日本生理誌・第42巻8・9号・昭和55年9月1日発行（毎月1日発行）
〔昭和27年5月6日　第3種郵便物認可〕

ISSN：0031-9341

日本生理学雑誌

JOURNAL OF THE PHYSIOLOGICAL SOCIETY OF JAPAN

42巻　8・9号　1980

The 57th Annual Meeting of the Physiological Society of Japan

March 27-29, 1980

KOBE University・KOBE

生理学教育シンポジウム……397
＜生理学研究のあり方シンポジウム＞
話題Ⅰ．大脳生理学の在り方……402
話題Ⅱ．視細胞における光受容機構……403
話題Ⅲ．内分泌生理学の研究から……403
会　報
日本生理学会昭和55年度第1回常任幹事会議事要録……406
第57回日本生理学会評議員会および総会議事要旨……408
昭和54年度第3回日本生理学教育委員会議事録……413
お知らせ
Mountcastle 教授の来日について……414
第7回（昭和55年度）日産学術研究助成候補推薦要領……414
学会事務局より……415

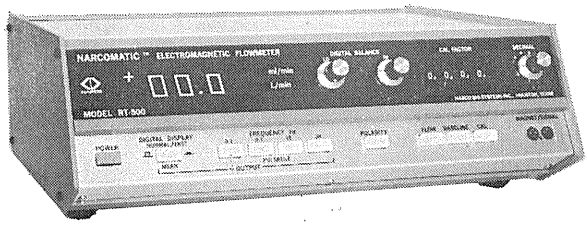
日本生理誌
J. Physiol. Soc. Japan

日本生理学会

NASAの技術を導入した未来のフローメーター登場！

NARCOMATIC電磁血流計

NARCO



RT-500

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

※カタログ等の御請求は本社医用電子課へ

《特　長》

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

日本総代理店

株式会社東海医理科
TOKAI IRIKA CO., LTD.

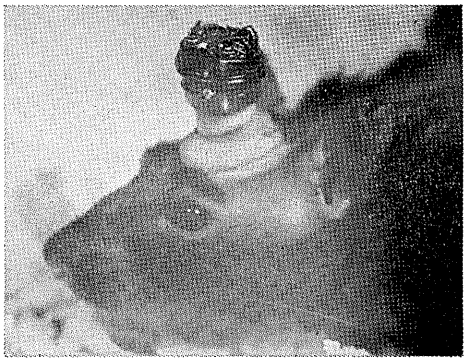
〒101 東京都千代田区内神田3-2-12クリハラビル ☎(03)254-0052㈹
札幌:(011)752-0176　北陸:(0764)78-5652　名古屋:(052)524-5408
大阪:(06) 787-0544　広島:(0822)93-2163　福　岡:(092)472-3800

米国MIDGARD社製

脳波からユニット電位まで
測定できるミニ・テレメータ

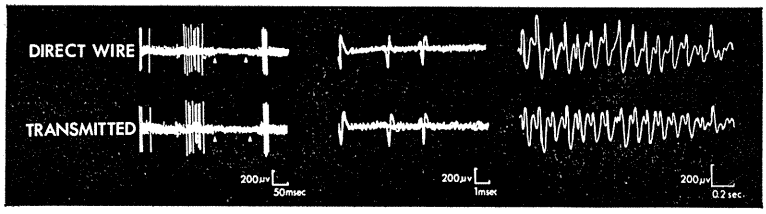
Miniature FM Transmitter

Model MXM-100



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

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



日本総代理店

株式会社東海医理科
TOKAI IRIKA CO., LTD.

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

第57回日本生理学会大会号目次

第57回日本生理学会大会記念写真……179
第57回日本生理学会大会を顧みて(当番幹事)……180
THE 57th ANNUAL MEETING OF THE PHYSIOLOGICAL SOCIETY OF JAPAN……181
Author's Index……385

1. 研究方法 (1—7)

1. 呈色反応による定量への色度座標系の応用. 秩父志行 (近畿大, 医, 第一生理) ……217
2. 微量液体の測定および記録法の再検討. 猪股孝四郎, 玉川恭子, 伊藤克之, 中村治雄*
(東園大, 歯, 生理・東園大, 歯, 口腔生理*) ……217
3. マイクロプロセッサを利用した刺激装置. 花井荘太郎 (保健衛生大, 医, 生理 I) ……217
4. 独立駆動マルチ微小電極法について. 相川貞男, 小林 勝, 太田和子*, 青木亨子*,
秋田久直*, 佐藤昭彦* (精研, 神経生理・北里大, 衛生, 生理*)……218
5. 表面筋電位処理による運動単位数の推定. 吉田正樹, 赤沢堅造, 藤井克彦, 彼末一之*
(阪大, 工, 電気工学・医, 第二生理*) ……218
6. パルス磁場勾配 NMR 法による筋細胞内分子拡散係数の測定. 吉崎和男, 瀬尾芳輝,
西川弘恭, 森本武利 (京都府医大, 第一生理) ……218
7. 透析定常法による酵素反応速度論. 橋本正史, 東 照正, 魚住光郎 (阪大, 医, 第一生理) ……219

2. 分子生理 (8—16)

