possible to study the role of supraspinal volleys and proprioceptive input in the centrally programmed activation. The modes of supraspinal activation of the stepping generator under different conditions will be mentioned by Mori.

The possibility of motor learning by the cerebellum has been a subject of debate. There is a hypothesis that the action of the climbing fiber synapses on Purkinje cells modifies the properties of the parallel fiber-Purkinje cell synapses and that this modification is the basis for motor learning in the cerebellum (Marr, 1969). Robinson (1975) showed that the decrease in the gain of the vestibulo-ocular reflex in cats, which was obtained by wearing left-right reversing prisms, did not occur after cerebellectomy. Robinson explained his results in line with the idea that the cerebellum is the seat of motor learning. Llinás et al. (1975) observed that specific chemical lesion of the rat inferior olive by administration of 3-acetylpyridine prevented recuperation from motor

abnormalities generated by unilateral labyrinthine lesion, indicating that the integrity of the olivo-cerebellar system is necessary for the acquisition and retention of this form of motor learning. However, in animals that had recuperated from the labyrinthine lesion, 3-acetylpyridine produced a recurrence of the symptoms. Llinás concluded that the climbing fibers cannot transfer the motor correction to the Purkinje cells and that the cerebellum itself is not the seat of such learning. The paper presented by Ito will be closely related to these controversial problems.

S2

MONKEY PYRAMIDAL TRACT NEURON ACTIVITIES AND VISUAL TRACKING TASKS

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In a single-step visual tracking task from a fixed start zone to a fixed target zone at the wrist joint, majority of task-related pyramidal tract neurons (PTNs) are activated bidirectionally during both phases of flexion-extension movement and minority of them are unidirectionally during one phase of the movement. Handle was rotated by hand with a weak force (50 g.cm). Bidirectional discharge patterns were task-dependent; bidirectional pattern changed to unidirectional one, if both initial and target stop periods were eliminated, the displacement size was made smaller, or direction of the movement to be performed was instructed before the movement.

To extend our studies along this line, monkeys were trained to perform a rapid flexion task in which the monkey was rewarded if the movement velocity falls into the range indicated visually before the movement. In 41 task-related PTNs, correlations of the rate to the velocity was found during contraction (N=20) but not before movement onset (N=1).

These results lead us to conclude that in the initiation of the voluntary movement PTNs are activated to specify the muscles to be contracted in a coordinated manner.

S3

PARIETO-RUBRO-OLIVARY CONNECTIONS IN THE CAT. H. OKA and K. JINNAI*. Dept. of Physiol., Inst. for Brain Res., Fac. of Med., Kyoto Univ., Kyoto and Dept. of Physiol., Med. Coll. of Shiga, Ohtsu*

Responses in the inferior olive to stimulation of the parietal association cortex as well as the frontal motor cortex were examined extracellularly and their recording sites in the nucleus were surveyed in cats. Then, localizations of the rubro-olivary neurons being incorporated in the parieto-olivary pathway were confirmed anatomically by using retrograde axonal transport of horseradish peroxidase (HRP). The parietal-induced olivary responses appeared at a longer and more unfixed latency than the frontal-induced ones, suggesting an existence of the indirect cortico-olivary pathway. The recording sites for the parietal-induced responses were located in the rostral half of the olive and these olivary areas were considered to give projection fibers to the neocerebellar cortex. Small neuronal cells were labelled with HRP homolaterally in the midbrain, after HRP was injected through recording microelectrodes into the inferior olive where only the parietal-induced responses were evidently recorded. These small cells were distributed in the rostral one-third of the red nucleus and they were identified as the parvocellular red nucleus neurons. The present results suggest, in association with our previous studies, that the parvocellular red nucleus participates in control of highly co-ordinated posture and movement through the neocerebellum.

S4

SEVERAL MODES OF HINDLIMB STEPPING ELICITED BY CUNEIFORM NUCLEUS STIMULATION IN THE MESENCEPHALIC CAT. S. MORI, H. NISHIMURA, M. AOKI. Dept. of Physiol., Asahikawa Med. Coll., Asahikawa., T. TOMIYAMA. Dept. of Otolaryngol., Asahikawa Med. Coll., Asahikawa.

Precollicular-postmamillary decerebrate acute mesencephalic cat has been extensively employed as a locomotor preparation. However, in such an animal, controlled locomotion on the moving treadmill was elicited only when postural tonus after decerebration was adequately developed. It is natural to assume that stimulation delivered to the cuneiform-nucleus (mesencephalic locomotor region, MLR) should suppress the highly developed postural tonus after decerebration for an initiation of locomotion. Same stimulation should increase postural tonus when it is weakly developed for an initiation of locomotion. Agreeing with this assumption, our recent analysis of hindlimb stepping on the still treadmill showed that the MLR stimulation elicits dual effect, one is excitatory, the other is inhibitory, upon the spinal stepping generator. We have also demonstrated that an increase in postural tonus and an activation of spinal stepping generator are not separate phenomena. All these results indicate that an activation of MLR is only one of necessary conditions for eliciting locomotion. Sufficient condition seems to be a simultaneous activation of MLR and the brain stem structure which sets the excitability of the brain stem and the spinal cord at an 'appropriate' level.

S5

EFFECT OF DESTRUCTION OF INFERIOR OLIVE UPON CEREBELLAR INHIBITION OF DEITERS NEURONS OF RABBITS. M. ITO, N. NISIMARU, K. Shibuki. Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

Destruction of the inferior olive rapidly diminishes the inhibitory action of cerebellar Purkinje cells upon discharges from Deiters neurons (Ito, Nisimaru & Shibuki, Nature, 277, 568-569, 1979). In the present study, the effect of destruction of the inferior olive was further investigated by intracellular recording from Deiters neurons of albino rabbits under anesthesia by α -chloralose and urethane. In Deiters neurons of control rabbits, juxtafastigial stimulation evoked IPSPs of up to 20 mV in amplitude (median for 86 cells, 7.2 mV) and of 0.5-1.2 msec in latency (median, 0.85 msec). When sampled seven to twenty hours after electrolytic destruction of the inferior olive, amplitude of the IPSPs was generally smaller (median, 2.8 mV for 65 cells) and their latency was longer (median, 1.25 msec) than controls. The resting membrane potential or the membrane impedance of Deiters neurons did not show any systematic difference between before and after destruction of the inferior olive. The membrane impedance was measured by intracellular application of rectangular hyperpolarizing currents of 2 nA for 5-10 msec.

S6

REGULATION OF AUTONOMIC FUNCTIONS: INTRODUCTION. ICHIKAWA, S.
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Autonomic functions are those functions which maintain the internal environment through control by the autonomic nervous system (so named by Langley). At present, two major directions are followed in the study of autonomic functions.

One is peripheral; this is investigation of the nature of nerve plexuses and functions in visceral organs. It includes transmitters. The other is centrally oriented; this is a search for central origins and their modes of control of the autonomic systems, including neural and humoral.

The subjects presented in today's symposium are primarily centrally oriented.

Dr. Yamamoto discusses his concepts of endocrine gland functions. He states that endocrine glands are controlled by the CNS as well as by humoral modulated feedback systems. The humoral feedback systems might be either hormonal-hormonal or hormonal-effector. CNS control has its origins primarily in the external environment while the feedback systems depend on homeostasis. He uses growth hormone as an example to illustrate his hypothesis.

Gastrointestinal motility is controlled by many factors including intra- and extraintestinal reflexes. Dr. Semba talks about the extra-intestinal reflexes. He explains how gastric motility is controlled by a balance of excitation levels in preganglionic excitatory and inhibitory neurons in the medulla, a structure long considered to contain gastrointestinal motility control centers, and preganglionic excitatory and inhibitory thoracic neurons. Dr. Semba does not discuss upper brain center control of GI motility to any great extent, but medulla and spinal level control mechanisms are made clear.

There are three major components of blood pressure. The first is due to heart beat, and the second to respiration. The third component, depending on its cause, may take any of several classical forms. One of these, which may be caused by poison, hypoxia, or hemorrhage is known as the Traube-Hering wave. Another, caused by chemoreceptor influence on the vasomotor center, is known as Mayer's wave. Still another, known as Roy-Nishimaru's wave is caused by contraction of the spleen.

Dr. Miyagawa discusses a 10-25 sec wave which is a form of this third component. There is a vasomotor control center, which is comparable to the neural control center for respiration in which respiratory variations originate. This vasomotor center has not been clearly shown until now, however, to cause these slow blood pressure variations. Dr. Miyagawa points out four possible causes of the slow variations and presents his reasons for selection of negative feedback as the most plausible of the four. By inducing pressure changes in the carotid artery and observing central neuron responses and their effects on peripheral neurons, he demonstrates the feasibility of control through the circuit which we call the circulatory system.

Respiration control centers have been identified in the medulla, the pons, etc. It has been proposed that these regions are subcenters for control of respiration and various features such as respiratory rhythm. Dr. Fukuhara has investigated the distribution of neurons in the brain stem which are involved in control of respiration. He makes it clear that respiratory rhythm is produced by complex neural circuits. Neuronal circuits within the pons, for instance, are connected by more extensive circuits to neuronal groups within the reticular formation, the medulla, etc. In this way, an inspiratory center in one nucleus may be connected to an expiratory center, possibly in another nucleus, and the entire complex of connections constitutes the CNS control of respiration and its rhythms. This mechanism is a departure from the classical concept of individual control centers.

There is no question about the existence of close relations between the autonomic functions and somatic functions. Dr. Homma discusses how

afferent impulses from proprioceptors in costal muscle inhibit respiration, thus displaying a neuronal respiratory control circuit. Ergometer tests have shown increased ventilation to be caused by a remarkable increase in the respiration rate, while the ventilation volume remained almost constant. Stimulation of the intracostal stretch receptors with 100 Hz produced decrease ventilation volume along with decreased inspiration time. He concludes that intracostal muscle proprioceptors inhibit inspiration by a mechanism similar to the Hering-Breuer reflex, and that afferents from the tendon spindle send excitatory signals to the inspiratory neuron pool.

S7

TWO SEPARATE TYPES OF MECHANISM, FEED-BACK AND FEED-FORWARD, OF THE CONTROL OF ENDOCRINE FUNCTIONS. K. YAMAMOTO. Dept. of Physiol., Inst. of Endocrinol., Gunma Univ., Maebashi

Feed-back regulation is a common mechanism of endocrine control and generally a "negative" one in nature, which enables both endocrine function and internal environment to remain within a certain range in animals at rest. On the other hand, feed-forward regulation is usually a "positive" one, which causes changes in internal environment which are needed to support move of animals in response to the stimulus from the external environment. Feed-forward regulation is mostly brought about through the higher central nervous system, the excitation of which is transmitted to the hypothalamus and alters endocrine functions. During the feed-forward stimulation, the feed-back mechanism is seemingly suppressed, but resumes its activity when external stimulus is over, and the constancy of the internal environment is recovered. Thus, the feed-forward control is unidirectional and tentative, in contrast to revolving and continuous feed-back mechanism. Since rest and move are essentially different situations, the control mechanisms to meet each situation, i.e. feed-back and feed-forward regulation, are also substantially different. In addition to these general considerations, some of our experimental results were reported concerning the two mechanisms of control of pituitary growth hormone synthesis and release in the rat and chicken.

S8

THE NEURAL REGULATION OF THE MOTILITY OF THE ALIMENTARY CANALS. SEMBA, T., FUJII, K. & MIZONISHI, T. Dept. of Physiol. Univ. of Hiroshima Med. Sch., Hiroshima

The motility of the alimentary canals is modified through intestinal reflexes. Three kinds of the intestinal reflex types are the intrinsic intestinal reflex, decentralized ganglionic reflex and extrinsic intestinal reflex.

The efferent pathways of the extrinsic excitatory reflex are demonstrated not only in the vagal and pelvic nerves but also in the splanchnic nerves in the dog. The efferent pathways of the extrinsic inhibitory reflex are also demonstrated in both splanchnic and vagus nerves. The stimulation of the dorsal nucleus of n. vagi produce both the excitatory and inhibitory gastric responses. The inhibitory response is obtained by the stimulation of lat. intermedial nucleus and med. intermedial nucleus, and the excitatory response is obtained by the stimulation of lat. intermedial nucleus and dorsal nucleus in the thoracic cord.

The electrical activities are recorded from the inhibitory areas or the excitatory areas in the medulla oblongata and thoracic cord. The area which augment the electrical activities during the inhibitory intestinal reflex and also reduce during the excitatory intestinal reflex is to be proposed preganglionic inhibitory neurons. And also the preganglionic excitatory neurons in the medulla oblongata and thoracic cord may be demonstrated.

S9

UNIT DISCHARGE RECORDED FROM THE BRAIN STEM "CARDIOVASCULAR CENTER"
DURING A BLOOD PRESSURE OSCILLATION IN RABBITS K. MIYAKAWA, K. KANAI
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Unit discharges of 157 neurons in the bulbar "cardiovascular center" were successfully recorded in rabbits by the method of floating micro-electrodes during blood pressure oscillation elicited by "side pressure exertion experiment". Systemic blood pressure and discharge of the phrenic and the renal nerves were simultaneously recorded. Two populations of the neurons were differentiated by comparing their discharge pattern with that of the renal nerve. Twenty-four out of 157 neurons generated impulses almost in parallel to the discharge of the renal nerve (population 2). Ten neurons discharged reciprocally to the renal nerve (pop. 1). The remaining 123 neurons were not influenced by the oscillation. While the discharge of the pop. 2 neuron was intensified by the cumulative section of the modulator nerves, that of the pop. 1 neuron was strongly depressed by the section. It can be postulated that the pop. 2 neuron is in charge of sympathetic tone and excited by hypoxia. The pop. 1 neuron is susceptible to the afferent information of the modulator nerves and can be related to the vagal tone.

S10

LOCALIZATION AND FUNCTIONAL ORGANIZATION OF BULBAR AND PONTINE RESPIRATORY NEURONS IN RABBITS. Hukuhara, T., Jr., Goto, K., Takano, K. and Hattanmaru, Y. Dep. of Pharmacol. II, Jikei Univ. Sch. Med., Minatoku, Tokyo

In aiming to elucidate the spatial distribution of reticular respiratory neurons in the rabbit, pontine as well as bulbar respiratory units were systematically explored. Experiments were performed in 37 unanesthetized and paralyzed rabbits under local anesthesia being maintained by artificial ventilation under monitoring end-tidal O_2 and CO_2 levels. Evaluating cross-correlation between unit activity and the phrenic nerve activity as well as auto-correlation of unitary discharges, a total of 173 reticular respiratory units were identified: inspiratory (17% of the total); expiratory (30%); another broader group (53%). They were scattered and intermingled in the entire area of the pontine and bulbar reticular formation. Spontaneous burst discharge of respiratory units varied to great extent in their regularity of volley period as measured by coefficient of variation of volley period ranging from 1.2 to 26.2% (N=106). Inspiratory and expiratory units discharging stably with fairly smaller value of coefficient of variation were located solely in the lateral part of the bulbar reticular formation. Such a heterogeneity of stability of rhythmic discharges of respiratory neurons supports the idea assuming the differences of functional significances among reticular respiratory neurons in relation to the mechanisms generating the respiratory rhythms.

S11

MEMBRANES AND TRANSPORT: INTRODUCTION. HOSHI, T.

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Our knowledge on biotransport mechanisms has been rapidly accumulating in recent years. The membrane components related to transport of specific substances have become to be grasped more substantially and many current investigations are directed toward understanding of biotransport on molecular basis. Also, developments of methodology for isolating purified membranes have led to discoveries of new transport functions in some biomembranes and establishment of true driving forces in some transport systems. Reconstitution of transport systems by incorporating isolated membrane components into artificial membranes has been successful for many transport systems including facilitated diffusion, primary and secondary active transport systems. From such studies, it has become possible to recognize more realistic features of transporter elements, such as channel, carrier, gate and energy-transformer. However, there are still many unanswered questions how transported substances are translocated within these transporter elements. Studies on ionophores incorporated into artificial lipid membranes have offered many useful information concerning the mechanisms of translocation. For example the difference in turnover number between mobile-carrier and channel-forming ionophores, current or conductance fluctuations and voltage-dependent conductance revealed by a certain ionophore such as alamethitin are all quite useful in interpretation of biotransport mechanisms. Noise analysis based on fluctuating property of conductance is now a powerful way of investigating ion transport through various biomembranes.

Excitable membranes are known to have specific ion channels for Na^+ , K^+ and Ca^{2+} . Also, Na^+ channels are assumed to have both activating and inactivating gates. These elements are currently investigated with specific binding substances and proteolytic or lipolytic enzymes. Dr. Okamoto will report on the effect on the inactivating gate of scorpion venom and phospholipase.

As to $\text{Na}^+\text{-K}^+$ pump, there are still controversial views on the mechanism of translocation of Na^+ and K^+ . The sequential theory postulates sequential formation of intermediates of $\text{Na}^+\text{-K}^+$ ATPase, $\text{E}_1\text{-P}$ and $\text{E}_2\text{-P}$. Biochemical studies in isolated $\text{Na}^+\text{-K}^+$ ATPase support this view. In contrast, the simultaneous theory denies the existence of such intermediates and argues simultaneous exchange of Na^+ and K^+ upon hydrolysis of ATP. The latter is supported by kinetic studies of the pump of intact membranes. In addition, observations in living cells show that Na^+/K^+ ratio is variable depending on intracellular Na^+ concentration and it exceeds 5 when $[\text{Na}^+]_i$ is elevated. From these and other observations, it has currently been accepted that $\text{Na}^+\text{-K}^+$ pump is essentially electrogenic. Concerning the activity of the pump in living cells, Dr. Kitasato reports on the relationship between $[\text{Na}^+]_i$ and ouabain action in skeletal muscle, and Dr. Koketsu speaks on electrogenic properties of the pump in arterial muscle.

Among other transport ATPase, $\text{K}^+\text{-H}^+$ ATPase found in the gastric mucosa is of particular interest. The membranes of intracellular canaliculi isolated from gastric mucosa possess this type of ATPase. A marked alkalization of suspension medium of membrane vesicles is seen when ATP is added to the medium. The ATPase activity was independent of the presence of Na^+ , unaffected by ouabain but needed the presence of K^+ . This ATPase is now regarded as to be responsible for active secretion of HCl by the oxyntic cells.

Another important progress in transport physiology is the establishment of the concept of secondary active transport. In renal proximal tubules and intestinal epithelia, there are many types of transport systems that actively transport organic solutes or electrolytes. In these cells, there is only one primary active transport system, i.e. $\text{Na}^+\text{-K}^+$ pump, and all other uphill transport processes are dependent on Na^+ electrochemical potential gradients across the membranes. There are two different modes of energy coupling, one the cotransport and the other the

antiport. The use of purified membrane vesicles enabled us to determine true driving forces in these coupled processes and to characterize the systems.

To investigate transcellular transport of ions, determination of exact electrochemical potential profiles for ions across the cells are essential. Several kinds of ion-selective intracellular microelectrodes are now available. Dr. Fujimoto presents the profiles for Na^+ and K^+ in renal proximal tubules which were determined with a tripple barreled ion-selective microelectrodes.

Techniques of isolation of a special membrane system is now applicable to intracellular membranes. Golgi membrane system, an intracellular organella for secretion and absorption, have been shown to have Ca^{2+} transport function with sensitivity to hormones. However, properties of this membrane, particularly its response to secretory stimuli or its dependence on metabolism are still largely unknown. Dr. Kanno will report on the relation of secretory activity to redox state in pancreatic acinar cells.

S12

BINDING OF SCORPION TOXIN TO Na CHANNELS.

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The previous electrophysiological studies indicate that a purified scorpion toxin binds specifically to Na channels in a one-to-one manner with a high affinity. The present study was aimed to establish the binding reaction of this toxin to Na channels *in vitro*, at the level of membrane fragments. The scorpion toxin was radioiodinated, and membrane fragments were prepared from the electroplaque of an electric eel, which is known to be enriched with Na channels. Analyses of binding properties by Scatchard plots showed the presence of two classes of binding sites (with low and high affinities). The similar preparation from an electric skate, of which the electroplaque is devoid of Na channels, possessed only the low affinity sites. The number of high affinity sites in the eel preparation was 41.8 ± 10.5 pmole/g tissue; the value was within the range reported for tetrodotoxin binding to similar preparations. A variety of cations competitively inhibited the high affinity scorpion toxin binding, as indicated for the toxin binding to Na channels by the previous electrophysiological study. K_D value in the presence of 120 mM Na ions (8 nM) agreed reasonably with that obtained for the scorpion toxin binding to excitable neuroblastoma cells or nerve ending particles under a comparable condition. The high affinity toxin binding is concluded to represent the binding to Na channels.

S13

The effect of the intracellular Na ions on the suppression of Na pump activity by ouabain. H. KITASATO, S. SATO, K. MURAYAMA AND K. NISHIO. Dept. of Physiol. Shiga Univ. of Med. Sci. Ohtsu 520-21

Although in a ouabain-free solution insulin increased Na efflux from muscles which had been poisoned by ouabain, in the presence of ouabain insulin had no effect on Na efflux. These findings seem to suggest the presence of latent carriers which can be activated by insulin but not bind to ouabain.

Against the expectation, the Na efflux vs. intracellular Na concentration relationship obtained from the measurement of Na efflux into a Na-free Li Ringer solution showed that insulin brought about the elevation of affinity to Na ions and ouabain lowered the affinity. The extent of inhibition of Na efflux by ouabain was the larger, the higher the intracellular Na concentration at which muscles had been poisoned. On the other hand, the excitatory effect of insulin on Na efflux did not depend on the intracellular Na concentration.

These findings eliminate the possibility that insulin activates the latent carrier and ouabain decreases the number of acting Na pumps. Possibly, ouabain may inhibit some reaction relating to a conformation change resulting in a change in affinity of binding sites which had rotated as a K-binding form from the outer surface to the inner surface while insulin facilitates this reaction.

S14

AN ACCELERATION OF THE ELECTROGENIC Na PUMP IN BULLFROG ATRIUM MUSCLE FIBRES.

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The membrane of bullfrog atrium muscle fibres is markedly hyperpolarized by the action of acetylcholine (ACh) in K-free solution. Although this hyperpolarization is accompanied with an increase of the membrane conductance and blocked completely by atropine (1.5×10^{-5} M), its large fraction is eliminated in the presence of ouabain (10^{-6} M). Ouabain in this concentration suppresses the K-activated hyperpolarization, which is induced by an electrogenic Na pump activated when 2 mM K is added to K-free solution. In order to analyse the ionic mechanism of the ACh-hyperpolarization, ACh currents and K-activated currents were recorded by a voltage-clamp method. K-activated currents were suppressed during an initiation of ACh-currents. ACh-currents recorded either in the absence or presence of ouabain were depressed when the membrane was hyperpolarized and reversed their polarity at a potential level which appeared to be K-equilibrium potential. Conclusion led from these results is as follows. ACh increases K efflux in K-free solution by increasing the membrane K permeability. This causes an accumulation of K at immediately outside of the membrane and consequently activates a Na-K exchange pump. Thus, a large fraction of the ACh hyperpolarization produced in K-free solution is actually initiated by an activation of the electrogenic Na pump.

S15

ELECTROCHEMICAL FEED-BACK MECHANISM ON THE REGULATION OF Na^+ AND HCO_3^- REABSORPTION BY THE PROXIMAL TUBULE. M. FUJIMOTO, N. SATAKE, K. KOTERA, Y. MATSUMURA, and K. KAJINO. Dept. of Physiol., Osaka Medical College, Takatsuki City, Osaka.

In order to know the electrochemical gradient for various ions across the proximal tubule, micropuncture studies using various kinds of double- (or triple-) barreled microelectrodes selective to Na^+ , K^+ , H^+ or HCO_3^- were performed on bullfrog kidneys. For net Na^+ reabsorption, luminal Na^+ enters the cell with the downhill electrochemical gradient of about 95 mV across the luminal border, and then transferred to the interstitium against the uphill gradient of about 105 mV across the peritubular border. For net reabsorption of HCO_3^- (or secretion of H^+), luminal HCO_3^- must be taken up by the cell against the uphill gradient of some 70 mV, and then it diffuses down along 65 mV gradient to the interstitium. The uphill steps in the peritubular Na^+ or luminal HCO_3^- transport can be selectively depressed by a peritubular perfusion of 10^{-5} M ouabain or a luminal perfusion of 10^{-5} M cyanide, respectively, where minor changes in the electrochemical gradient less than 10 - 15 mV are produced reversibly. There exists a close correlation ($r = -0.99$) between the chemical gradient of H^+ across the luminal border and the electrochemical gradient of Na^+ across the peritubular border. The regulation of these two seems to couple together via electrochemical potential changes across the individual borders of leaky epithelium with a negative feed-back mechanism.

S16

SECRETORY RESPONSES AND REDOX STATE OF THE PANCREATIC ACINAR CELL. T. KANNO, A. SAITO AND Y. HABARA. Dept. of Physiol., Faculty of Vet. Med., Hokkaido Univ., Kita-Ku, Sapporo 060.

The isolated pancreas was perfused with a well-oxygenated Krebs-Henseleit solution, and the redox state was recorded with the aid of Redoximeter probe attached on the surface of the pancreas. The pancreatic juice was simultaneously collected from the common duct. The effects of continuous administration of 5×10^{-8} M acetylcholine on the pancreas resembled those of 5 mU/ml cholecystokinin-pancreozymin (CCK): (1) a sustained output of pancreatic enzymes at high level, (2) a gradual reduction in redox state toward the certain level (several per cent of resting level). Administration of these secretagogues with higher concentration caused an early onset of reduction in redox state, and a fast initial increase in enzyme output followed by rapid declining phase. In Ca-deficient environment, the secretagogues caused a sustained reduction in redox state, and a slight increase in enzyme output. In low Na or low K environment, CCK caused a transient reduction in redox state, and a slight and delayed increase in enzyme output. These results show that the secretagogues with lower concentration induce a sustained enzyme output which coincides with no or a slight reduction in redox state.

S17

CENTRAL CONTROL AND PERIPHERAL MODULATION OF FEEDING. OOMURA, Y.
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Involvement in control of feeding by two centers of the hypothalamus has been shown by lesions, stimulation, behavior experiments and clinical evidence. Stimulation of the lateral hypothalamic area (LHA) induces both eating, and behavior related to eating, while its inhibition or destruction has opposite effects. The ventromedial nucleus of the hypothalamus (VMH) acts conversely, and neuronal activities in the two centers have reciprocal relations. Feeding behavior is controlled by LHA-VMH interaction in conjunction with limbic, extrapyramidal, motor cortex (MC), association cortex, and other systems.

Glucose stimulates VMH neurons and inhibits LHA neurons, while free fatty acid (FFA) has the opposite effects, and each suppresses the other. Insulin stimulates in the LHA and inhibits in the VMH when applied without glucose, but it enhances glucose stimulation in the VMH. Glucose antagonizes insulin stimulation in the LHA. Insulin secretion is induced by orogastric stimulation, by glucose, and by other hormones. It acts to remove glucose and FFA from the blood, and to modify their effects on CNS control of the hunger sensation and feeding behavior. VMH glucoreceptors react to glucose through membrane receptors and by assimilation and metabolism. Hormones and transmitters such as TRH, gastrin, noradrenaline and dopamine have all been shown to be closely associated with eating, and to control eating behavior through their effects on the LHA and VMH. In this sense the two centers are said to be information processing centers for endogenous chemicals. The hypothalamus also receives peripheral information through the autonomic nervous system. This consists of such things as glucose information from the liver, stretch receptor information from the gastro intestinal tract, temperature, and other visceral conditions. All of these effects lead to control of feeding which depends on these and probably many other factors.

Chemoneurons, integrate chemical information with afferent sensory information in microcircuits within the hypothalamus. Integrated information is sent to surrounding centers through extensive macrocircuits which interconnect microcircuits of the hypothalamus, transmitter specific systems, limbic system, inferotemporal area, prefrontal area, etc. Interaction between the LHA-VMH and the frontal cortex (FC) probably bases in action on past experience. Hypothalamic connections to pyramidal tract neurons (PTN) and the extrapyramidal system initiate appropriate neuromuscular stimulation. Neuronal circuits from the LHA and VMH relate recognition of hunger and satiation, and through the MC and extrapyramidal systems which control the effectors of feeding behavior, motivate physical behavior associated with food intake.

Activity of neurons in the LHA correlates with bar press behavior. Activity of LHA neurons which respond when the animal begins feeding gradually rises less as the animal becomes satiated and each successive reward becomes less meaningful.

Circadian rhythmicity of neuronal activity in the LHA and VMH has been reported. Feeding habits of most organisms follow rhythmic patterns. The suprachiasmatic nucleus (SCN) has anatomic connections with the hypothalamus, and is related to the circadian rhythm of food and water intake in the rat, possibly through optical sensory, and pineal gland activity. From this one can deduce that the biorhythm seen in feeding patterns could be a result of SCN modulation of LHA and VMH activity.

The validity of present concepts is demonstrated by electron microscopy and modern cell identification techniques; by chemical and electrical stimulation; by measurements at the neuronal level; and by computer controlled and analyzed experiments involving behavioral and electrophysiological techniques. Precise time measurements between controlled environment, motor reactions, and neuron activity verify that

the hypothalamus is the source of feeding behavior motivation. Observations at the neuronal level distinguish the chemical and electrical properties, and the connections which accomplish this.

In summary: Composite results indicate initial integration in the LHA, associative reaction between the LHA and the OBF, and control by one or the other, or both of these centers over PTH's. LHA activity displays evidence of anticipation, which reflects memory effects from the OBF, and appears to control the MC. Thus the site of initial motivation for food intake is assumed to be the LHA, and it is tentatively concluded that the demonstrated chemoresponsiveness of hypothalamic neurons, the known neuronal connections between the LHA, and VMH, and the identified connections with associated centers, through the macrocircuits, are all necessary for the motivation and integration of feeding behavior.

S18

THE ROLE OF CHEMOSENSITIVE NEURONS IN FEEDING BEHAVIOR. T. ONO, H. NISHINO, K. SASAKI and K. MURAMOTO. Department of Physiology, Faculty of Medicine, Toyama Medical and Pharmaceutical University, Toyama 930-01.

Chemosensitive neurons in the hypothalamus play an important role in regulating feeding behavior by giving rise to hunger and satiety sensations. In this report we studied further correlation between the chemosensitive neurons and feeding behavior. 1) In monkey lateral hypothalamic area (LHA, feeding center) there are glucose-sensitive neurons whose activity is inhibited by glucose. These glucose-sensitive neurons showed early excitation (2.0-0.5 sec) prior to bar press feeding. Stimulation applied in the motor cortex (MC) produced short latency excitation (0.5-1.5 msec) followed by inhibition and late excitation in glucose-sensitive neurons. No such early excitation prior to the bar press or short latency excitation after MC stimulation were observed in non glucose-sensitive neurons. 2) Iontophoretically applied morphine and enkephalin, a morphine like peptide which is abundant in the hypothalamus, amygdala, etc. inhibited the activity of glucose-sensitive neurons in rat LHA but excited neurons in the ventromedial nucleus. Systemic administration of morphine depressed food intake during the 12 hours in the night following the administration. These results suggest that glucose-sensitive neurons which are also sensitive to morphine like peptides are important in regulating feeding behavior.

S19

THE ROLES PLAYED BY THE PERIPHERAL INPUTS FOR THE REGULATION OF FOOD INTAKE. A. NIIJIMA, T. HIRANO, T. SAKAGUCHI, A. FUKUDA. Dept. of Physiol., Niigata Univ. School of Med., Niigata.

It can be stated that there are three main peripheral inputs affecting for the regulation of food intake. Those are;

1. Oral input (taste receptors).
2. Gastro-intestinal inputs (mechanoreceptors and glucoreceptors reported by Mei).

3. Hepato-portal input (glucose sensitive afferents).
Our studies were mainly focused on the hepato-portal input. The effect of glucose and other substances on the afferent discharge rate of the hepatic vagal nerve filaments was observed in the guinea pig. Infusion of glucose solution into the portal vein caused a decrease in firing rate. Infusion of mannose solution caused no change in firing rate. An increase in firing rate was observed following administration of 2-DG solution. Infusion of insulin (20mU) or Sod. Butyl. (10µg) also caused an increase. These results show the similarity between LH neurons and glucose sensitive afferents in the liver.

S20

GUSTATORY CENTER AND FEEDING BEHAVIOR. T. YAMAMOTO. Dep. of Oral Physiol., Osaka Univ. Dental Sch., Kita-ku, Osaka

Studies were performed to elucidate the role of the cortical taste area in feeding behavior in rats. Rats were trained to drink solutions of sucrose, NaCl, tartaric acid and quinine-HCl in a test box, and the licking pattern was recorded with a drinkometer on a pen-recorder. They were then trained to avoid a taste stimulus by pairing the taste with intraperitoneal injection of LiCl. This technique is called a conditioned taste aversion (CTA). The previously acquired CTA was abolished after lesions of either the cortical taste area or the basolateral amygdala. Electrical stimulation of the cortical taste area induced responses in the basolateral amygdala with a latency of about 30 msec. When HRP was injected in the basolateral amygdala, labeled cells were found in the perirhinal cortex posterior to the cortical taste area and in the parabrachial nuclei. It is proposed from these results that the cortico-amygdaloid connection via the perirhinal cortex is a neural substrate for the acquisition of CTA. This idea was supported by loss of CTA after lesions of the perirhinal cortex.

S21

NEURAL BEHAVIOR OF THE LATERAL HYPOTHALAMUS IN OLFACTION: EFFECTS OF STOMACH DISTENSION. S. KOGURE, N. ONODA, S. F. TAKAGI. Dep. of Physiol., Gunma Univ. Sch. Med., Maebashi, Gunma

Effects of stomach distension upon the single unit activities of the lateral hypothalamic (LH) neurons which were sensitive to odours were studied in unanesthetized rabbits. In the phasic periods of inflation and deflation, most units showed a transient increase of discharges. This is not consistent with the findings obtained in anesthetized cats by Anand and Pillai's study (1967). Responsiveness of odor sensitive LH neurons were modified by stomach distension: First, the units which had responded to less than 4 odors before distension responded to more odors during distension and vice versa. Second, the low response probability to amyl acetate before distension increased during distension and the high response probabilities to 3 kinds of odors (CL, UDL, CM) before distension decreased during distension. Third, most units showed the non-linear concentration-response curves both before and during distension. By stomach distension, the curve showed marked but complicated and contradictory shift partially or totally. These findings on the qualitative and quantitative changes of the LH neuronal activities suggest a close interaction between olfaction and feeding behavior. As neural mechanism underlying this interaction, a selective modulation of the olfactory activity by the centrifugal nerve pathway was assumed.

S22

A POSSIBLE ASSOCIATION MECHANISM BETWEEN VISUAL STIMULUS AND FOOD IMAGES IN THE INFEROTEMPORAL CORTEX OF MONKEYS. E. IWAI, Dept. of Behavioral Physiology, Tokyo Metropolitan Institute for Neurosciences, Fuchu, Tokyo 183

I will here present our recent two findings concerning a possible association mechanism between visual stimulus and food images in the inferotemporal cortex (IT) of monkeys. The monkeys with removal of the IT cortex (IT-monkeys) showed a marked impairment on a concurrent object learning, whereas they indicated only a slight deficit on discrimination between a pair of two objects. In the concurrent learning the animals have to learn 24 objects in a sharp distinction between rewarded and non-rewarded ones more or less simultaneously, i.e., the task is implicated in much more complicated stimulus-reward association than that in a pair of objects. Also, the IT-monkeys showed a significant deficit on a replacement test, in which the stimulus positively rewarded in the training task was replaced with a neutral stimulus as the positive, whereas they could do the test quite well, in which the negative training stimulus was exchanged with a new stimulus as the negative. Since in the above studies food as the reward was always hidden under the positive stimulus and since the IT-monkeys never failed to perform the food vs. non-food discrimination, the above findings strongly suggest that the IT cortex is involved in the association between visual stimulus and food images.

S23

DIRECT APPLICATION OF LEUCOCYTE PYROGEN ON THE MEDULLARY TEMPERATURE-RESPONSIVE NEURONES OF RABBIT

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It has been believed that changes in the activity of the temperature-responsive neurone in the preoptic/anterior hypothalamic (PO/AH) region relate to resetting in the setpoint of the body temperature expected during fever. Recently, it was revealed that the medullary temperature-responsive neurone also influences largely to the resetting of the body temperature. Then, effect of direct application of the pyrogen on the medullary neurone was examined. The same result to that in the PO/AH region with intravenous application of the pyrogen was obtained when directly administered in the medulla. That sigmoid dose-response relations were observed in both the cold- and warm-responsive neurones, may imply the presence of pyrogen receptor on the temperature-responsive neurones. Since lack of the pyrogen sensitivity of the neurone followed pretreatment of a small amount of neuraminidase, sialic acid may contribute to binding of leucocyte pyrogen with the temperature-responsive neurones.

S24

THERMOREGULATORY BEHAVIOR OF RATS DESENSITIZED BY CAPSAICIN IN THE EARLY POSTNATAL LIFE

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Previous studies have shown that the new-born rat decreases its body temperature in response to capsaicin and becomes desensitized with the repeated application, probably by its action on warm-receptors, and the neonatal PO/AH warm-sensitive neurons responds to capsaicin. Thirty-one new-born rats from 3 litters aged 8-10 day-old were randomly divided into two groups. One group received repeated injections of capsaicin in a total dose of 4.63 mg in 6 hrs (capsaicin-desensitized group) and the other received solvent alone. Either when the age of rats exceeded over 80 days or when the body weight exceeded over 150 g, the abilities to defend against heat and cold by autonomic and behavioral thermoregulation were tested. Before the test, all the animals were trained to perform thermoregulatory operant behaviors (skin-cooling behavior against heat and skin-heating behavior against cold) for one week and more intensive training were made for desensitized rats. The rats had been desensitized by capsaicin had a permanent deficiency of autonomic and behavioral thermoregulation against heat, but no impairment against cold. It is suggested that the warm-detector responsible for thermoregulation is not newly formed after birth or not recovered from desensitization with growth.

S25

COMPARATIVE STUDY ON THE AXON REFLEX SWEATING IN THE DIGITAL PADS OF PRIMATES.

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The intradermal injection of nicotine in human skin causes a definite local sweating response through the axon reflex mechanism. This implies that the peripheral portion of sudomotor nerves are supplied with a specialized nicotinic receptor. In the present study the sensitivity of sudomotor nerves to nicotine was investigated in the digital pads of some primates. Three rhesus monkeys, 3 Japanese monkeys, 2 Formosan monkeys, 2 spider monkeys, 2 green monkeys and 2 slow loris were used. Definite axon reflex sweating was produced in the latter 3 species. In contrast, the former 3, all of which belong to the macaque, failed to show any trace of axon reflex sweating, in spite of the fact that sweat glands themselves responded well to mecholyl. Cholinesterase (ChE) activities in sudomotor nerves in these primates were examined histochemically. In all of macaques, which failed to respond to nicotine, the sweat nerves showed strong reaction not only of true but also of pseudo ChE, whereas in other 3 species, which revealed axon reflex sweating, pseudo ChE activities were almost negative or quite less remarkable, as compared with those of true ChE. These findings lead us to speculate that pseudo ChE might be associated with a barrier to the nicotine receptor sites in nerves, though it also cannot be excluded that these macaques are primarily devoid of nicotinic receptor in their peripheral sudomotor nerves.

S26

TEMPERATURE ACCLIMATION AT CELLULAR LEVEL - WITH SPECIAL REFERENCE TO THERMOGENIC RESPONSES OF WHITE AND BROWN ADIPOCYTES. A. KUROSHIMA, M. KURAHASHI, T. YAHATA. Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa

Increased non-shivering thermogenesis, metabolic characteristic of cold acclimation, has been shown to be mainly mediated by noradrenaline (NA) released from sympathetic nerve terminals. Recently, our laboratories reported that glucagon may be involved in temperature acclimation. Isolated adipocytes from interscapular brown fat (BAT) and epididymal white fat (WAT) were obtained in warm-acclimated control (WA), cold-acclimated (CA) and heat-acclimated (HA) rats. Heat production of isolated adipocytes were measured by use of twin-type conduction microcalorimeter. Maximal thermogenesis of WAT cells per unit cell to NA was not influenced by cold acclimation, while it was reduced by heat acclimation. Maximal response of total WAT cells to NA was increased in CA, but not changed in HA due to increased number of cells in CA and HA. Maximal response per unit cell as well as total WAT cells to glucagon was increased in CA and decreased in HA. Maximal thermogenesis of BAT cells per unit cell to NA was potentiated in CA and reduced in HA. Response to glucagon was reduced both in CA and HA. It was noted that maximal heat output of BAT cells to glucagon almost doubled that to NA. These results indicate that modified responsiveness of target adipocytes to NA and glucagon are involved in metabolic temperature acclimation.

S27

SKIN TEMPERATURE AND THERMAL SENSATION DURING A LIGHT EXERCISE --- STUDY ON THE OPTIMAL THERMAL CONDITIONS. Y.OSADA, S. OGAWA and K.YOSHIDA* Dep. Physiol. Hyg., Inst. Publ. Health, Minato-ku, Tokyo and Dep. Publ. Health, Sch. Med., Showa Univ., Shinagawa-ku, Tokyo*

Eight male students were exposed to $ET^{*}20, 22, 24, 26$ and 28°C on the separate days for one and half hrs in nude. Relative humidity was 50% and air velocity was less than 20 cm/s. Subjects sat on bicycle ergometer and kept rest for one hr then took exercise at 60 r.p.m. for 30 min. Work load was 40 watt. Metabolic rate, rectal temperature, skin temperatures at 10 sites, and thermal and comfort sensations were determined and comparison was made between rest and work. Neutral, i.e. neither cool nor warm, sensation was obtained at $ET^{*}26^{\circ}\text{C}$ at the end period of rest and at $ET^{*}22^{\circ}\text{C}$ at the end of exercise. Mean skin temperature was 32°C at rest and was 30°C at work under the neutral thermal sensation. This increase in warm sensation during the exercise could not be explained by the change in whole body heat balance. Heat loss at rest, calculated by the heat balance equation, had a positive relation with thermal and comfort sensation but heat storage during the exercise, calculated by the equation, had no relation with thermal or comfort sensation. Also, exercise gave no influence on the relation between ambient temperature and mean skin temperature. Increase in local skin temperatures at shoulder, hand, thigh and leg produced by the muscular work might induce the growth of whole body warm sensation.

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FUJITA, Y.	130
FUJITANI, Y.	156
FUJITANI, Y.	272
FUJIWARA, T.	301
FUKAI, K.	300
FUKATA, K.	155
FUKUDA, A.	315
FUKUDA, A.	S19
FUKUDA, H.	307
FUKUDA, J.	74
FUKUDA, Y.	201

FUKUI, M.	434
FUKUOKA, M.	324
FUKUSHIMA, T.	323
FUKUROTANI, K.	195
FUNAHARA, Y.	344
FUNAKOSHI, M.	235
FUNAKOSHI, M.	242
FURUKAWA, T.	217
FURUYA, K.	58
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GORIS, R. C.	251
GOSHIMA, K.	286
GOTO, K.	273
GOTO, K.	S10
GOTO, M.	275
GOTO, T.	22
GOTO, T.	35
GOTO, Y.	320

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HABARA, Y.	370
HABARA, Y.	S16
HACHISU, M.	182
HADA, J.	190
HAMADA, I.	S2
HANADA, M.	175
HANAI, S.	247
HANAMORI, T.	228
HANAWA, I.	195
HANAWA, I.	209
HASE, H.	195
HASEGAWA, K.	15
HASEGAWA, K.	20
HASEGAWA, K.	32
HASHIGUCHI, T.	81
HASHIMOTO, M.	2
HASHIMOTO, M.	142
HASHIMOTO, M.	147
HASHIMOTO, M.	427
HASHIMOTO, T.	216

HASHIMURA, S.	96
HASHIMURA, S.	255
HATA, N.	356
HATAKEYAMA, I.	334
HATASE, O.	31
HATTANMARU, Y.	S10
HATTORI, N.	284
HAYASHI, H.	38
HAYASHI, H.	90
HAYASHI, H.	277
HAYASHI, K.	134
HAYASHI, M.	331
HAYASHI, M.	345
HAYASHI, M.	383
HAYASHI, R.	143
HAYASHI, R.	146
HAYASHI, R.	412
HAYASHI, T.	212
HAYASHI, Y.	190
HAYASHI, Y.	320
HAYASHIDA, Y.	250
HIGASHI, A.	162
HIGASHI, H.	67
HIGASHI, T.	2
HIGUCHI, Y.	329
HIGUTI, K.	401
HIJI, Y.	88
HIJIKATA, A.	351
HIKOSAKA, O.	139
HIMUKAI, M.	368
HINO, N.	278
HIRAI, M.	152
HIRAI, S.	60
HIRAI, T.	92
HIRAKAWA, S.	338
HIRAMURA, K.	181
HIRANO, S.	186
HIRANO, T.	315
HIRANO, T.	S19
HIRAO, N.	262
HIRAOKA, M.	280
HIRATA, K.	405
HIROSE, T.	373
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HIROTA, A.	72
HISADA, M.	98
HISAMITSU, T.	112
HOMMA, I.	159
HOMMA, I.	361
HOMMA, S.	94
HONDA, K.	162
HONDA, M.	48
HONDA, Y.	356
HONGO, T.	95
HONJO, R.	348
HORI, N.	131
HORI, S.	419
HORI, S.	421
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HORI, Y.	174
HORIE, H.	50
HORIE, H.	70
HORIE, K.	187
HORIE, N.	347
HORIIKE, K.	3
HORIKAWA, J.	218
HORIMOTO, M.	362
HORIUCHI, E.	277
HOSHI, T.	36
HOSHI, T.	368
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HOSOMI, H.	318
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ICHIKAWA, O.	88
ICHIKAWA, R.	226
ICHIKAWA, S.	S6
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IKAWA, Y.	10	ISHIKAWA, N.	176		
IKEDA, N.	325	ISHIKAWA, T.	301	K	
IKEDA, T.	284	ISHIKAWA, T.	324	KADOYA, T.	434
IKEGAMI, S.	107	ISHIKO, N.	228	KAGEYAMA, K.	27
IKEGAMI, Y.	400	ISHIKO, N.	234	KAGEYAMA, N.	320
IKEHARA, T.	30	ISHIYAMA, Y.	159	KAIGA, Y.	106
IKEHATA, K.	176	ISHIZAWA, M.	271	KAJINO, K.	S15
IKEZAWA, K.	351	ISHIZUKA, N.	95	KAKEGAWA, T.	386
IKUNO, H.	305	ISOBE, Y.	430	KAKIUCHI, Y.	350
IMAI, K.	341	ISOJIMA, C.	258	KAKUTANI, Y.	411
IMAI, S.	92	ISONO, K.	231	KAMADA, K.	313
IMAI, Y.	22	ITAKURA, K.	171	KAMADA, T.	221
IMAI, Y.	35	ITO, A.	393	KAMEDA, K.	221
IMAIZUMI, K.	341	ITO, F.	245	KAMEI, H.	120
IMANAGA, I.	279	ITO, H.	324	KAMEYAMA, M.	74
IMANISHI, S.	295	ITO, H.	329	KAMINO, K.	72
INAGAKI, Y.	352	ITO, K.	127	KAMIYA, A.	326
INASAKA, T.	284	ITO, M.	132	KAMIYA, A.	420
INOMATA, K.	50	ITO, M.	418	KANAI, K.	S9
INOMATA, K.	70	ITO, M.	422	KANAMATSU, T.	186
INOMATA, K.	366	ITO, M.	S5	KANDA, K.	89
INOMOTO, T.	414	ITO, S.	180	KANEDA, T.	279
INOMOTO, T.	431	ITO, Y.	82	KANEKO, A.	214
INOUE, H.	50	ITO, Y.	345	KANIKE, K.	39
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INOUE, M.	401	ITOH, K. B.	421	KANNO, T.	S16
INOUE, S.	162	ITOH, Y.	306	KANNO, Y.	18
INOUE, T.	392	ITOW, H.	396	KANNO, Y.	237
INOUE, H.	7	IWAI, E.	S22	KANO, A.	36
INOUE, H.	11	IWAMA, K.	115	KANO, M.	76
INUI, T.	338	IWAMA, K.	201	KANOSUE, K.	144
IRIKI, A.	164	IWAMOTO, J.	310	KARITA, K.	229
IRIKI, M.	162	IWAMOTO, M.	118	KARITA, K.	238
IRIKI, M.	415	IWAMURA, Y.	139	KASAGI, T.	88
IRISAWA, H.	289	IWASE, Y.	142	KASAHARA, T.	171
IRIUCHIJIMA, J.	335	IWASE, Y.	147	KASAHARA, Y.	224
ISHIDA, A.	291	IWATA, T.	64	KASAI, S.	1
ISHIDA, A.	391	IWATA, T.	184	KASAI, S.	343
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ISHIDA, H.	154			KASANUKI, H.	294
ISHIGURO, S.	17	J		KASEDA, M.	276
ISHIKAWA, K.	378	JIIWA, H.	128	KATADA, A.	153
ISHIKAWA, M.	162	JIIWA, H.	146	KATADA, A.	154

KATAGIRI, N.	213	KITAGAWA, T.	3	KOKETSU, K.	S14
KATAGIRI, Y.	213	KITAHARA, M.	43	KOMABAYASHI, T.	402
KATAKURA, T.	20	KITAJIMA, S.	24	KOMABAYASHI, T.	403
KATAOKA, K.	303	KITAMURA, K.	129	KOMANO, Y.	27
KATAYAMA, Y.	77	KITAMURA, K.	187	KOMATSU, A.	359
KATAYAMA, Y.	428	KITAMURA, K.	269	KOMATSU, Y.	245
KATO, M.	87	KITAMURA, K.	400	KOMODA, Y.	162
KATO, M.	93	KITAMURA, T.	311	KON, K.	9
KATO, M.	316	KITaura, T.	395	KON, K.	342
KATOH, K.	49	KITANI, K.	369	KONDO, H.	205
KATSUDA, N.	131	KITASATO, H.	61	KOSAKA, H.	341
KAWAGUCHI, T.	4	KITASATO, H.	S13	KOSAKA, I.	265
KAWAHARA, K.	36	KIYOHARA, S.	227	KOSAKA, M.	414
KAWAKAMI, K.	420	KIYOHARA, T.	42	KOSAKA, M.	431
KAWAKAMI, M.	169	KIYONO, S.	179	KOSHIHARA, Y.	409
KAWAKAMI, M.	376	KIYOSUE, T.	295	KOTERA, K.	S15
KAWAKAMI, M.	387	KOASE, K.	434	KOYAMA, H.	147
KAWAKITA, K.	242	KOBAYASHI, K.	80	KOYAMA, I.	183
KAWAMURA, H.	107	KOBAYASHI, K.	361	KOYAMA, T.	284
KAWASAKI, R.	358	KOBAYASHI, K.	424	KOYAMA, T.	350
KAWASE, M.	5	KOBAYASHI, H.	81	KOYAMA, T.	362
KAYAMA, Y.	201	KOBAYASHI, N.	108	KOYANO, H.	310
KELLY, J. S.	117	KOBAYASHI, S.	13	KOZUKA, M.	65
KIDA, K.	338	KOBAYASHI, S.	249	KUBA, K.	57
KIDA, T.	40	KOBAYASHI, Y.	361	KUBA, K.	85
KIKUCHI, K.	394	KOBAYASHI, S.	372	KUBOTA, K.	180
KIKUCHI, K.	399	KOBORI, T.	64	KUBOTA, K.	284
KIKUCHI, Y.	362	KOBORI, T.	184	KUBOTA, T.	48
KIM, K.	357	KODAMA, H.	1	KUBOTA, K.	S2
KIMURA, E.	19	KODAMA, H.	343	KUDO, N.	91
KIMURA, E.	27	KOFUNE, K.	402	KUDOH, M.	219
KIMURA, H.	282	KOGA, M.	15	KUKITA, F.	58
KIMURA, M.	123	KOGA, M.	32	KUKITA, F.	62
KIMURA, N.	382	KOGA, R.	404	KUMADA, M.	308
KIMURA, S.	13	KOGA, S.	287	KUMADA, M.	317
KIMURA, S.	19	KOGAWA, H.	340	KUMAGAI, S.	399
KIMURA, S.	411	KOGURE, S.	S21	KUMAGAI, Y.	276
KINOSHITA, Y.	19	KOHNO, M.	163	KUMAZAWA, T.	357
KINOSHITA, Y.	27	KOHSAKA, S.	208	KURAHASHI, M.	S26
KINOSHITA, Y.	352	KOIKE, H.	84	KURAMITSU, M.	31
KISHIDA, A.	169	KOIKE, T.	153	KURAMOTO, T.	151
KITA, H.	86	KOIKE, T.	154	KURATA, K.	150
KITA, H.	111	KOIZUMI, K.	371	KURIYAMA, H.	82
KITA, T.	78	KOKETSU, K.	57	KURIYAMA, H.	269

KURODA, E.	337
KURODA, H.	44
KURODA, Y.	80
KURONO, M.	21
KUROSHIMA, A.	432
KUROSHIMA, A.	S26
KUSACHI, R.	359
KUSUMI, H.	424
KUWANA, S.	363

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MAEKAWA, K.	123
MAEKAWA, M.	167
MAENO, T.	83
MAEZAWA, R.	241
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MARU, E.	160
MARUI, T.	242
MARUHASHI, J.	37
MARUMO, F.	46
MARUYAMA, N	219
MARUYAMA, S.	117
MARUYAMA, Y.	157
MARUYAMA, Y.	285
MASADA, Y.	165
MASHIMA, H.	291
MASUDA, M.	413
MASUDA, Y.	352
MASUMURA, S.	427
MATSUBAYASHI, K.	159
MATSUDA, Y.	66
MATSUI, H.	31
MATSUI, H.	400
MATSUI, N.	407
MATSUKAWA, K.	120
MATSUKURA, H.	329
MATSUMOTO, I.	373
MATSUMOTO, J.	165

MATSUMOTO, M.	75
MATSUMOTO, N.	134
MATSUMOTO, N.	140
MATSUMOTO, Y.	16
MATSUMURA, M.	282
MATSUMURA, Y.	
MATSUOKA, Y.	302
MATSUSHITA, H.	4
MATSUSHITA, H.	424
MATSUTANI, T.	185
MATSUURA, S.	8
MATSUZAKA, A.	399
MATSUZAWA, I.	130
MATUMOTO, M.	69
MAYUZUMI, M.	419
MAYUZUMI, M.	421
MIENO, M.	375
MIKAMI, A.	180
MIKAMI, T.	355
MIKI, K.	322
MIKI, M.	344
MIKOSHIBA, K.	208
MIMURA, K.	188
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MISHINA, T.	46
MITANI, A.	127
MITARAI, G.	163
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MIURA, M.	311
MIYAGAWA, T.	418
MIYAGAWA, T.	422
MIYAKAWA, K.	331
MIYAKAWA, K.	S9
MIYAKAWA, M.	333
MIYAKE, A.	146
MIYAKE, M.	71
MIYAMOTO, H.	30
MIYAMOTO, M.	68
MIYAMOTO, S.	21
MIYAMOTO, Y.	355
MIYAMURA, M.	400
MIYAZAKI, E.	270
MIYAZAKI, E.	271

MIYAZAKI, S.	60
MIYAZAWA, T.	102
MIYAZAWA, T.	301
MIYOSHI, M.	88
MIZONISHI, T.	S8
MIZUMURA, K.	357
MIZUNO, Y.	143
MIZUNO, Y.	320
MIZUTANI, T.	320
MOCHIZUKI, M.	364
MONOI, H.	6
MOHRI, M.	425
MORI, A.	21
MORI, E.	351
MORI, H.	35
MORI, J.	56
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MORI, K.	126
MORI, K.	141
MORI, S.	163
MORI, S.	S4
MORIMOTO, K.	244
MORIMOTO, S.	413
MORIMOTO, T.	23
MORIMOTO, T.	45
MORIMOTO, T.	322
MORITA, F.	190
MORITA, K.	57
MORITA, M.	332
MORITA, Y.	176
MORITA, Y.	207
MOROOKA, N.	352
MOTOKIZAWA, F.	241
MOTOMURA, S.	290
MURAI, M.	182
MUNAKATA, Y.	238
MURAKAMI, F.	121
MURAKAMI, M.	35
MURAKAMI, M.	200
MURAKAMI, N.	388
MURAKAMI, N.	408
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MURAKAMI, S.	93
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MURAMOTO, A.	287
MURAMOTO, K.	113
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MURAYAMA, K.	61
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MUTSUGA, N.	97
MUTSUGA, N.	320

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NAGAI, K.	10
NAGAI, T.	230
NAGAI, T.	257
NAGAI, T.	265
NAGAI, T.	361
NAGAMI, K.	266
NAGAMI, K.	367
NAGASAKA, T.	405
NAGASAKA, T.	425
NAGASAKI, H.	162
NAGASHIMA, Ch.	329
NAGASHIMA, Ch.	324
NAGANO, M.	55
NAGAOKA, S.	7
NAGAOKA, S.	11
NAGATA, A.	390
NAGATA, Y.	24
NAGATA, Y.	175
NAGAYOSHI, M.	185
NAITO, H.	297
NAITO, K.	48
NAKABUSHI, M.	186
NAKAGAKI, I.	22
NAKAHARA, Y.	145
NAKAJIMA, H.	92
NAKAJIMA, Y.	94
NAKAMURA, H.	309
NAKAMURA, H.	366
NAKAMURA, H.	365
NAKAMURA, J.	77
NAKAMURA, S.	115

NAKAMURA, T.	207
NAKAMURA, Y.	114
NAKANO, S.	266
NAKANO, S.	367
NAKAO, S.	103
NAKASATO, M.	49
NAKASE, Y.	12
NAKATANI, A.	5
NAKAYA, M.	406
NAKAYA, S.	348
NAKAYAMA, S.	299
NAKAYAMA, T.	417
NAKAZAWA, K.	24
NAMAI, K.	32
NANBA, T.	24
NARA, Y.	46
NARA, Y.	325
NARITA, K.	86
NARUSAWA, M.	266
NARUSAWA, M.	367
NATSUI, T.	363
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NEGISHI, K.	203
NEGISHI, K.	212
NEGORO, H.	372
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NEMOTO, T.	420
NEYA, T.	299
NEZU, E.	313
NEZU, E.	365
NIHEI, S.	1
NIIJIMA, A.	315
NIIJIMA, A.	S19
NIIZEKI, K.	364
NINOMIYA, I.	336
NINOMIYA, Y.	235
NISHI, S.	67
NISHI, S.	77
NISHIKAWA, H.	23
NISHIKAWA, H.	45
NISHIKAWA, N.	106
NISHIKAWA, Y.	106
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NISHIMURA, H.	119

NISHIMURA, H.	S4
NISHIMURA, S.	28
NISHINA, Y.	3
NISHINO, H.	111
NISHINO, H.	113
NISHINO, H.	S18
NISHIO, K.	61
NISHIO, K.	S13
NISHIYAMA, A.	152
NISHIYE, H.	291
NISIDA, I.	31
NISIDA, I.	169
NISIMARU, N.	S5
NISIMARU, Y.	316
NODA, K.	172
NODA, Y.	135
NOGUCHI, T.	379
NOMOTO, T.	374
NOMURA, H.	296
NOMURA, M.	175
NOSAKA, S.	312
NOZAKI, S.	99
NOZAKI, S.	114
NUMAO, Y.	335

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OBA, T.	256
OBARA, S.	54
OCHI, K.	282
OCHI, R.	278
OGASAHARA, Y.	337
OGATA, E.	13
OGAWA, H.	244
OGAWA, M.	34
OGAWA, S.	S27
OGAWA, T.	418
OGAWA, T.	422
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O'HATA, S.	26
O'HATA, S.	29
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OHBA, M.	293
OHHASHI, T.	319
OHHASHI, T.	328

OHKUBO, C.	330	OOMURA, Y.	87	SAKAGUCHI, M.	319
OHNO, T.	303	OOMURA, Y.	111	SAKAGUCHI, M.	328
OHNO, S.	106	OOMURA, Y.	S17	SAKAGUCHI, T.	315
OHSAKI, R.	252	OOYAMA, H.	220	SAKAGUCHI, T.	372
OHSAWA, K.	36	OOYAMA, H.	223	SAKAGUCHI, T.	398
OHTA, H.	434	OSADA, H.	398	SAKAGUCHI, T.	S19
OHTA, K.	249	OSADA, Y.	S27	SAKAI, A.	68
OHTA, M.	110	OSHIBA, S.	346	SAKAI, A.	327
OHTA, Y.	85	OSHIMA, K.	383	SAKAI, M.	49
OHWATARI, N.	414	OSHIMA, T.	137	SAKAI, S.	26
OHWATARI, N.	431	OZAKI, H.	153	SAKAI, S.	29
OHYE, C.	92	OZAKI, H.	154	SAKAI, S.	43
OIKAWA, T.	156	OZAKI, T.	158	SAKAI, T.	30
OIKAWA, T.	272	OZAWA, N.	121	SAKAI, T.	46
OJIMA, H.	76	OZAWA, N.	125	SAKAI, T.	55
OKA, H.	S3	OZAWA, S.	382	SAKAI, T.	253
OKA, K.	112			SAKAI, T.	361
OKA, Y.	17			SAKAKIBARA, M.	202
OKA, Y.	347			SAKAKIBARA, Y.	356
OKADA, H.	300			SAKAKIBARA, Y.	360
OKADA, J.	311			SAKAMOTO, S.	402
OKADA, Y.	59			SAKAMOTO, S.	403
OKAI, O.	321			SAKAMOTO, Y.	268
OKAI, O.	324			SAKATA, Y.	S23
OKAMOTO, H.	S12			SAKO, H.	19
OKAMOTO, S.	351			SAKURANAGA, M.	130
OKAMOTO, U.	347			SAMEJIMA, C.	172
OKAMOTO, Y.	280			SANO, A.	165
OKUMURA, A.	2			SANO, K.	165
OKUBO, S.	171			SANO, T.	280
ONISHI, M.	16			SANO, T.	288
ONO, K.	155			SASAKI, K.	75
ONO, M.	397			SASAKI, K.	111
ONO, T.	111			SASAKI, K.	113
ONO, T.	113			SASAKI, S.	22
ONO, T.	246			SASAKI, S.	95
ONO, T.	S18			SASAKI, S.	103
ONODA, N.	141			SASAKI, S.	161
ONODA, N.	S21			SASAKI, T.	404
ONODERA, K.	79			SASAKI, Y.	210
ONOHAMA, E.	272			SASAKI, K.	S18
ONOUKA, M.	64			SASAMOTO, K.	110
ONOUKA, M.	184			SATAKE, N.	S15
OOKAWA, T.	136			SATO, A.	298

SATO, A.	309	SHIGENAGA, Y.	127	SUGANO, T.	410
SATO, H.	416	SHIMADA, H.	46	SUGANO, Y.	405
SATO, K.	155	SHIMADA, M.	410	SUGANO, Y.	425
SATO, M.	225	SIMADA, Z.	334	SUGAWARA, Y.	54
SATO, M.	310	SHIMAZAKI, K.	225	SUGAYA, E.	64
SATO, S.	S13	SHIMAZU, H.	S1	SUGAYA, E.	135
SATO, S.	61	SHIMAZU, T.	378	SUGAYA, E.	184
SATO, S.	408	SHIMIZU, H.	157	SUGI, H.	254
SATO, T.	233	SHIMIZU, H.	182	SUGI, H.	262
SATO, T.	325	SHIMIZU, N.	87	SUGIE, I.	345
SATŌ, T.	427	SHIMIZU, N.	111	SUGIMOTO, K.	233
SATO, Y.	157	SHIMIZU, T.	296	SUGISAKI, T.	379
SATO, Y.	260	SHIMODA, Y.	200	SUGITA, K.	320
SATO, Y.	264	SHIMOJI, K.	157	SUHARA, K.	153
SATO, Y.	298	SHIMOKOCHI, M.	166	SUHARA, K.	154
SATO, Y.	309	SHIMOKOCHI, M.	175	SUMI, T.	247
SATOH, T.	97	SHIMOSHIMA, C.	428	SUMINO, R.	99
SATOU, E.	338	SHIMOTAHIRA, K.	224	SUMOMOGI, H.	18
SATOU, M.	126	SHINAGAWA, Y.	25	SUMOMOGI, H.	237
SATOW, Y.	53	SHINAGAWA, Y.	25	SUNANO, S.	270
SAWADA, M.	83	SHINGAI, T.	305	SUNAYASHIKI, K.	303
SAWANOBORI, K.	288	SHIO, H.	25	SUZAKI, T.	13
SAWANOBORI, K.	330	SHIOTA, M.	410	SUZUKI, H.	124
SCHOLER, D. W.	41	SHIOZAWA, K.	243	SUZUKI, H.	153
SEKI, S.	434	SHIRAISHI, Y.	272	SUZUKI, H.	154
SEKI, T.	297	SHIRAKI, K.	339	SUZUKI, H.	196
SEMBA, T.	346	SHIRATAKA, M.	325	SUZUKI, H.	215
SEMBA, T.	S8	SIMPSON, A.	298	SUZUKI, H.	269
SENO, H.	176	SIMPSON, A.	309	SUZUKI, K.	395
SEO, M.	179	SLAYMAN, C. L.	44	SUZUKI, M.	187
SETO, K.	389	SOEDA, H.	172	SUZUKI, M.	386
SETO, K.	412	SOGAMI, M.	7	SUZUKI, M.	393
SEYAMA, I.	274	SOGAMI, M.	11	SUZUKI, N.	76
SHIBA, Y.	18	SOMEI, K.	75	SUZUKI, N.	142
SHIBA, Y.	237	SORIMACHI, M.	303	SUZUKI, N.	147
SHIBAGAKI, M.	179	SORIMACHI, M.	385	SUZUKI, S.	102
SHIBATA, H.	405	SUDA, K.	211	SUZUKI, S.	262
SHIBATA, T.	292	SUDA, T.	9	SUZUKI, T.	140
SHIBAZAKI, T.	92	SUDA, T.	342	SUZUKI, T.	304
SHIBUKI, K.	S5	SUDO, K.	340	SUZUKI, T.	373
SHIGA, K.	3	SUDOH, M.	406	SUZUKI, T. A.	134
SHIGA, T.	9	SUGA, H.	283		
SHIGA, T.	342	SUGAI, T.	220		
SHIGEMATSU, Y.	204	SUGAI, T.	223		
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				TABATA, T.	238

TACHIBANA, M.	214	TAKEDA, T.	123	TERASAWA, T.	343
TADAKI, E.	357	TAKEGAMI, T.	142	TERASHIMA, S.	251
TAIRA, K.	134	TAKEGAMI, T.	147	TERUI, N.	308
TAIRA, K.	140	TAKEMIYA, T.	329	TERUI, N.	317
TAIRA, N.	281	TAKENAKA, T.	50	TODA, K.	164
TAIRA, N.	290	TAKENAKA, T.	70	TOGASHI, T.	279
TAJIMA, K.	82	TAKEO, T.	158	TOGAWA, T.	420
TAKABA, S.	430	TAKEOKA, M.	409	TOHORI, M.	411
TAKABAYASHI, A.	202	TAKESHIGE, C.	112	TOKUDA, M.	31
TAKAFUJI, M.	229	TAKESHIGE, C.	182	TOKUNO, H.	268
TAKAGI, M.	129	TAKEUCHI, A.	79	TOMITA, S.	10
TAKAGI, S.	163	TAKEUCHI, A.	386	TOMITA, T.	33
TAKAGI, S. F.	126	TAKEUCHI, H.	68	TOMITA, T.	267
TAKAGI, S. F.	240	TAMAI, Y.	118	TOMITA, T.	268
TAKAGI, S. F.	S21	TAMARU, M.	185	TOMIYAMA, T.	S4
TAKAGI, Y.	186	TAMURA, M.	364	TONOUE, T.	374
TAKAHASHI, F.	31	TAMURA, T.	420	TSAI, C. T.	115
TAKAHASHI, K.	65	TAMURA, Y.	407	TSAI, T. H.	404
TAKAHASHI, K.	177	TANABE, S.	17	TSUBOI, M.	402
TAKAHASHI, K.	195	TANAKA, H.	164	TSUBOI, M.	403
TAKAHASHI, K.	380	TANAKA, I.	194	TSUCHIYA, K.	415
TAKAHASHI, K.	381	TANAKA, I.	423	TSUCHIYA, W.	59
TAKAHASHI, M.	433	TANAKA, K.	138	TSUDA, K.	84
TAKAHASHI, Y.	177	TANAKA, M.	139	TSUDA, Y.	275
TAKAHASHI, Y.	380	TANAKA, M.	182	TSUJIMOTO, T.	12
TAKAHASHI, Y.	381	TANAKA, M.	420	TSUJIMOTO, T.	118
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TAKAHIRA, H.	122	TANAKA, N.	421	TSUJITA, J.	421
TAKAI, H.	260	TANAKA, R.	149	TSUKADA, Y.	185
TAKAI, H.	264	TANAKA, T.	104	TSUKADA, Y.	208
TAKAKI, M.	299	TANAKA, Y.	322	TSUKADA, Y.	379
TAKAMATSU, K.	208	TANAKA, Y.	348	TSUKAHARA, N.	121
TAKAMATSU, T.	366	TANAKADATE, A.	20	TSUKAHARA, Y.	192
TAKANASHI, Y.	147	TANIGUCHI, I.	167	TSUKAHARA, Y.	231
TAKANO, K.	89	TANJI, J.	150	TSUKEDA, K.	191
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TAKANO, N.	354	TASAKI, K.	215	TSUMURAYA, Y.	276
TAKANO, T.	14	TASHIRO, Y.	8	TSURUMOTO, Y.	427
TAKASHIMA, S.	408	TATEDA, H.	189	TSUTSU-URA, M.	257
TAKASUGI, S.	314	TATSUNO, J.	56	TSUZUKI, S.	404
TAKATA, M.	105	TATSUNO, J.	160	TSUZUKI, S.	429
TAKATO, M.	135	TAUCHI, M.	194	TSUZUKI, S.	S24
TAKAUJI, M.	257	TAZAKI, K.	63	TYUMA, I.	341
TAKEDA, K.	259	TAZAWA, H.	353		

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UCHIDA, T.	142
UCHIDA, T.	147
UCHINO, K.	413
UCHINO, Y.	102
UCHIYAMA, H.	222
UCHIZONO, K.	162
UDO, M.	120
UEDA, G.	327
UEDA, G.	409
UEDA, K.	19
UEDA, K.	230
UEDAIRA, H.	6
UEHA, T.	40
UEMURA, K.	101
UENO, M.	178
UEZU, E.	165
UMAZUME, Y.	263
UMEZU, M.	232
UMINO, O.	199
UNO, M.	121
UNO, M.	125
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USAMI, M.	135
USHIKOSHI, A.	389
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USHIYAMA, N. S.	81
USUNE, S.	267
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WAKABAYASHI, S.	286
WAGMAN, I. H.	101
WARASHINA, A.	73
WARASHINA, A.	315
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WATANABE, A.	55
WATANABE, A.	148
WATANABE, A.	321
WATANABE, H.	119
WATANABE, K.	172
WATANABE, K.	173
WATANABE, K.	199
WATANABE, M.	229
WATANABE, M.	238
WATANABE, M.	379
WATANABE, S.	102
WATANABE, S.	128
WATANABE, S.	146
WATANABE, S.	168
WATANABE, S.	352
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WATANABE, Y.	96
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YAGI, K.	116
YAGI, S.	426
YAGISHITA, Y.	302
YAHATA, T.	S26
YAJIMA, Y.	190
YAMADA, E.	243
YAMADA, K.	64
YAMADA, K.	184
YAMADA, K.	261
YAMADA, M.	88
YAMADA, M.	204
YAMADA, S.	23
YAMADA, S.	45
YAMADA, T.	232
YAMADA, Y.	377
YAMAGAMI, K.	28
YAMAGISHI, S.	58
YAMAGISHI, S.	62
YAMAGUCHI, H.	17
YAMAGUCHI, K.	166
YAMAGUCHI, K.	175
YAMAGUCHI, K.	372

YAMAGUCHI, M.	395
YAMAGUCHI, S.	393
YAMAGUCHI, T.	91
YAMAGUCHI, T.	169
YAMAJI, K.	146
YAMAMOTO, C.	129
YAMAMOTO, D.	52
YAMAMOTO, H.	345
YAMAMOTO, K.	172
YAMAMOTO, K.	417
YAMAMOTO, K.	S7
YAMAMOTO, M.	76
YAMAMOTO, S.	306
YAMAMOTO, T.	236
YAMAMOTO, T.	312
YAMAMOTO, T.	S20
YAMAMOTO, Y.	142
YAMAO, M.	29
YAMAO, M.	43
YAMASHITA, E.	285
YAMASHITA, E.	375
YAMASHITA, H.	371
YAMASHITA, K.	375
YAMASHITA, S.	189
YAMASHITA, S.	227
YAMAUCHI, N.	156
YAMAURA, H.	396
YAMAZAKI, S.	76
YANAGIHARA, K.	289
YANAGISAWA, K.	243
YANAGISAWA, T.	281
YANASE, M.	388
YANO, J.	59
YANO, J.	220
YANO, J.	223
YASUHARA, M.	297
YASUNAGA, K.	312
YATANI, A.	275
YAWO, H.	59
YOKOI, I.	21
YOKOI, I.	68
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YONEDA, T.	391	YOSHIMURA, H.	411	YOSHIZAKI, K.	310
YONEMURA, K.	302	YOSHIMURA, K.	313	YUASA, S.	349
YONEZAWA, N.	221	YOSHIOKA, T.	50	YURUGI, R.	398
YONEZAWA, Y.	336	YOSHIOKA, T.	70	YUYAMA, N.	434
YONEZU, T.	17	YOSHIOKA, T.	266		
YOSHIDA, K.	S27	YOSHIOKA, T.	367	Z	
YOSHIDA, S.	66	YOSHIZAKI, K.	23	ZIMMERMANN, M.	100
YOSHIDA, T.	408	YOSHIZAKI, K.	45		

第56回日本生理学会大会生理学教育シンポジウム

教育委員長
大村 裕

昭和54年度生理学教育シンポジウムは、4月4日、東京慈恵会医科大学において行われた。酒井敏夫教授司会のもとで本間三郎教授による「生理学教育と独創性」、中馬一郎教授司会のもとで真島英信教授による「生理学教育法の現状と将来

像」、本郷利憲教授による「筑波方式による生理学教育」、石河延貞教授による「WHO方式による教育理念」が講演された。参加者も多く、簗島先生をはじめとする教育熱心な先生がたの活発な討議が行われた。

生理学教育と独創性

千葉大, 医, 生理
本間三郎

日本学術会議は第11期の活動要綱の重点項目として学問研究の独創性・先見性の尊重を掲げることとなった。そのことにもとづいて去る3月27日独創性・先見性の啓発に関するシンポジウムが開催された。日本学術会議会長 伏見康治、国立教育研究所所長 木田 宏、前日本原子力研究所理事長 宗像英二の各氏により次のことが披露された。

独創的業績：独創的研究を成し遂げるためには、個人の力量と共に研究者の若さが関係する。専門分野ごとにその発達の時代的な背景があり、その機に遭遇することも必要である。研究者の相互関係特に仲間内作用も重要である。環境や社会構造も等閑視できない。

本邦での独創的研究業績：わが国は単一民族であり、同じ物の見分をする社会であることはアメリカとは大いに異っている。このような社会のなかから違った物の考え方、研究面でも独創的なものを生み出すことは難しい。社会構造を変えることで独創性のある仕事の生れることも多い。

独創性の涵養への方策：研究に一致点がないからとしてその研究を否定してはいけない。研究や教育において試行（試み）を展開する、そういった試みをさせるに社会を含めてすべてが寛容でなければならない。大学が既存の体制の枠内で働いてはならず、固定観念にとらわれないことである。生理学研究所は固定観念にとらわれること

なく研究への試行を展開して欲しいとの要請がなされた。

独創的研究を遂行するために：多くの人が選ぶような、人の選んだものの後を追うような研究題目を選んではならない。既知に捉われ過ぎてはならないし、文献に左右されてはならない。本というものは事実の報告であり、読んでも直にその事実に触れることはできない。実在する真理は実験によってえられる。教授自らが実験に精進することこそ必要であるとする。

まとめ：生理学教育について大学を卒業した若い生理学者者に対して、もしわれわれが対応するとすれば、それら若い人が自由にして闊達な研究を試行することへの寛容さを持つことであろう。大学生についての生理学教育をみると、例えば医学部では修得する教育内容が多いため2ケ年間他の学部より長い。この2ケ年間は他の学部の修士課程に相当するとわれわれは言及している。しかしそのためには医学部教育課程は大学院の修士課程の教育内容をとるべきでなかろうか。この観点にたってみると医学部教育課程のなかで生理学教育がその種の教育内容を分担することではなかろうか。具体的に一例をあげると、生理学実習教育のなかに、最近の進んだ研究レベルの実験を試みさせる項目を組み入れ、将来の研究に対応できる素地を思考の面と内容の面とで修得できるよう実習教育の充実に腐心すべきではなかろうか。

生理学教育法の現状と将来像

順天堂大, 医, 第二生理
真 島 英 信

医学部専門課程における生理学教育を考えるに当たっては, まず医学全体の中の一分科としての生理学であることを念頭に置かねばならない。生理学だけを切り離したのでは実効があがらないのである。

1) 現 状

医学部長病院長会議が行った昭和52年度医学教育カリキュラムの現状¹⁾によれば, 現在大幅なカリキュラム改革を行いつつある医科大学は75校中27校であり, 近い将来に行わんとしている大学は22校におよんでいる。このように盛んなカリキュラム改革の原動力は, 第一に情報量の急速な膨脹であり, 第二に医科大学の急速な新設である。学術情報量の激増により, 4年の専門課程では到底必要な知識を講義できなくなっている。生理学ももちろん例外ではない。昭和52年の生理学の授業時間数は平均256時間, 全授業時間数の5.5%となっている。数年前には247時間であったからほとんど変わっていない²⁾。情報量が増しているのに時間数が変わらないとすれば, そこになんらかの授業方法の変化がなければならぬ。次に医科大学数の増加についてみると, 戦後昭和44年までは46校で変化がなかったのに, 45年以後10年間に33校が新設され, 現在では79校となった。1.7倍の増加である。入学学生数にしてみると昭和44年に3,900名であったものが, 昭和52年には7,969名で約2倍になっている。この数字は1クラスあたりの学生数も増したことを意味し, 教育密度の低下, 留年率の増大³⁾, すなわちの学生レベル低下を起している。現に昨年の国家試験合格率は81.2%と低かった。昔のようにエリートの学生だけを教育しているわけではなくなっているのである。したがって教育にある程度手をかけなければならなくなっている。それにもかかわらず科学の細分化, 高度化に伴い教員側の研究に当てるべき時間が増し, 教育へのそれは削られる傾向にある。どうしても効率のよい教育法が開発されなければならない。これらの原因が重なって現在の日本では空前

ともいえるカリキュラム改革が行われているのである。

カリキュラム改革の中で主なものは, 第一に6年一貫教育であり第二に統合カリキュラムである。6年一貫教育は進学課程と専門課程とを有機的に結合したものであるが, もちろん教授会や学期制を統一したものにすることから始めなければならない。新設大学の多くがこれを採用している。統合カリキュラムには京都, 筑波大学の方式と, 自治, 北里, 浜松医大の方式とがあるが, いずれも講座制科目制を廃し, 器官別あるいはレベル別コース制を採用している。もちろん6年一貫にしても統合カリキュラムにしても, これが従来のカリキュラムより優れているという結果はまだ出ていない。要は形式より内容にある。しかし従来の科目別カリキュラムでは講座間の教育上の連絡が悪いので, 統合カリキュラムの採用によって教員の教育に対する関心や情熱を引き出すことができるから, その成果が期待される。

2) 将来像

どのようなカリキュラムを採用するにせよ, 結局のところ大学における学習とは自己学習に他ならず, 教員は学生の自己学習を援助するのが建前である。その際カリキュラムの動力学を理解しておく必要がある。まず教育目標を設定し, それを満すべき授業を計画実施し, その評価を行って目標ないし授業にフィードバックするという回路である。この回路の日常の繰返しが教育である。この回路は研究者なら誰でも研究を行うとき踏んでいる手続きであろう。私共は研究と教育は別だと考えがちであるが, そのやり方へ変わったところはない。教育もまた科学的に行うのが最も効果的であろう。このような動力学を教育の実践面で納得するための試みとして, WHO方式のワークショップがある⁴⁾。厚生省主催で毎年1回, すでに6回行われて来ている。その他大学単位のミニワークショップも筑波大学では5回, 順天堂大学では4回行われている。

教育目標については、学部全体の一般教授目標 (GIO) が置かれ、各科目 (コース) およびユニットの目標が矛盾なく計画される必要がある。さらに学生の自己学習の内容を指定した個別行動目標 (SBO) を示す必要がある。このような目標は単なるフィロソフィーやビジョンではなく、現実に行うことができるようになる必要があるかが書かれていない。行動目標の項目は直ちに試験問題になりうるものである。また目標には単に知識領域だけでなく、技能領域や情意領域 (態度習慣) を含む必要がある。人格形成の必要な医学教育においてはこの点がとくに重要とされている。

次に授業の実施については、講義は依然として重要な方法であるが、その長所と短所を心得ていて活用すべきであろう。講義法改善のための最も良い方法は、自分の講義をビデオに撮っておいて、自分で反省するなり、他人に見て貰うなりすることだといわれている。その他行動目標を示した詳細な手引書 (教育要項) その他の教材が非常に重要な意味を持つ。講義の準備より良い教材の作製に時間をかけるべきであろう。講義、実習以外の形式もとり入れる努力が必要である。

評価は目標に合致していなければならない。中間試験 (形式的評価) を適当に行ってその結果を学生にフィードバックすることが望ましい。一夜漬けの知識は忘却もまた速やかである。試験形式もいろいろあるが、その得失を知って使いわけなければならない。客観試験について札幌の大会ですでに述べた⁵⁾。

まとめ：教育も科学的に行うこと、および学生の自己学習を援助する教育、すなわち学生中心の教育を行うことが将来の生理学教育の中心となるであろう。

文 献

- 1) 昭和52年度医学教育カリキュラムの現状, 全国医学部長病院長会議編 (1978)
- 2) 酒井敏夫: 望ましい生理学教育の時間配分について, 日本生理誌 35 (8.9), 560-562 (1973)
- 3) 真島英信: わが国の医学教育カリキュラムの現状, 医学教育 7 (5), 290-292 (1976)
- 4) 真島英信: Teacher Training について, 日本生理誌 37 (12), 447-448 (1975)
- 5) 真島英信: 客観試験の実際, 日本生理誌 36 (8.9), 429-430 (1974)

筑波方式による生理学教育

筑波大, 基礎医学, 生理
本 郷 利 憲

筑波大学医学専門学群では、発足以来新しいカリキュラムによる教育を試行し、満5年を経過した。このカリキュラムの内容と実施について、とくに生理学関係の部分を中心に紹介する。御批判と御助言を頂ければ幸いである。

1. カリキュラムの構成

全体のカリキュラムは、6年一貫教育と統合型教育を主旨として編成されている。図1のように、医進課程相当の科目と専門科目は時期的に境されず、互いに楔形に入り組んでいる。専門科目のカリキュラムは、Phase I (医学セミナー), II (医学生物学), III (人間生物学), IV (臨床入門), V (臨床実習) の五つの Phase より成り、一学年から順次積み上げられる。Phase II は医学基礎科学と細胞生物学より成り、前者はさらに感染生物学、生物有機化学、生物物理化学に内訳される。

生理学に対応する教育は、主として生物物理化学、細胞生物学、人間 (個体) 生物学の三つのカリキュラムで行われる。しかし、この中で生理学が科目として成立している訳ではなく、内容として編入されているのである。カリキュラムの編成が統合型を主旨としているためである。なお、統合の程度はどの Phase でも一様とは限らない。一般に高学年のカリキュラムほどその程度は高くなっている。

2. 生理学関係のカリキュラム

生物物理化学は基礎医学の物理化学的基礎を強固にするためのカリキュラムである。熱力学と溶液論の基本、拡散、吸着、膜平衡などの物理化学と、医学エレクトロニクスを内容としている。

細胞生物学では、細胞以下のレベルでの細胞一般に共通の構造と機能を統合的に学習する或る種

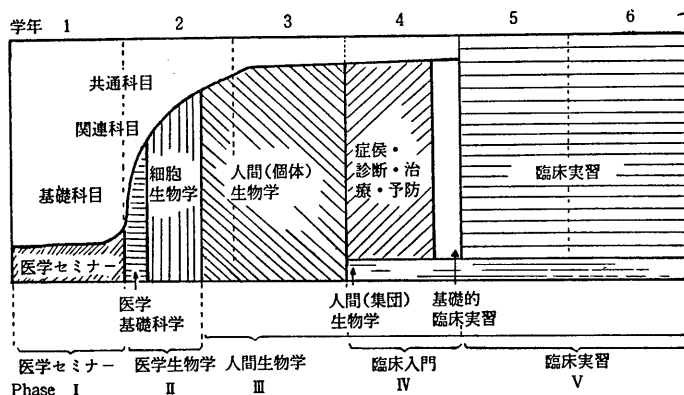


図1. 筑波大学医学専門学群カリキュラム

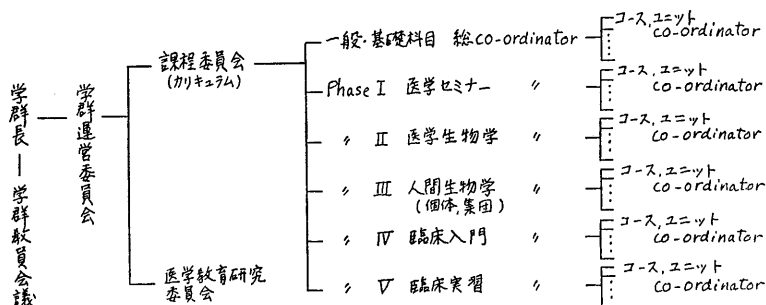


図2. 医学専門学群における運営組織の模式図

の分化された細胞（筋細胞，神経細胞など）も対象とする。12のユニットより成り，生理学に関する項目は細胞膜，シナプスと化学伝達物質，細胞の運動性，細胞の刺激と受容のユニットに編入されている。

人間（個体）生物学は主として器官系別に編成された16のコースより成る。その中の13のコースでそれぞれの器官系の機能を学ぶが，この部分が生理学の教育に対応する。

3. カリキュラムの実施と運営

図2に医学専門学群の運営組織を示す。学群長-学群運営委員会-課程(カリキュラム)委員会でカリキュラムの基本方針が策定される。これを受けて各コース（またはユニット）のco-ordinatorがカリキュラム，時間割の作成，担当教官の選定など，細部にわたる実施計画の原案をまとめる。この原案が課程委員会で調整，承認されて，実施に移される。

統合型カリキュラムの実施にあたっては，担当教官と学生の両者がその構成，内容，日程を予め

熟知していることが必須である。このために，

1) コース（またはユニット）の構成，各講義のタイトルと内容項目，在来科目（生理学，解剖学，生化学……）との対応関係などを説明した小冊子，2) 講義テキスト (syllabus)，3) 時間割表，を学生と担当教官全員に予め配布している。これらの資料の作成もco-ordinatorが中心になって行う。

統合型カリキュラムによる教育が実を挙げるためには，各コースの計画が予め十分な検討を経ていることと，実施状況の把握に基づくフィードバックが適確になされることが不可欠である。この面でco-ordinatorの果たす役割は極めて重要である。またこのカリキュラムは，計画-実施-試験の過程を通じて相当量の作業を必要とするので，教官の熱意に依存するところが大きいことも事実である。

以上のように，本学における生理学の教育は全体のカリキュラムの基本方針に沿って行われている。私たちは，ふの試行を成功させるために努力

を続けているが、その成果は、どのような医師、
医学者が育成されるかによって、いずれ客観的に

評価されることになるう。

WHO 方式による教育理念

宮崎医大、第一生理

石 河 延 貞

WHO (世界保健機構) は保健と医療の中心となる医師の質を向上させるため、世界各国が医学教育に従来より合理的で効果的な教育法を導入することを望んでいます。その具体的方策として WHO は医学教育者のための Teacher Training Center を世界の幾つかの地域に開設しその活動を通じて望ましい教育理念とカリキュラムモデルの普及を行っています。東南アジア地域の Center はオーストラリアにあり、ここで開かれた国際ワークショップにわが国から参加した人々によって昭和49年以降、日本各地でも医学教育改善のための運動が推進されるようになりました。私が医学教育の改善に関心を持ち、それを実行するための原則について知ることができたのは富士研修所で行われた第1回ワークショップに参加してからですが、一週間の合宿研修を体験した結果これまでもっていた教育観を2つの点で根本的に修正致しました。その第一は教育という活動の主体者は学習者でありカリキュラムは学習者がどのような学習経験をもつことが望ましいかという見地から立案されねばならないということであり、第二は教育の基本原則に沿ったカリキュラムを実行することによってより効果的な教育が期待されるであろうということでした。富士研修所で学習したカリキュラムモデルは元来医育機関全体が同じ原則の下に統制ある教育計画を作成することを想定したのですが、現実にはワークショップの体験なしでは教育理念の急速な変革はむずかしいことがわかったので、先ず私自身が担当する神経生理学コースでの改善を試みることにしました。本シンポジウムでは講義の媒体として図表テキストを利用した過去3年間の経験について述べたいと思います。

宮崎医科大学では6年一貫教育を実施しておりますが、生理学の教育は第2学年後期から開始され3学年前期で終了します。この期間の講義時間

は83時間ですが私は予めテキストを作成して学生に配布しています。テキストの最初には神経生理学の一般教授目標として講義によって到達すべき認知領域、実習において習得すべき精神運動領域(技能)およびこれらを通じて獲得すべき情意領域(態度)が示してあり学習上の注意や評価の方法、講義予定表などがこれに続きます。講義は12の題目にわけましたが各題目毎に講義内容に適切な図表を参考書や文献から選び講義順に配列したプリントを学生に与えて解説を行っています。図表の総数は全部で200以上ありプリントの頁数にして100頁以上ありました。図表テキストを講義の媒体として利用した理由ですが私は学生が生理学的知見を習得するに際しては手元に正確な図表を置いて積極的考察を行えるようにしてやる必要があるだと考えたからです。このようなテキストに対する学習者の評価を求めるため、第2学年後期終了時に調査書を配布して回答を求めました。先ず使用した図表が適切であったかどうかを知るため理解困難であった図表番号を講義項目毎に記載させましたが、全回答者の34%が理解困難と回答した図もあり、図表の難易度に応じた解説を行うとかもっと理解し易い図表と入れ替える必要があると思いました。図表テキストを利用した講義がよい学習経験を学生に与えるかどうかを知るためスライドなどを媒体とする講義と比較した場合の長短も調べました。その結果学習効果を高めるのに役立ったという肯定的な評価の方が否定的な評価より多く、後者の内容を検討してその改善を行うことにより図表テキストによる講義の有効性をもっと高めることが可能と思われました。このほか神経生理学のどの分野に如何なる理由で関心を持ったかという点についても調査し、興味ある回答をえました。学習者による以上のような評価をフィードバックすることによって、教授目標と教育法を常に修正することが可能です。

[シンポジウム]

「運動制御の中 枢 機 構」

東大, 医, 脳研生理
島 津 浩

運動制御の中 枢 機構は多方面にわたって研究されているが, このシンポジウムでは, 運動時における錐体路ニューロンの活動, 大脳小脳連関機構, stepping generator に対する中枢性制御, および運動学習の四つの問題がとり上げられた。

1965~68年に Evarts は, 運動しているサルの皮質運動野錐体路ニューロン(PTN)の活動様式に関していくつかの重要な発見をした。中でも, 大部分の PTN の活動は, 腕の位置よりむしろ腕の力および力の微分に関係することを見出したことは注目される。これに関連して久保田氏(京大, 霊長研)は, PTN の活動と運動の速度および加速度との比例関係は, 手関節の偏位のある範囲内でしか成立しないと述べた。また, ある PTN は屈曲時にも伸展時にも活動するので, breaking action をもつのではないかとの見解を示した。PTN のこのような活動様式は対応する筋の活動とは一致しないので, PTN の機能について多くの論議を呼んだ。

運動制御にとって, 運動の結果に関する自己受容性の情報が重要であるが, このような反射的調節, すなわち外在フィードバックに加えて, 中枢神経系の中だけで起る内在フィードバックの重要性が, 近年になって強調されている。内在フィードバック系は, 脊髄まで含めて中枢神経系の種々のレベルにあるが, 特に大脳-小脳-大脳ループは随意運動の制御機構として重視されている。岡氏(京大, 医, 脳研)は, 頭頂葉連合野-赤核-下オリーブ核投射系について精細な解析を加え, これまでの同氏および協同研究者によって蓄積された大脳小脳連関機構に関する豊富な知見をさらにひろげた。

運動パターンの形成には反射的な修飾が重要であるが, ある種の運動パターンは中枢神経系の中だけで作られる場合がある。1911年に Brown は, 両側後根を切断した脊髄ネコで, 適当な方法で上部脊髄を刺激すると, 歩行運動の基本的なパ

ターンを形成しうることを示した。この方向の研究は, 生物学の領域で中枢内のパターンジェネレーターあるいは中枢プログラムの概念が次第に実験的根拠を重ねてくると並行して, 神経生理学でも注目を集めてきた。森氏(旭川医大, 生理)は, 脊髄の stepping generator を活動させる下行性信号には, 興奮性と抑制性の両者が含まれていることを示し, 特に左右伸筋間の相反性パターンをつくるジェネレーターが, 一側の屈伸筋の相反性活動とは別個に賦活されることを示した点は注目された。

1969年に Marr は, 下オリーブ核から小脳皮質のプルキンエ細胞に投射する登上線維の活動によって, 平行線維からプルキンエ細胞に接続するシナプスの機能が修飾され, これによって小脳が運動学習の機能をもつという理論的仮説を提唱した。これに対して Llinás(1975)は, 下オリーブ核の選択的破壊によって, すでに学習されている運動機能が壊れてしまうことから, 小脳自体が運動学習の座ではないと結論した。この実験に関して伊藤氏(東大, 医, 生理)は, 下オリーブ核の破壊はプルキンエ細胞による抑制作用を著しく減弱させ, ウサギでは小脳破壊に似た姿勢変化を起すので, 小脳を学習の座とする考えを否定することにはならないと述べて注目された。これに対して, ネコやサルでは, 下オリーブ核を破壊しても小脳皮質破壊の症状は出ないとの論議が出され, 動物の種による違いを含めて問題の複雑さが指摘された。

以上のように, 運動制御の神経機構に関して, 多くの興味ある知見が出され, 活発な論議がおこなわれた。この領域でのわが国の研究の水準は極めて高い。このシンポジウムは一般演題から構成したことと, 限られた時間の関係もあって, 残念ながら他の多くの優れた研究を含むことができなかったが, この領域での研究の一端を御理解頂くのに大変有意義であったと感ずる次第である。

「膜 と 輸 送」

東 大 医 第 二 生 理

星

猛

膜と輸送の問題は生理機能の多くの分野に関連しており、またそれぞれの分野で膜輸送に関して多くの新しい進展が見られるので、今回のシンポジウムの構成に当っては、ある特定の問題（例えばポンプやチャネル）に焦点をしばってその共通した性格を浮き出させるといったシンポジウム本来の型式をとるより、種々の分野での新しい研究を可能な限り提示して膜輸送研究の全体的な趨勢を明らかにするワークショップ的な性格とする方が望ましいと考えた。時間的制約のため5題の講演で組織したが、講演できなかった他の分野にも多くの重要な進展があるため、予め司会者が膜輸送研究の全般的な最近の趨勢ならびに重要な知見について概説を行い、次いで各演者の講演に移った。

岡本治正氏の研究は興奮性膜の Na^+ チャネルのゲートに関係したものである。近年興奮に関するイオンの膜透過路についてはチャネルの概念が定着しつつあり、かつチャネルの活性化、不活性化の分子機構が解明されつつある。演者はサソリ毒が特異的に不活性化機構を阻害し、フォスホリパーゼ A_2 作用時と同様の I_{Na} 変化を示すことを電気生理学的に示し、さらに ^{131}I で標識した毒と電気ウナギ発電器官より調製した膜断片との結合を観察した結果を報告した。結合には Scatchard プロットより2種あり、高親和性結合 (K_D 8 nM) のものが Na^+ チャネルとの結合であること、高親和結合座数は TTX のそれと等しく、同毒素は Na^+ チャネルと1:1に結合することを示した。

北里 宏氏の講演は骨格筋細胞での Na^+-K^+ ポンプに対するインスリン、ウバイン作用の機序に関したもので、 Na^+ エフラックスの $[\text{Na}^+]_i$ 依存性に対するそれら物質の作用を見たものである。インスリンは潜在的ポンプを活性化すると予測がえられていたが、 $[\text{Na}^+]_i$ -エフラックス関係からはポンプの親和性を高め、ウバインは低めるとの結論をえた。ウバイン作用は $[\text{Na}^+]_i$

が高い程強い。その点は $\text{E}_2\text{-P}$ 中間体形成を考える逐次説に合うが、結合座数を減らすというよりは K^+ 結合に適したコンフォメーション変化のおこるのを抑制して親和性を低下させるとの解釈がより妥当であるとの考えを示した。

額額教三氏の研究はカエル心房筋の Na^+ ポンプの起電性を扱ったものである。近年無傷膜での Na^+-K^+ ポンプの Na^+/K^+ 比は固定的でなく、特に $[\text{Na}^+]_i$ 上昇と共に著しく増大し、ポンプは一般的に起電性をもっていることが明らかにされてきているが、今回は無 K^+ 液中での ACh による過分極反応が、 g_k の増大によって細胞外に出た K^+ が Na^+-K^+ ポンプを活性化することによって生ずるものであることを明らかにした。

藤本 守氏は経細胞性イオン輸送に関して各膜ステップの駆動力を明らかにするため、イオン交換体を用いた細胞内イオン選択性電極を用いて、複雑にイオン輸送の行なわれている尿管管で各種イオンの電気化学的ポテンシャルプロファイルを測定した結果を報告した。近年イオン交換体または引込み型ガラス電極を用いることにより細胞内イオン活動度測定の信頼度が高まりつつあるが、今回の研究では特に Na^+ と H^+ の輸送の干渉が膜電位を介するものであることを示した。

菅野富夫氏は膵腺細胞の消化酵素分泌と細胞の redox 状態の関係を調べ、ACh, CCK-PZ による分泌刺激時には何れの場合も還元方向へ推移することを示した。分泌反応には細胞内の複雑な過程が関与し、特に分泌、吸収の小器官としての Golgi 膜系の反応が重要であるが、それと分泌刺激、代謝との関係は尚興味ある問題が残されている。

講演終了後質疑討論に移ったが引き続き、評議員会、総会が予定されており、時間切れとなって十分な質疑討論ができなかったことは司会者として誠に申し訳なく、この紙面をかりてお詫び申し上げます。

「自 律 機 能 調 節」

昭和大, 医, 第二生理
市 河 三 太

このシンポジウムの司会を引受けた時, これは非常に広範囲な問題であるので, これをまとめるという事は至難な業と思った。そこで専門外の人にもよくわかるように, 演者に分担領域について, それぞれ歴史的に簡単に顧み, 現在の問題点, 現在この領域でどこ迄研究が進んでいるかなどについて解説的な事も含めて講演して頂くようお願いした。

自律機能というと, 自律神経の調節の元に内部環境の恒常性を維持する機能と一応定義されている。しかし, 体液性の調節を考えないと片手落ちとなる。そこで, 内分泌機序の事を含めたいと思い, 群馬大, 内分泌研の山本 清教授の演題を選んだ。また, 自律機能も体性系の調節機構と中枢において密接に連関しているので, この点も強調したかった。そこで, 司会者の指名発言として, 慈恵大, 第二生理の本間生夫先生に発言をお願いし, 一応の形をととのえた次第である。

現在, 自律機能の研究には二つの主な方向があると思う。一つは末梢で, これは内臓臓器の機能, 末梢受容器の問題, さらにこれは消化機能で主に問題となるが, 壁内神経叢の性状などを調べる事で, 興奮の伝達物質の問題も含まれる。他の一つは, 中枢に関する研究である。このシンポジウムでは中枢の問題をとり上げた。

先ず, 群馬大, 山本教授は, 内分泌機能がホルモンの負のフィードバック機構により調節されている事だけが現在強調されているが, 高位神経中枢からの体性活動に伴う刺激によっても, 丁度刺激と興奮という生理学の概念そのもののようにより, 内分泌機能が左右されるという新しい面を成長ホルモンの分泌調節に関する実験成績をあげて説明した。

広島大, 第二生理の銭場武彦教授は外来神経による中枢神経を介する腸外反射について, 延髄, 胸髄にある消化管運動中枢における, それぞれの促進ニューロンと抑制ニューロンとの興奮準位のかねあいにより胃運動が調節されている事を話し

た。消化管運動は壁内神経による腸内反射, 自律神経である外来神経による腸外反射, 消化管ホルモンによって調節されているが, この内, 腸外反射の研究が遅れている。その理由は紙面の都合上ここでは述べないが, 銭場教授はこの問題をさらに中枢の方に迄のぼして研究をされているので, その一部を解説的に話して貰った。(文献: 胃腸運動の基礎と臨床, 真興医書出版刊, 1979)

信州大・第二生理の宮川 清教授は血圧の第三級変動について歴史的に話を展開した後, イヌの頸動脈に側圧を負荷して血圧に振動を催起させ, その時の延髄中枢ニューロン, 末梢交感神経ニューロン活動を記録し, 循環系という一つの調節環の中での振動という考え方をわかり易く説明し, 血圧に対する神経性調節について解説した。(文献: 血圧振動からみた循環系神経支配, 自律神経15巻, 3号139頁, 1978)

慈恵大, 第二生理の福原武彦教授は, 延髄, 橋などにある呼吸中枢, すなわち呼吸中枢, 吸息中枢, 調節中枢などは中枢の局在リズム形成の起こる機序を説明するためのものであり, 呼吸リズムは脳幹部における呼吸に関するニューロンの複合系によって形成されるという研究を, まず歴史的に話した後で解説した。(文献: 呼吸と自律神経, 医学のあゆみ, 98巻5号, 352頁, 1976)

最後に慈恵大の本間先生に呼吸中枢でのパターン産生機構と末梢からの入力について発言して頂いた。肋間筋の固有受容器からの求心性衝撃は吸息を抑制するが, その機序は, ヘーリング・プロイエル反射と同じようなものである。しかしエルゴメーターにより生体に負荷をかけると吸息の興奮が高まるが, これは吸息ニューロンプールに興奮入力を入れるためであろうという発言であった。

予定の二時間を過ぎて, 討論の時間が無くなってしまったため, 一, 二の質問しか受ける事ができずに残念であったが, 聴衆の人にはよく問題点など理解して頂けたのではないかとと思っている。

「温熱生理学の諸問題」

阪大, 医, 第二生理
中山 昭 雄

今回のシンポジウムは、はじめにタイトルを決めてから演者を選んだのではなく、すでに申し込まれた一般演題の中から選んで構成されたものである。当番幹事から送られてきた演題名は環境生理・体温調節の分野に限ってもまことに多岐にわたっていた。環境生理学の定義は人によって異なり、これを広義に解釈すれば個体を取巻く環境のあらゆる物理的・化学的因子の影響ということになって、感覚生理学などはその一部として包括されてしまう。音と光は感覚生理学の主要な研究対象であるが、騒音や明暗周期の人体におよぼす影響となると環境生理学に入れられるようだ。

気候因子の中で、生体におよぼす作用が最もよく研究されているのは温度であろう。暑さ寒さの問題はいろいろな角度から、さまざまな手法によって古くから研究されて来たが、それらが次第に相互関連の度を深め、温熱生理学と呼ぶにふさわしい体系をなして来たのはここ10数年のことである。Thermophysiology という言葉が一般に用いられるようになったのはIUPSに同名の委員会が1970年に発足して以来である。筆者は数年間その委員を勤めたが、この委員会はこの方面の研究の促進に大いに役立ったと思う。

さてそこでこのシンポジウムのタイトルを「温熱生理学の諸問題」とすることとした。一つにはある特定の問題を集中的に討議するには、似たような演題を集めることが困難であったことにもよるが、いま一つはThermophysiologyについての一般の理解をえたいと願ったからである。後者のねらいが成功したのか、会場にはこの分野の集りでは日頃あまりお目にかかれない顔ぶれが多く見受けられた。温熱生理学で取扱っている領域は、①生体と環境との熱交換、②暑さ寒さに対する生理的調節反応、③調節の制御機構、④睡眠・冬眠・運動・発熱などの応用病態生理、⑤温度適応、⑥冷暖房や衣服などの日常生活に関連した学際領域など多方面にわたっている。時間の制約上

話題を5に限り、演者には発表演題の歴史的背景、現在の問題点、各自の実験の目的と意義などを広い視野に立って話して下さるようお願いした。かつてFederation meetingにおいて、大学院学生の理解を深める目的で、各Sessionの初めにその方面の大家がIntroductory Remarkを行ったことがあるが、司会をしながらふとそのことを思い出した。しかし今回のシンポジウムはそれとはいささか趣を異にしている。

先ず村上憲教授は脳内温度受容器について解説し、発熱時の温度感受性ニューロンの特性変化が視床下部のみならず、延髄でも観察されることを報告し、体温調節中枢の階層性を強調した。視床下部破壊時の発熱と、白血球性発熱物質の細胞膜への作用について討論が行われた。

最近行動性調節が注目を浴びているが、これと自律性調節の関連について、堀 哲郎教授はキャプサイシン脱感作ラットにおける成績などを引用しながら、両者が相補的に発現することを報告した。暑さに対する調節回路と寒さに対するその間には、従来想像されていたような相互抑制的な線維連絡があるのか疑問視された。またいわゆる冷ニューロンの膜にそのような特性があるのか、あるいは温ニューロンによって抑制される介在ニューロンであるのかという問題が討議された。

青木 健教授は軸索反射性発汗から見た霊長類の種の違いを報告し、比較生理学的研究の面白さ、重要さを指摘した。温度順化の過程はまだ充分明らかではないが、その現状を紹介した後、黒島教授はNAの他にグルカゴンの関与を指摘し、また奏効細胞の反応性の変化を強調した。公衆衛生院の長田部長は多年の研究課題である至適温度の問題について、作業時の温度感覚に言及しながら解説し、衛生学的研究のもつ困難さ、問題点に触れた。司会者の印象としてもう少し時間が欲しかった。

摂食の中枢性および末梢性の調節

司会 演者	九大, 医, 生理	大 村 裕
	富山医薬大, 医, 生理	小 野 武 年
	新潟大, 医, 生理	新 島 旭
	阪大, 歯, 口腔生理	山 本 隆
	群馬大, 医, 生理	高 木 貞 敬
	東京都神経研, 医学心理	岩 井 栄 一

4月6日, A会場で午後2時から本シンポジウムを開催した。はじめに司会者大村が解説講演を行った。摂食の中枢性機序としてはまず空腹感の発現であり, ついで摂食行動への移行であり, ついで満腹感の認知による行動停止である。1950年代になって視床下部外側野 (LHA) と腹内側核 (VMH) の果たす役割が重要であることがわかってきた。Kennedyによる脂肪定常説, Brobeckによる温度定常説, さらには Mayerにより精定常説が提出された。これらの説は視床下部に脂肪酸感受性, 温度感受性あるいはブドウ糖感受性の部位があり, 血中の変動を感知して摂食の調節を行っている, と述べている。電気生理学的研究によって, LHA 内には, ブドウ糖で活動が抑制されるブドウ糖感受性ニューロンが, VMH にはブドウ糖で活動上昇するブドウ糖受容ニューロンの存在が証明されている。現在の考え方を要約すると, 空腹を認知し, 摂食行動を起こすものになるのは, 主として血中の遊離脂肪酸が増加し, LHA 内のブドウ糖感受性ニューロンが活動し, いわゆる摂食中枢の活動高進による。満腹機構は, 血中ブドウ糖濃度の上昇により VMH のブドウ糖受容ニューロンが活動し, 満腹中枢の活動高進による。また摂食の調節には, 胃・肝臓など末梢臓器からの VMH や LHA への入力に影響すること一般に認められている。これら中枢は前頭野や扁桃体と相互に機能的に結合している。したがって, 両中枢で分析した血中化学情報はそこで適切に判断されるのであろう。また視床下部二中枢は運動野および錐体外路系と相互に結合しているから, 摂食行動や停止の発現はこの回路を使用していると考えられる。司会者は, さらに摂食行動調節の中心となるのは視床下部であるが, 視覚, 味覚, 嗅覚, 内臓からの情報など各種の入力も摂食行動に影響を与えていると述べている。

小野は, 視床下部 LHA ニューロンと摂食行動

との関係についてえた実験結果を報告した。サル LHA のブドウ糖感受性ニューロンは, パー押し動作を始める 2.0~0.5 秒前に興奮を起こす。運動野を刺激すると 0.5~1.5 ミリ秒の潜時で抑制ついで興奮を起こす。ブドウ糖感受性のないニューロンはこれら反応を示さない。つまり, ブドウ糖感受性ニューロンが摂食行動に直接関与している事実を示すデータである。

新島は, 摂食行動調節に影響すると思われる末梢性の入力, とくに肝からのブドウ糖感受性求心線維について述べた。モルモットで, ブドウ糖の十二指腸内注入は門脈血糖値を上昇させ, 同時に肝ブドウ糖感受性求心線維の活動低下を起こす。また, 酪酸 Na 塩やインスリンも求心性活動の増強をみる, など LHA ブドウ糖感受性ニューロンとの類似性を指摘している。

山本は, ラットで味覚と摂食行動との関係を調べ, 皮質味覚野を破壊してもキニーネ溶液や, 高濃度食塩水に対する拒否行動は影響されない。LiCl の腹腔内投与により形成された特定の味覚に対する条件拒否行動は味覚野や扁桃基底核破壊で消失するし, 味覚野と扁桃基底核は機能的連絡している。味覚が摂食中枢の働きに直接影響するのでなく, 皮質-扁桃体の回路を介して間接的に摂食中枢に作用するようである。

高木は, 無麻酔ウサギで LHA ニューロンには胃の拡張あるいは縮小に一過性に活動上昇するものがある。またにおい刺激で, 胃を拡張すると4種のおいに応じたものが5種以上に応じたり, 逆に減少したりする。また大部分のユニットは拡張前と後では nonlinear な濃度-反応曲線を示す。以上の結果は嗅覚刺激が量的質的にも LHA ニューロン活動を変化させることを意味し, 嗅覚と摂食行動が密接に関係していることを示している。ちなみに前頭眼窩回のおい識別野と考えられるところは LHA からの投射を受けている。

岩井は、視覚刺激と摂食行動の関係についてサルでの実験結果を述べた。下部側頭回摘除サルは多対物体弁別学習で顕著な障害を示すが、一対の物体弁別という簡単な学習では、軽度の障害しか示さない。また、正の強化がえられる正刺激と負の強化がえられる負刺激の一方を別の刺激で置換するテストで、下部側頭回摘切サルは、正刺激を中間刺激に置換すると障害を示すが、負刺激を新たな負刺激で置換しても障害されなかった。一方、扁桃体の破壊実験からみて、ここは下部側頭回と連絡しているが、食物性・非食物性の区別をあまりしていないようである。これらより下部側頭回は視覚像と食物像との連合機構に密接に関与していることを示唆している。

5人の演者の発表後総合討論に移り、脳内血液の化学環境の変化が摂食行動の開始あるいは停止を起こすほど変化するか、また LHA 化学感受性

ニューロンが実際に摂食を調節している証拠はあるか、との質問に対し、食後の血中ブドウ糖濃度の上昇は VMH ニューロンの活動を促進し、また LHA ニューロンの活動を低下させ摂食を停止するに充分である、と司会の大村から説明があった。また LHA の化学感受性ニューロンだけがバー押しに反応するところから、このニューロンと行動との密接な関係がうかがえると、小野から説明があった。その他、空腹感と食欲との関係、LHA 化学感受性ニューロンと肝臓内ブドウ糖感受性求心線維のコーディング機構、各種中間代謝物質と上記ニューロン活動との関係など活発な討論が行われた。この討論を通して、空腹感の認知、味覚、嗅覚、視覚などと空腹感や満腹感との関連など、今後の研究に待たなければならない多くの問題が含まれていることも改めて感じられた。午後4時30分盛会のうちに終了した。

〔会 報〕

日本生理学会昭和54年度第1回常任幹事会議事要録

日 時：昭和54年4月3日 午後2時30分～6時30分

会 場：東京慈恵会医科大学 高木会館5階B会議室

出席者：加藤正道，鈴木泰三，田崎京二，本間三郎，高木貞敬，川上正澄，石河利寛，伊藤正男，星 猛，真島英信，塚田裕三，島津 浩，佐藤昌康，古河太郎，内藺耕二，御手洗玄洋，大原孝吉，宮川 清，岩間吉也，井上 章，岡本彰祐，中山昭雄，及川俊彦，松本淳治，大村 裕，後藤昌義，額額教三，増田 允，酒井敏夫

勝木保次（生理科学研究連絡委員会委員長）

名取礼二（日本生理学史編集委員会委員長）（以上31名）

議 長：酒井敏夫（当番幹事）

1. 報 告

1. 庶務報告（伊藤庶務幹事）：昭和53年4月より現在に至る会員の移動は入会150名，退会86名（死去8名）で，現在の会員総数2,817名，評議員総数781名，特別会員19名である（表1），またこの間に緒方維弘特別会員の逝去があり，学会より弔礼を行った。

佐々木祐治氏（編集校正係）が昭和53年12月31日引退された。日本学術会議第7部会報に日本生理学会の活動に関する原稿を送った。鹿児島大学医学部，福島医科大学より教授候補の推薦依頼があり，真島委員長と相談の上，助教授・講師リストを作製，それぞれに送った。JJJ編集委員会委員選挙の結果，高木貞敬（感覚生理），入沢 宏（心臓脈管生理），中山昭雄（環境生理），渡辺 昭（興奮性膜生理）の諸氏が編集委員として選出された。本学会は，第3回国際睡眠学会，第10回国際脳波臨床神経生理学会議に対し，後援団体として参加することになった。山田財団研究助成金に推薦した3名の会員のうち，高橋国太郎氏の分（200万円）が採択され，昭和54年度朝日学術奨励金応募には川合述史会員を推薦した，など報告された。

2. 会計報告（星会計幹事）：昭和53年度の決算報告がなされ了承された（表2）。

3. 日本生理学雑誌編集報告（塚田編集幹事）：日本生理学雑誌昭和53年度における編集状況は次の通りであった。40巻1～12号（8・9号合併学会号），発行11回，総頁数626頁（内訳，原著6編，短報11編）。41巻については40巻の総目

次が41巻1号に入り，現在3～4号までの編集は完了，5～6号は準備中，査読中のもの原著2編，短報2編である。本年度の学会号は英文オフセット版として発行することが報告された。なお業績表題集の掲載が有料になったが，その支払には御協力を願いたい旨依頼がなされた。

4. JJP編集会計報告（真島委員長）：JJJ編集委員改選の結果，吉村寿人，勝木保次両委員に代って高木貞敬，中山昭雄の両委員が加わり，真島委員長が委員長に互選された。29巻より原著の性格のShort Communicationの掲載を開始した。昭和53年度JJJ編集決算，昭和54年度予算案および刊行状況の説明がなされ了承された（表3，4，5）。

5. 教育委員会報告（大村委員長）：文部省への生理学学生実習充実にする要望書提出後，医学教育課より各国立大学医学設備費に対する200万円の増額を行う旨回答があった。この件に関し，各大学において対応策を考えられたい。生理学実習書の紹介をプダベストのIUPSで行うための英文小冊子の作製，生理学実習講習会開催，科研費総合研究Bへの応募などの活動を計画している。

6. 会則委員会報告（島津委員長）：会則第五条の末尾に「名誉会員は，本会に多大の貢献のあった外国人で，評議員会から推薦され総会の賛同によって定められる。名誉会員の会費は免除される」と追記することが適当である。

7. 研究費委員会報告（田崎委員長）：特別報告事項なし。

8. 昭和53年度科学研究費配分結果報告（佐

藤委員長): 前常任幹事会で行ったので特別報告事項なし。

9. 教授候補者推薦委員会・評議員選考委員会報告(真島委員長): 生理学会へ鹿児島大学、福島医大より教授候補者推薦の依頼があったため、本委員会は大学関係の生理学助教授、講師名簿を作製、その取扱いを庶務幹事に一任した。1979年度新評議員推薦者は全員その内容が十分満たされている。また、本委員会の任務より、教授推薦を除き、評議員選考のみとした。

10. 交流委員会報告(内菌委員長): 交流委員会委員数を縮小することにつき前回の常任幹事会で了承をえたが、その実施については今回は審議未了となった。そのほか最近の生理学研究所の人事ならびに事業内容について報告があった。

11. 国際交流委員会報告(本間委員長): 中間報告案を作成し、この案について討議した。

12. 国際生理科学連合および生理科学研究連絡委員会報告(勝木委員長): 1980年ブダペストで開催される第20回 IUPS 大会について ①予備登録の状況 ②Second announcement 発行日 ③Registration 締切日 ④名簿訂正 ⑤理事任期などの説明・報告があった。

13. 日本生理学史編集委員会報告(名取委員長): 東北大、東大、九大などまだすんでいない所をできるだけ早く完成したい。

14. 第57回(昭和55年)日本生理学会大会に関する報告: 岡本幹事より神戸大学にて明年3月末に開催すべく準備を進めるとの挨拶があった。

15. 日本医学会報告(真島幹事): 第20回日本医学会総会が、学術講演、総合医学展示の二本立で、4月4日より開かれること、日本医学会は医学用語辞典作製の意向があることが報告された。その後伊藤庶務幹事より日本医学会開催年における日本生理学会大会の当番幹事の1名を分科会長として任命する必要があるとの意見が述べられた。

Ⅱ. 議 題

1. 前回の議事録が承認された。

2. 昭和54年度予算案が星幹事より提出され承認された(表6)。日生誌校正係であった佐々木祐治氏へ謝礼金5万円を支給することが承認された。

3. 準会員(購読会員)の年会費の値上げを

検討したい旨提案され承認された。また2年以上の会費滞納者に対してはその会員としての資格を失ったものと認め会誌の配布を停止することが星幹事より提案され、承認された。

4. 特別会員推薦について: 斎藤幸一郎会員について川上幹事、松田幸次郎会員について星幹事よりそれぞれ経歴、業績の説明があり、特別会員に推薦したい旨発言があり、審議の結果推薦することとなった。

5. 生理学用語委員会委員長の指名について: 前会の常任委員会で市岡正道評議員が委員長に指名されたが、その後辞退の申し出があった旨伊藤幹事より報告され、指名取り消しが承認された。新しい委員長の選出について議された結果、酒井幹事が指名された。

6. 交流委員会の改選に関しては次回まで延期することとなった。

7. 選挙管理委員会の常置について: 伊藤幹事より次回常任幹事選挙の時から常置委員会として同委員会を発足させたいとの提案があり了承された。

8. 評議員選考、教授候補推薦委員会の名称変更の件: 今後教授推薦委員会を廃し、評議員選考委員会のみとすることが承認された。委員会提出の1979年新評議員候補者リストが承認された(表7)。

9. 昭和54年教育委員会の活動計画: 生理学実習書の英文小冊子作製に対し国際交流基金より20万円の補助を行うことが承認された。

10. 国際交流委員会の活動計画: 中間報告で提案された国際交流事業案の中 ①国際生理科学連合への援助 ②国際生理科学会議に対する代表の派遣 ③外国人学者の招へいの三項目が了承された。

11. 会則委員会より提出された名誉会員(外国人)に関する会則改正案は、案文のまま会則第五条末尾に入れ総会に附議されることが了承された。

12. 日本生理学会大会において発表するための資格について議され、日本生理学会の会員であることが必要であるとの統一見解が採択された。

13. 第58回(昭和56年)日本生理学会大会は、徳島で開催したい旨松本幹事より提案があり、承認された。

第56回日本生理学会評議員会および総会議事要旨

日 時：昭和54年4月5日 午後4時10分～5時30分

会 場：東京慈恵会医科大学中央講堂

出席者：約400名

議長団：増田 允、酒井敏夫（当番幹事）

議長は開会にあたって、本生理学大会に関する企画、運営についての説明を行い、今回のシンポジウム、展示並びに一般口演の座長担当者に謝意を表した。評議員会、総会を並行して行い、必要に応じてそれぞれの議事内容を随時切り換えて審議することを提案し了承された。

1. 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、評議員数及び特別会員について報告がなされた（表1）。

2) 昭和53年度会計決算報告（星会計幹事）：昭和53年度の決算報告がなされた承された（表2）。

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40巻（昭和53年度）の編集内容は次の通りであった。40巻1～12号（8・9号合併学会号）、発行11回、総頁数626頁。次いで41巻の編集進行状況の説明があり、第40巻総目次は第41巻1号に入ったこと。3～4号はすでに編集が完了していること。本年度の学会号は英文オフセット版として発行すること。業績表題集が有料になったが、その件については御協力を願いたいことなどが報告された。

4) JJP編集会計報告（真島委員長）：JJP編集委員改選の結果、吉村寿人、勝木保次両委員に代り高木貞敬、中山昭雄の両委員が加わり、真島委員が委員長となった。第29巻より原著的性格のShort Communicationが掲載されることになった。次いで、昭和53年度JJP編集決算、昭和54年度予算案および刊行状況の説明が行われた（表3、4、5）。

5) 教育委員会報告（大村委員長）：文部省への生理学学生実習充実にする要望書提出後の医学教育課の反応につき報告があり、各大学に対しその対策を考えるよう要望された。教育委員会今後の活動としては生理学実習書を英文パンフレットとしてブダペストのIUPSへ提出するなどの事業を行いたい。

6) 会則委員会報告（島津委員長）：名誉会員（外国人）に関する会則改正案「名誉会員は、本会に多大の貢献のあった外国人で、評議員会から推薦され総会の賛同によって定められる。名誉会員の会費は免除される」の提案があった。

7) 教授候補推薦委員会、評議員選考委員会報告（真島委員長）：鹿児島大、福島医大より教授候補者推薦の依頼があったが、委員会は生理学助教授、講師名簿を作製、その取扱いを庶務幹事に一任した。1979年度新評議員推薦者は全員その内容が十分満たされている。委員会名称変更に関して、今後は教授推薦委員会は廃し、評議員選考委員会のみとする提案があった。

8) 交流委員会報告（内園委員長）：交流委員会委員数減少についての意向が述べられた後、生理学研究所の人事ならびに事業内容の説明があった。

9) 国際交流委員会報告（本間委員長）：国際交流事業の中間報告があり、この中の一部は実施可能であることの説明がなされた。

10) 国際生理科学連合および生理科学研究連絡委員会報告（勝木委員長）：第20回IUPS大会（Budapest）に関連して、名簿訂正、演題締切期日などの説明、理事任期についての報告がなされた。

11) 日本生理学史編集委員会報告（名取委員長）：完成への協力が要請された。

2. 議 題

1) 昭和53年度決算ならびに昭和54年度予算案に関する件：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。

2) 会則変更の件：会則委員会より提案のあった外国人会員に関する「名誉会員は、本会に多大の貢献のあった外国人で、評議員会から推薦され総会の賛同によって定められる。名誉会員の会費は免除される」は評議員会の議を経て総会の承認がえられた。

3) 特別会員推薦について：富田恒男，斎藤幸一郎，松田幸次郎各会員の特別会員推薦につき塚田教授，川上教授，星教授よりそれぞれ推薦の辞がのべられたあと，評議員会より推薦することが承認され，更に総会の賛同をえた。

4) 新評議員について：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。

5) 生理学用語委員会の再編成について：生理学用語委員会の再編成のため常任幹事会は委員長として酒井敏夫幹事を推薦する旨提案され承認された。

6) 教授候補推薦委員会・評議員選考委員会の名称変更について：真島委員長の提案による名称変更の件を了承し，今後は評議員選考委員会とすることになった。

7) 日本医学会評議員の選出について：伊藤庶務幹事より真島幹事を推薦した旨報告され総会の承認をえた。

8) 日本医学会連絡委員の選出について：伊藤庶務幹事より酒井幹事を推薦した旨報告され，評議員会の賛同をえた。

9) 第57回日本生理学会大会に関する件：神戸大学 須田 勇，岡本彰祐，埴 功 三教授が当番幹事として第57回日本生理学会大会を開催することが承認され，岡本教授から開催に関する挨拶があった。

10) 第58回日本生理学会大会に関する件：伊藤庶務幹事より昭和56年 第58回日本生理学会大会開催候補地として徳島大学が挙げられ，松本教授の説明を受けたのち総会の承認をえた。

別表 1. 日本生理学会庶務報告

(昭和53年12月末現在)

会 員 総 数	2,817名
評 議 員 数	781名
特 別 会 員	19名

別表 2. 日本生理学会昭和53年度決算報告

(自 昭和53年1月1日)
(至 昭和53年12月31日)

		収 入			
		53年度予算	53年度決算		
①	前年度繰越金	2,524,300	2,524,300		
②	昭和53年度収入	16,370,000	17,012,375		
	(内 訳)			増 減	備 考
	会 費	11,800,000	12,030,763	+	2,324名
	購 読 料	1,300,000	1,252,000	-	191件
	論 文 掲 載 料	2,000,000	1,598,265	-	22件
	広 告 掲 載 料	800,000	1,105,600	+	11件
	会 誌 分 冊 売	40,000	55,210	+	27冊
	預 金 利 子	50,000	71,951	+	第一勧業銀行
	奨 励 金	100,000	100,000		日本医学会52年度
	印 税	100,000	369,105	+	生理学実習書
	そ の 他 収 入	180,000	429,481	+	生理学大会案内掲載料
①+②	合 計	18,894,300	19,536,675		
	差 額		642,375		
		支 出			
		53年度予算	53年度決算	増 減	備 考
	会 誌 印 刷 代	9,000,000	9,242,506	+	39巻11号～40巻10号
	通信及び発送料	2,600,000	2,347,297	-	39巻11号～40巻9号

編集会議費	60,000	48,148	－	会議 6 回
校正料	195,000	216,900	＋	日本生理学雑誌
原稿料	50,000	25,500	－	査読料
人件費	2,500,000	2,276,493	－	3 名
事務用印刷費	500,000	607,904	＋	印刷物, 封筒, コピー代
事務用雑費	80,000	84,510	＋	
交通費	500,000	525,020	＋	常任幹事会, 他
備品費	80,000	42,100	－	テープレコーダー, 他
事務室使用料	684,000	684,000		東洋文庫支払い 1 ～12月
職員健康保険	50,000	26,910	－	
会合費	100,000	102,042	＋	常任幹事会
渉外費	120,000	0	－	
委員会費	500,000	584,680	＋	委員会, 交通費も含む
積立費	100,000	100,000		職員退職金
予備費	1,000,000	187,487	－	IUPS 分担金, 供花
昭和54年度繰越金	775,300			
合 計	18,894,300	17,101,497		
差 額		1,792,803		
昭和54年度繰越金総額		<u>2,435,178</u>		

別表 3. J J P 53年度決算および54年度予算

(昭和54年 3月 6日)

	53 年 度			54 年 度		
	予 算 額	決算額 (見込)	摘 要	予 算	摘 要	
製 作 費	7,680,000	8,202,540	880頁 6 回	8,300,000	880頁 6 回	1.5%up
審査・英文校閲料	1,200,000	1,154,000		1,200,000		
旅 費・会 議 費	600,000	563,060		700,000		
通 信 消 耗 品 費	800,000	800,000		880,000		10%up
人 件 費	1,500,000	1,500,000		1,600,000		6 %up
雑 事 雑 費	600,000	600,000		640,000		6 %up
送 料 (外 国)	2,590,000	2,460,000		2,860,000		
送 料 (国 内)	1,500,000	1,632,800		1,715,000		
支 出 合 計	16,470,000	16,912,400		17,895,000		
国 内 会 員	3,660,000	3,720,000	620名 @6,000	3,780,000	630名 @6,000	
国 内 機 関	1,440,000	1,440,000	120名 @12,000	1,440,000	120名 @12,000	
外 国 購 読	6,480,000	5,940,000	500名 @220 54ドル	6,460,000	500名 @190 68ドル	
別刷バックナンバー	1,785,000	1,132,600		1,350,000		
文 部 省 助 成	3,000,000	4,720,000		4,720,000		
繰 越 金	105,000	105,000		145,000		
収 入 合 計	16,470,000	17,057,600		17,895,000		
差 引 繰 越		145,200				

別表 4. JJP 刊行状況 (Vol. 28, No. 6) 刊行部数 1,300部

個人購読	620	}	747
団体購読	120		
国内寄贈	7		
海外購読	500	}	517
海外寄贈購読	17		

別表 5. JJP 原稿投稿状況

(昭和54年 3月10日現在)

昭和53年 3月末日原稿手持ち数													34 a)
	'78 Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	'79 Jan	Feb	Mar	Total
受 理 数	8	4	9	6	6	5	11	8	4 _{うち S1}	4	11 _{うち S1}	3	79 b)
掲 載 数	10		10		10		11		11		9		61 c)
返 却 数		1		2			1	1	2				7 d)

3月10日手持ち数: (a+b)-(c+d)=45

(内 訳)

掲 載 可 12

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審査訂正中 33

計 45

別表 6. 日本生理学会昭和54年度予算

(自 昭和54年 1月 1日)
(至 昭和54年12月31日)

収 入

① 前年度繰越金 2,435,178

② 昭和54年度収入 16,420,000

(内 訳)

会 費	12,080,000	備考 (会費 5,000円 90%)
購 読 料	1,100,000	(学校, 図書館, 研究所等 90%)
論 文 掲 載 料	1,500,000	
広 告 料	1,000,000	
会 誌 分 冊 売	40,000	
預 金 利 子	50,000	(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)
そ の 他 収 入	300,000	生理学大会案内掲載料

①+② 合 計 18,855,178

支 出

(内 訳)

会 誌 印 刷 代	9,000,000	備考 (40巻11号~41巻10号)
会 誌 発 送 料	1,400,000	(40巻10号~41巻10号)

編集会議費	60,000	(日本生理学雑誌)
校正料	220,000	(日本生理学雑誌)
原稿査読料	30,000	(日本生理学雑誌)
事務室使用料	696,000	(54年1月～12月)
通信費	1,100,000	(会誌外通信)
事務費	850,000	(印刷物, 封筒, コピー代)
備品費	70,000	
会合費	250,000	(常任幹事会, 委員会)
旅費	900,000	(常任幹事会, 委員会)
講演謝金	90,000	(外人講演3名分)
人件費	2,000,000	
職員健康保険	50,000	
職員退職金積立	100,000	
国際交流基金	800,000	
雑費	50,000	
予備費	1,189,178	
合計	18,855,178	

別表 7. 日本生理学会新評議員 (1979年度)

計37名 (五十音順)

氏名	所 属	現 職
青 峰 正 裕	九大, 医, 生理, 助手	
赤 池 忠	名大, 医, 生理, 助手	
浅 野 泰	自治医大, 内科講師	
朝 山 正 巳	愛知医大, 生理, 助教授	
有 田 彰	埼玉医大, 生理, 助手	
伊 藤 宗 之	愛知県心障者コロニー室長	
石 川 洋 蔵	阪大, 医, 生理, 助手	
磯 部 芳 明	名古屋市大, 医, 生理, 助手	
植 木 キ ク 子	東京女子医大, 生理, 助手	
上 田 至 宏	阪大, 医, 生理, 助手	
遠 藤 政 夫	東北大, 医, 薬理, 助教授	
小 野 憲 爾	長崎大, 医, 生理, 助教授	
奥 田 宣 明	名古屋市大, 医, 生理, 助手	
蟹 池 健 一	近畿大, 医, 生理, 助教授	
金 田 能 子	金沢医大, 医, 生理, 助手	
鬼 頭 昭 三	広島大, 医, 内科, 教授	
久 田 研 二	鳥取大, 医, 生理, 講師	
高 坂 新 一	慶大, 医, 生理, 助手	

佐々木貞雄	阪大, 医, 生理, 助手
鈴木理文	神奈川歯大, 生理, 助教授
田端孝義	東北大, 歯, 生理, 助手
高田真理	埼玉医大, 生理, 助手
名津井悌次郎	帝京大, 医, 生理, 助教授
中瀬雄三	和歌山県立医大
長池一博	慶大, 医, 助手
永吉道子	名古屋保健大, 慈医研, 助手
野田行文	中外製薬総研研究員
林 治 秀	東京医歯大, 歯, 助手
林 田 嘉 朗	大阪市大, 医, 生理, 助手
原 田 邦 彦	東京慈恵医大, 講師
古山富士弥	名古屋市大, 医, 助手
本間生夫	東京慈恵医大, 助手
宮崎俊一	自治医大, 助教授
宮本嘉巳	北大, 応用電研, 助教授
元村成	東北大, 医, 薬理, 助手
八谷アツ子	九大, 医, 生理, 助手
岡田安弘	都神経研, 神経生化学, 副参事研究員

学 会 事 務 局 よ り

1. 昭和54年度会費 5,000円を振込用紙(本号および1号に添付)または現金書留にてお払い込み下さい。特に前年度会費(5,000円)を未納の方は“至急に”お願いいたします。
2. 会員の住所変更・退会等の場合は、遅滞なく事務局あて、お知らせ下さい。
3. 入会または購読御希望の方は、所定の用紙にて、お申し込み下さい。用紙は、事務局にご請求下さい。

〒113 東京都文京区本駒込 2-28-21

東 洋 文 庫 内

日本生理学会事務局

振替口座東京 3-86430

電話 (03) 945-2840



昭和52年度版会員名簿が若干ございます。

会員でご入用の方は 200 円切手同封の上事務局までお申し込み下さい。

〔編集後記〕

大会号をお届けします。紙面は一新され、英文オフセット印刷となりました。初めてのことでありますので、ここに到るまでのうら話でも御披露いたします。

昨年春の編集委員会であります。「大会号の抄録は英文にしたらどうでしょうか、そうすれば国際的なものにもなりますし」、「それならオフセットですね」、「だけどちゃんとタイプ打ってくれるかな?」、「もう日本ではどこへ行ってもカーボンリボンはあるでしょう」、「それに校正しなくてもいいから早く発行出来ます」、「その線で行きましょう」というスタートでした。

さて、ここは慈恵医大の大会々場です。

「受付の皆さんへ注意します。演者の人がこのタイプした紙を持って来ます。大変大切なものですから、持つ時は必ず手袋をして下さい」。大会も終り最後の後かたづけをしました。「今日は抄録に通番号をふり、目次用の原稿は順番に台紙に

貼り付けて下さい」。

「あの一、この抄録、題も名前も所属もないんですけど」、「電話して打ち直して送ってもらいましょう」、「アッ、やぶけちゃった。でもなんとかかな。ピタッと合わせてテープを貼ればOKだ」。なんとか無事大会の仕事も終り、株式会社慈恵生理企画は解散になりました。

学会事務局への大会号の打合せに行った帰りの駒込駅のホームです。「暑いなー、索引カードは大切だからこの袋に入れておこう。アッ、カードを落した!」400枚以上のカードは丁度入って来た山手線にあおられ、一部は50m先の線路上まで持って行かれてしまったのです。「すみません。あそこの紙ひろっていただきたいのですが、大切な紙なのです。」「あれですか、はいはい」駅員さんは快くとってくれました。なんとか回収出来たようでした。皆様、御自分のお名前、索引に出てますでしょうか?

7月の大会号の編集委員会です。「結局、和文、英文目次と人名索引は版をおこさなければなりま

せんね」。「思ったより手間がかかりますね」。「それに英文目次の原稿は、題、人名、所属の打ち方がまちまちです。手本のように打ってないのが沢山あります。印刷にまわす前に直しましょう。」
「訂正が多いのは赤ばかりでわからなくなりそう
だ。もう少し注意して打ってくれたらなー」。

7月末に鶴岡印刷に原稿をわたした時にはホッとしたのでした。

今回はシンポジウムのまとめを座長の方々に御

執筆いただき、ブルーページも大変読みごたえのあるものになりました。また、この大会号の抜刷りは1題につき30部御要望に応えられます。英文抄録発行記念大バーゲンとして、特別価格500円です。ので、どしどし学会事務局までお申し込み下さい(詳細は6号199頁)。

夏バテでいつも以上に思考力も衰えておりますので、お粗末なドキュメンタリーもどきで御勘弁いただきます。
(馬詰良樹)

編 集 委 員

塚 田 裕 三 (幹 事)	馬 詰 良 樹	植 村 慶 一
大 島 知 一	上 山 章 光	中 村 嘉 男
菅 野 富 夫 (北海道)	中 浜 博 (東 北)	新 島 旭 (関 東)
角 忠 明 (中 部)	品 川 嘉 也 (近 畿)	村 上 憲 (中・四国)
河 田 溥 (九 州)		

静動協の受託試験研究所

医薬，食品添加物，農薬，化粧品，化学物質等の諸物質に関する安全性試験をお引受けいたします。

生産から試験終了まで、一貫してSPF施設で実施

＜ 受 託 項 目 ＞

- | | |
|----------|----------------|
| ◇ 一般毒性試験 | ◇ 催奇性試験 |
| ◇ 発癌性試験 | ◇ 世代試験 |
| ◇ 刺激性試験 | ◇ 組織標本の作成並びに検査 |



株式会社 生物科学技術研究所

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Technical Research Laboratory of Biological Science Co.,Ltd.

Barrier System (SPF) 実験動物の生産販売

SPF 動物

クローズドコロニー

マウス Slc :ddY	(国立予衛生研究所)
マウス Slc :ICR	(Charles River Lab.)
マウス Slc :C3H/He	(東大医科学研究所)
マウス Slc :C57BL/6	(")
マウス Slc :DBA/2	(")

近交系

マウス BALB/cCr Slc	(東大医科学研究所)
マウス C57BL/6Cr Slc	(")
マウス C3H/He Slc	(")
マウス DBA/2Cr Slc	(")

交雑群

ラット Slc :SD	(Charles River Lab.)
ラット Slc :Wistar	(東大医科学研究所)
ラット Slc :Wistar/ST	(")
ラット Slc :Fischer	(Charles River Lab.)
ラット HOS®:Donryu	(星野試験動物飼育所)

マウス SLC-CDF ₁	(東大医科学研究所)
マウス SLC-BDF ₁	(")
マウス SLC-B6C3F ₁	(")

ミュータント

ヌードマウス BALB/c- ^{nu/nu} Slc	(東大医科学研究所)
ヌードマウス BALB/c- ^{nu/nu} Slc	(")

Conventional 動物

クローズドコロニー

マウス Std :ddY	(国立予衛生研究所)
ラット Std :Wistar	(東大医科学研究所)
ラット Std :Wistar/ST	(")

モルモット Std :Hartley	(国立予衛生研究所)
ハムスター Std :Golden	(")
イヌ FUJ:Beagle	(富士アニマル)

カニクイザル
アカゲザル 輸入検疫9週間経過後出荷



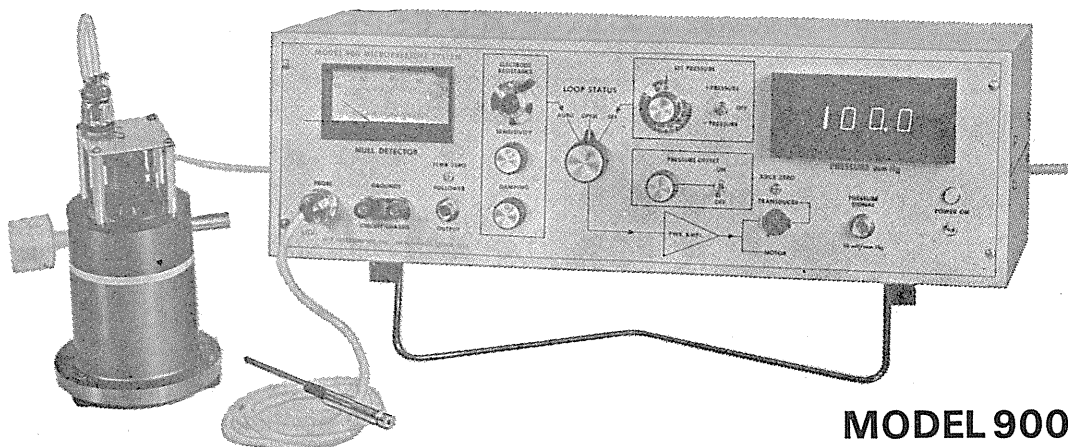
静岡県実験動物農業協同組合

〒435 静岡県浜松市小池町1616番地 TEL(0534)63-0865(代)

Shizuoka Agricultural Cooperative Association
for Laboratory Animals.

生体の微小圧力を正確にキャッチする全く新しいシステム!!

MP マイクロプレッシャー・システム



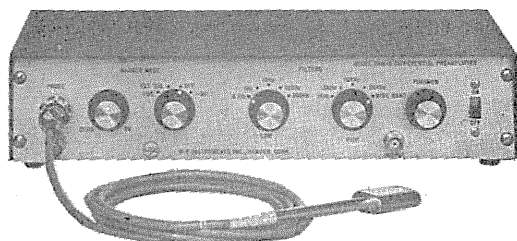
MODEL 900

本装置は、小さい組織・細胞の生体圧力を測定するためのシステムで、 $-70 \sim +100$ mmHgまで測定でき、精度は0.1mmHgと極めて高くなっています。

- 圧力と電位を同時に測定できます。
- センサーは2~3ミクロンの微小ガラス電極を使用。
- 腎尿細管、毛細血管、細胞等の圧測定に最適。

細胞外研究に最適の高性能アンプ

差動型交流増幅器



MODEL DAM-5A

本装置はユニット電位、細胞電位等の細胞外研究に適したバッテリー駆動の差動アンプです。

〈特長〉

- 超小型プローブとユニークなマーカ回路を装備
- 高入力抵抗、低ノイズ、高利得の高性能アンプ

〈仕様〉

- 利得：100~1000倍
- 入力抵抗：500M Ω 以上
- ノイズ：10 μ Vp.p以下
- 最大出力：10 V
- 電源：12 Vバッテリー(2ヶ)

薬物・色素の微量注入に便利なシステム

MICRO-IONTOPHORESIS PROGRAMMER MODEL 160

本装置は微小電極を通じて、薬物または色素をイオン電気導入法によって細胞内へ注入するための定電流発生装置です。

〈主な仕様〉

- モード：Eject 又は Retain
- 出力：0~100nA, 0~1000nA
- コンプライアンス：100 V



日本総代理店



株式会社 **東海医理科**
TOKAI IRIKA CO., LTD.

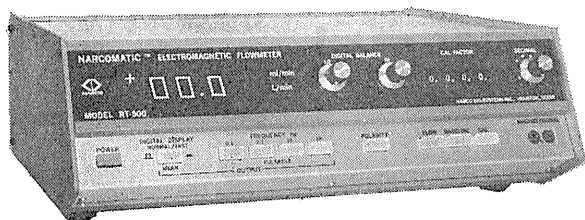
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営業所：大阪(06)787-0544/福岡(092)472-3800

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。

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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

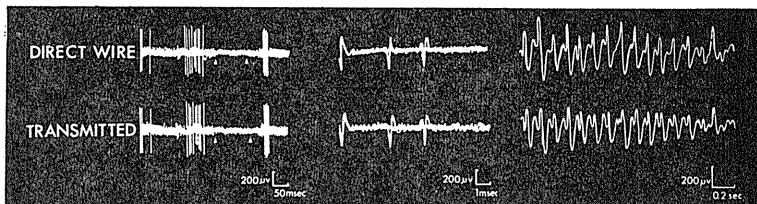
Miniature FM Transmitter

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。



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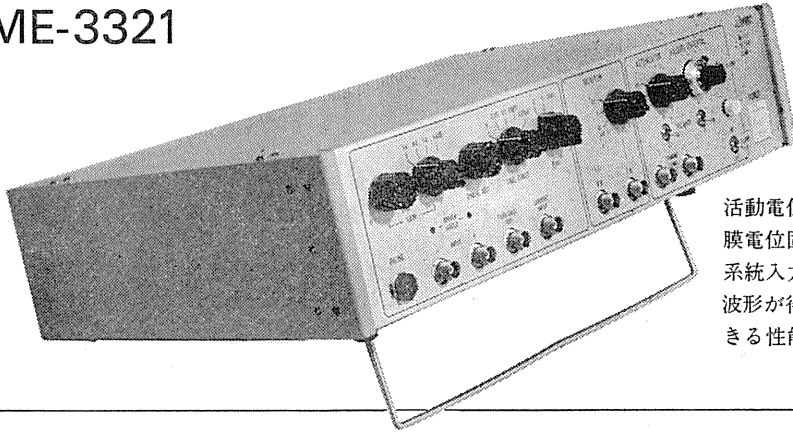
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膜電位固定法に必要な機能をフルに搭載

ボルテージクランプユニット

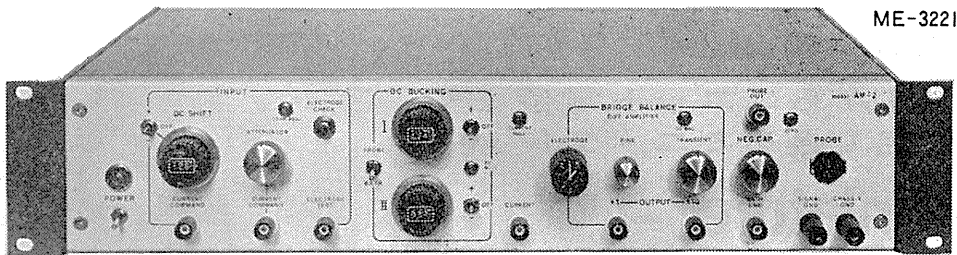
ME-3321



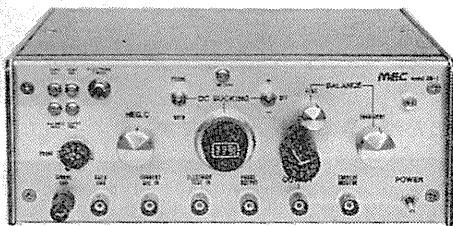
活動電位発生メカニズムを追求する膜電位固定法のための専用装置で、2系統入力を組み合わせた複雑なクランプ波形が得られ、高抵抗の電極を使用できる性能をもっています。

電極抵抗の高い実験にも抜群の威力

微小電極用増幅器 ME-3200シリーズ



ME-3221



ME-3211

ME-3221 通電回路・DCシフト・2ch DCバックキックつき

ME-3211 通電回路つき

- 細胞電位の研究をおこなうために特に設計された装置で、1000MΩまでと広範囲の電極が使用できます。
- 差動増幅器を内蔵しています。
- ME-3221は、色素注入が可能なDCシフトなど、高度な機能を盛り込んでいます。



株式会社

エム・イー・コマーシャル

本社：〒166 東京都杉並区和田3-54-11 ☎(03)317-1451(代表)

大阪営業所：〒564 大阪府吹田市江坂町2-2-20 ☎(06)380-2601(代)

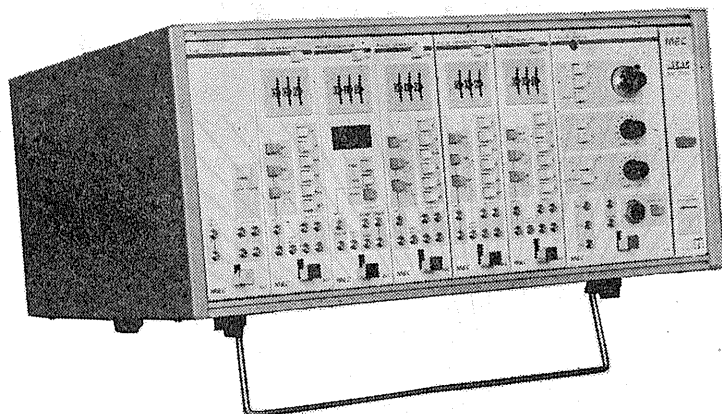
福岡営業所：〒814 福岡市西区茶山5-12-18 ☎(092)863-2757

工場：〒419-01 静岡県田方郡函南町平井597-2 ☎(05597)8-7658

ME機器の機能をシステムデザイン

MEAC

メアックシステム
ME-2100シリーズ



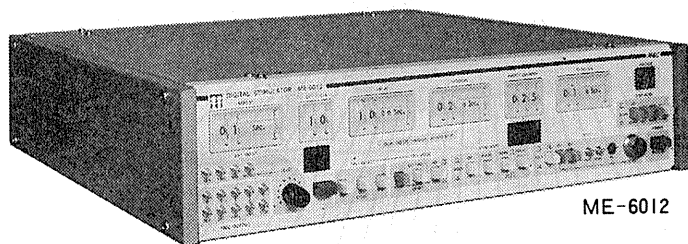
個々の装置として別れていた専用機能を有機的にユニット化し、用途に応じてひとつの装置として組みあげることができるシステムです。

★構成ユニット

- 301—トリガ
- 302—パルスジェネレータ
- 303—プリセットカウンタ
- 304—パワーアンプ-A
- 305—ステップパルスジェネレータ
- 306—プログラブルジェネレータ
- 307—タイムマーカ
- 308—パワーアンプ-B
- 309—オーディオモニタ
- 310—ウインドディスクリミネータ
- 311—マルチカウンタ
- 312—パワーアンプ-C

高度化する電気生理学に対応する

デジタル刺激装置 ME-6000シリーズ



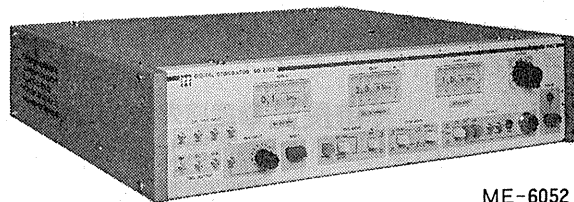
ME-6012

研究用高級機 ME-6012

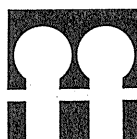
- 階段波やステップ波に至る4種の刺激電圧パターンを持っています。
- 各設定部をトリガで作動させることができ、豊富な刺激時間パターンをつくりだせます。
- 出力電圧がデジタル設定できます。

実用機 ME-6052

- 水晶発振子とデジタルスイッチの使用により、波形精度そのものは高級機と同一できわめて高精度です。
- 設定された時間間隔のダブルパルスが得られます。
- 外部装置との組み合わせが容易です。



ME-6052



株式会社

イム・イー・コマーシャル

本社：〒166 東京都杉並区和田3-54-11 ☎(03)317-1451(代表)
 大阪営業所：〒564 大阪府吹田市江坂町2-2-20 ☎(06)380-2601(代)
 福岡営業所：〒814 福岡市西区茶山5-12-18 ☎(092)863-2757
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0.7mm 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！

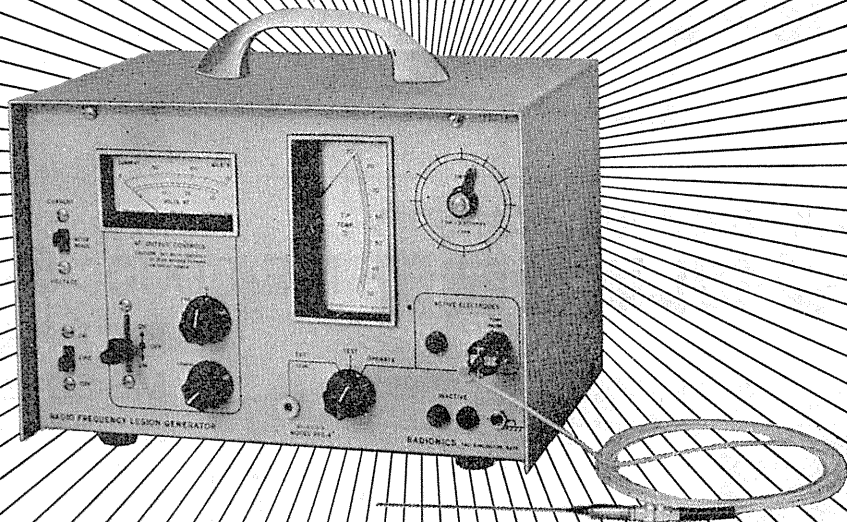
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動物用

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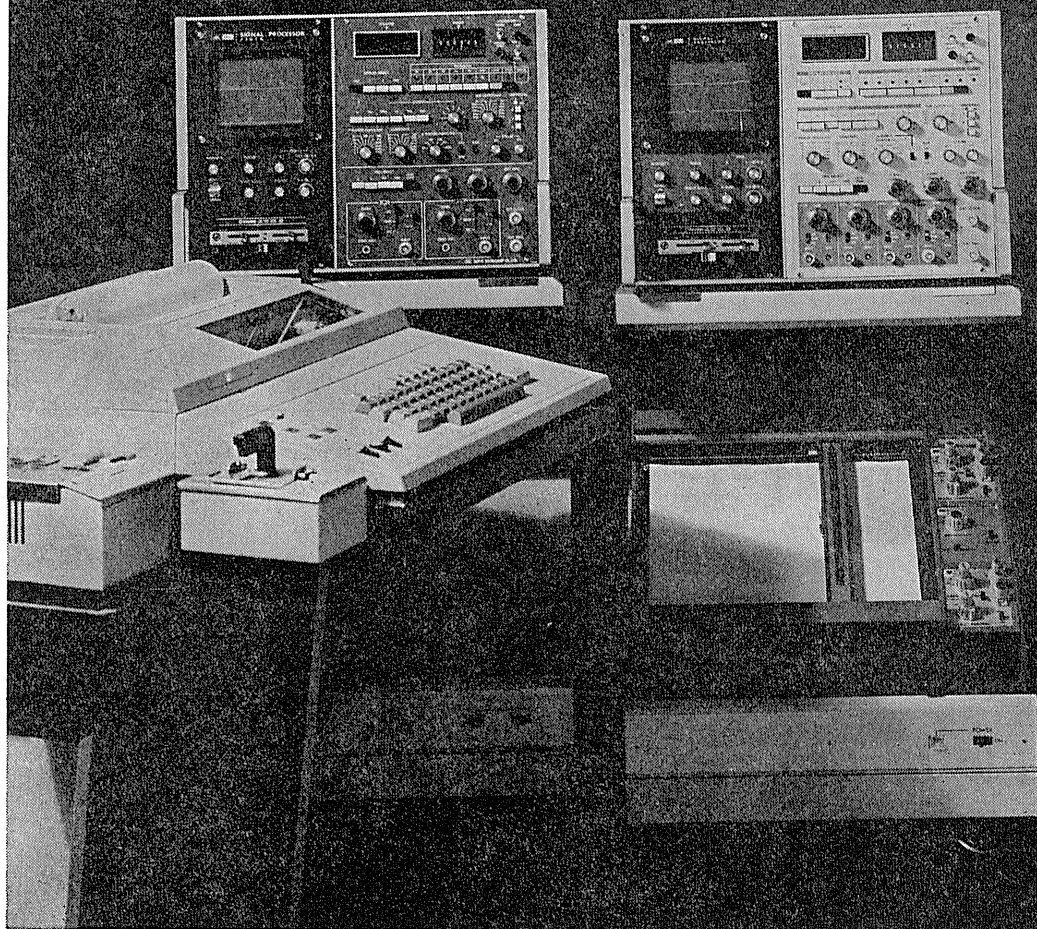
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ソフトウェアがさらに充実、処理プログラムは100種類を突破しました。メモリは最大16Kまで内蔵可能で、ほとんどのアナログデータの統計処理が可能です。

主なプログラム／アベレージ（アーチファクトクリア付、オルタネート加算、CNVなど各種）、パワースペクトル(2ch)、コリレーション、ヒストグラム及びバリエーション(各種)、フーリエ変換・逆フーリエ変換、回帰直線係数、スペクトルアレイ等。

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Integrative Control Functions of the Brain Vol. 1

—英文書—

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国際的に著名な伊藤教授を中心に文部省の特定研究をまとめた。わが国の脳神経学者を網羅し総力をあげて編集されたもので、各パートごとに総説を中心に10～25の最新報文を含み、編者のまとめが付される。

主要目次：1. Elementary Process of the Nervous System 2. Neural Mechanisms of Sensation and its Disorders 3. Motor Control and its Disorders 4. Central Nervous System Control of Cardiovascular and Respiratory Functions 5. Neural Control of the Digestive System 6. Neuroendocrine Control Mechanisms 7. Neural Mechanisms of Intrinsic Behavior; Sleep-Wakefulness Control 8. Brain Mechanisms for Learning and Memory

Minamata Disease

—Methylmercury Poisoning in

Minamata and Niigata, Japan.—

—英文書—

椿忠雄・入鹿山且郎編

150×225mm・328頁・7,000円

水俣病についての医学的な総合情報は、日本国内でも必ずしも充分であるとはいえなかった。本書は水銀の生体内代謝、環境での消長を軸として、疫学、神経医学、治療、リハビリテーションなどを含め、総合的に詳述した国際版である。

主要目次：1. History and Background 2. Pathology and Pathogenesis of Minamata Disease 3. Clinical Aspects of Minamata Disease 4. Countermeasures and Unresolved Problems Appendix: Concentration of Methylmercury by Organisms, Especially Fish, in the Agano River Subject Index

行動分析学

—行動と文化—

西川 泰夫著

A 5・218頁・1,800円

パブロフ、ワトソン、スキナーを原点とする現代行動分析学の成立とその内容を、基礎的な用語や概念の解説を含めて論述した入門書。さらに、個人行動と環境との関係、行動体系としての社会・文化の側面に光をあてる。

主要目次：1. 自らを問う 2. 行動の分析 3. オペラント行動 4. オペラント行動(その2) 5. 強化 6. 葛藤と欲求不満 7. 行動と文化 8. 行動分析学小史

行動生物学 (上・下)

R.A.ハインド著

桑原 万寿太郎・平井 久 監訳

行動学の最新の成果を集積し、人間の社会行動の生物学的基盤を全面にわたり解析した定本。心理・社会・生物・医学などでの教養書としての機能のほかに、そのダイナミックな内容は興味あふれる教科書として魅惑される。

上巻—A 5・296頁・2,300円

主要目次：セクションA 1. 動物と人間の行動 2. 社会行動とは何か セクションB 3. 動機づけに関する問題 4. 発達に関する問題 セクションC 5. コミュニケーションとは何か 6. 社会的なリリーサー 7. 社会的リリーサーの研究アプローチの限界 8. 信号機能に適合しない運動 9. 非言語的コミュニケーションの発達 10. 人間の非言語的コミュニケーション セクションD 11. 鳥類における社会行動の発達 12. 霊長類における社会行動の初期発達 13. アカゲザルにおける母子関係の推移 14. 母親以外の社会的な相手 15. 社会的初期経験がその後及ぼすある種の影響 257

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主要目次：セクションE 16. 攻撃行動 17. 攻撃行動の発達 18. 社会的な性行動 19. 社会的な性行動の発達 セクションF 20. 集団構造の問題 21. 群れの凝集と拡散; 利他主義 22. 順位 23. 構造の複雑性 24. 役割 25. 集団の空間関係 26. 集団構造における適応の相違

ライフサイエンスの英語論文

溝口 歌子著

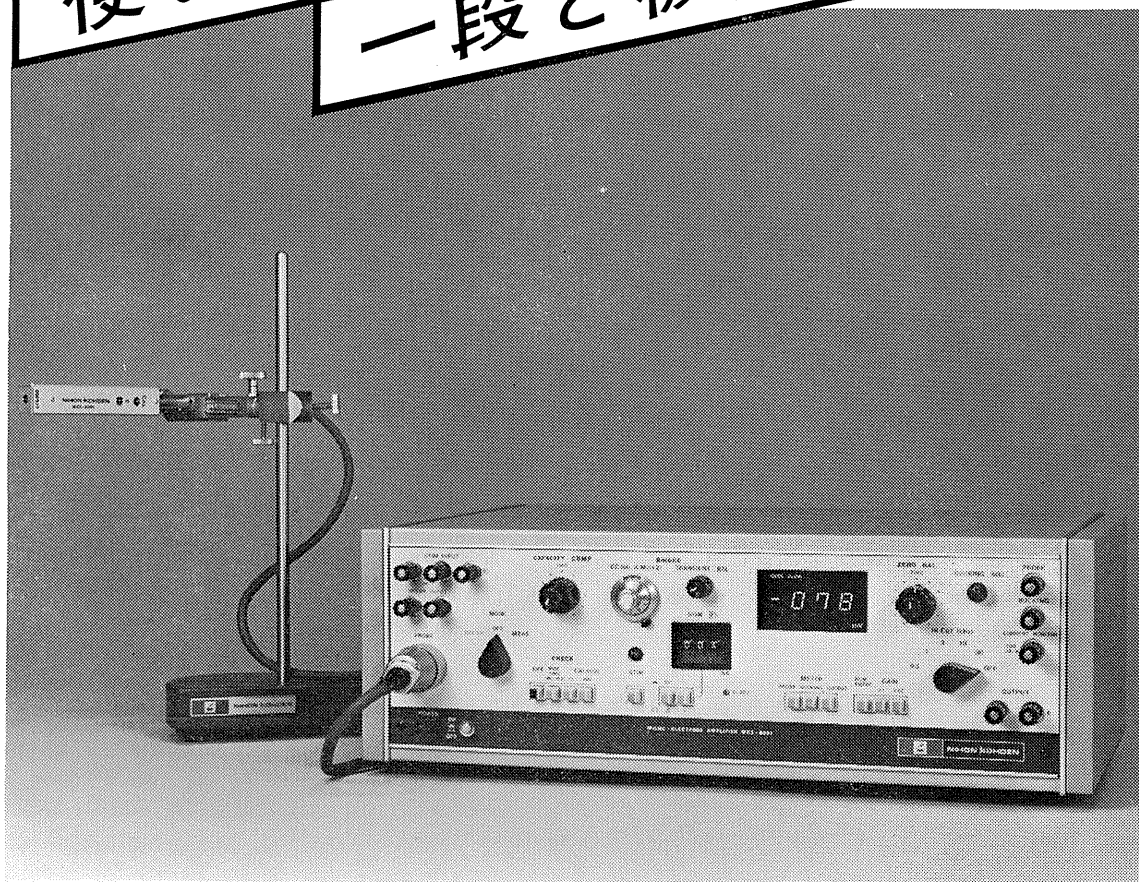
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演習 ライフサイエンスの英語

溝口 歌子監修・(財)国際医学情報センター編
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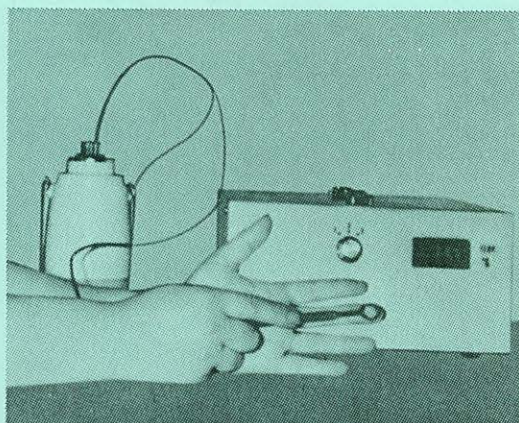
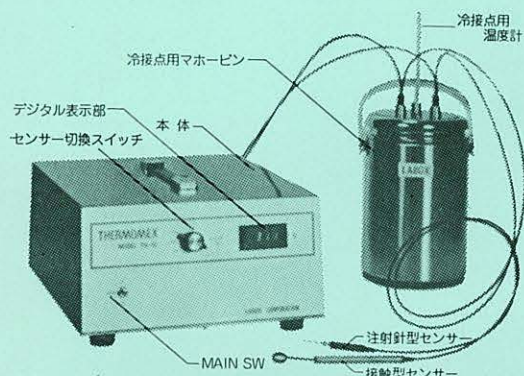
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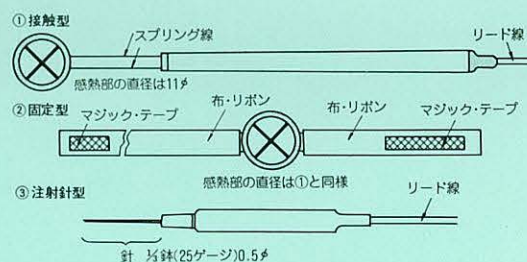
1秒以下で安定し正確に計れる KN-91瞬間表面温度計



各種の診断や、研究のために、人や動物の体のさまざまな部位の表面の温度、赤斑の温度、神経の作用による表面温度の変化等々瞬間的に表面の温度を測りたいという要望はたいへん多くなっています。しかし現実には、到達時間が長くなかなか安定しなかったり、温度精度が悪くおおざっぱにしか測れなかったり、あるいは、価格が高かったりなど、問題が多く、実用的な表面温度計はみられませんでした。今回夏目製作所から発売いたしますKN-91瞬間表面温度計は、それらの問題をすべて解決した素晴らしい製品として登場いたしました。

ハンディタイプで、氷と電源さえあれば、どこでも測ることができますし、温度精度は0.1℃、到達時間は1秒以下です。表示は、デジタル表示ですので、たくさんの人が同時に読みとることもできます。

センサーの形状は次の三種類です。



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 温度精度：0.1℃
 温度範囲：0～45℃
 到達時間：1秒以下
 温度補償：氷による
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