8. Nernst-Planck-Poisson 方程式の有理関数解. 品川嘉也 (京大, 医, 第二生理) ……220
9. レーザー光散乱により調べた膵チモーゲン顆粒の性質. 藁科 彬 (新潟大, 医, 第一生理) ……220
10. 不均一系におけるスピン 3/2 核の核磁気緩和. 物井宏之 (東北大, 医, 第一生理) ……220
11. リン脂質膜 ^{31}P-NMR スペクトルの Simulation. 亘 弘, 西川弘恭*, 安里令人**
(生理研, 分子生理・京府医大, 第一生理*・京大, 医, 脳外科**) ……221
12. フラビンセミキノンの共鳴ラマンスペクトル. 二科安三, 志賀 潔, 亘 弘, 堀池喜八郎*,
東城博雅* (生理研・阪大, 医, 生化*) ……221
13. 変種フラビン (8-アミノフラビン) のπ電子構造について. 志賀 潔, 二科安三, 亘 弘,
堀池喜八郎*, 東城博雅* (生理研・阪大, 医*)……221
14. アルブミン電気泳動パターンにおよぼす各種タンパク阻害剤の影響. 川口孝義, 松下 宏
(和歌山医大, 第二生理)……222
15. ウシ血漿アルブミン (BPA) 分子内 SH, S-S 交換反応. 井上 洋, 恵良聖一, 長岡俊治,
曾我美勝 (岐大, 医, 第二生理)……222
16. ナノ秒螢光法による蛋白質-界面活性剤複合体の研究. 曾我美勝, 長岡俊治, 井上 洋,
恵良聖一, 芦田 広*, (岐大, 医, 第二生理・防衛医大, 第二生理) ……222

3. 細胞生理 (17—40)

17. マウス頭蓋骨由来細胞株 (MC 3T3) の樹立. 小玉博明, 天貝裕地, 葛西四朗 (東北歯大,
生理) ……223
18. 神経成長因子 (NFG) による副腎髄質細胞の神経様細胞への変化. 小川正晴, 浅見耕司,
入交昭彦, 石川知一*, 瀬口春道* (高知医大, 第二生理・第二解剖*)……223
19. マウス・マクロファージに対するカルシウムイオンの影響. Maria Ori, 柴 芳樹,
菅野義信 (広島大, 歯, 生理) ……223

20. 細胞間連絡とその形成過程に対する2，3の薬物の影響．榎本　平，柴　芳樹，菅野義信
(広島大，歯，口腔生理)……224
21. ラット肝上清中のオリゴヌレオチド性細胞増殖抑制因子について．畠瀬　修，倉光　誠，
松井秀樹，徳田雅明，高橋史生，堀　泰雄（岡大，医，第一生理）……224
22. ラット培養肝細胞の DNA 合成の誘起 (V)．長谷川薫，大竹英樹，古閑睦好（独協医大，
第一生理）……224
23. L細胞の細胞周期における ATP 水準と高分子物質合成について．山口久雄，米津武郎，
田辺伸悟，岡　芳包（徳島大，医，第一生理）……225
24. 胸腺液性因子（THF）によるT細胞系の分化を反映する新しいパラメーターについて．
木下喜博，木村修平，木村英一，中森　宏*（大阪市大，医，第二生理・大阪市大，医，
産婦人科*)……225
25. Spontaneous healing へ，Cortisone-Carnosine-system による生理学的アプローチ．
永井甲子四郎（日大，歯，生理）……225
26. 膵腺房細胞の電気生理：アミノ酸の作用．西山明徳，岩月矩之*（山形大，医，第二生理・
東北大，医，応用生理，ダンディー大，医，生理*)……226
27. 電子線照射X線微小部分析法による膵腺房細胞内元素分布．中垣育子，佐々木貞雄，
村上政隆，森　博彦，今井雄介，寺西伸介*，志熊道夫*（大阪医大，第一生理・外科*)……226
28. 刺激によって誘発される唾液腺組織 K^+ イオンの動的変化．加藤和雄，今野健也，西山明徳
(山形大，医，第二生理)……226
29. メチル水銀による組織呼吸に対する影響と Hg および K イオンの動きについて．大西瑞男，
松本保久*（鹿児島大，医，第一生理・国立水俣病研究センター*）……227
30. イモリ赤血球膜電位に対する Cl^- と温度の影響．福島真知世，河野貴美子，雪吹周秀
(日本医大，第一生理)……227
31. イカの星状神経節におけるタンパク質のリン酸化．堀江秀典，堀　英明，吉岡　亨，竹中敏文
(横浜市大，医，第一生理)……227
32. ^{31}P-NMR 法による神経細胞内リン化合物の種による比較研究．西川弘恭，吉崎和男，
森本武利，安里令人*（京府医大，第一生理・京大，医，脳外*）……228
33. 分離 neuron と glia 細胞群の環状 nucleotide 生成系の活性化の調節．難波経篤，
安藤正人，永田　豊，中沢欽哉*（保健衛生大，医，生理・京大，医，薬理*）……228
34. ラット顎下腺のホスホジエステラーゼについて．横山紀子，阿部まゆみ，古山俊介（日大，
松戸歯，生理）……228
35. 血清糖タンパク質に対するラット肝細胞リセプターの生合成．中田　博，沢村隆也，田代　裕
(関西医大，第一生理)……229
36. ミトコンドリア膜における蛋白-脂質相互作用．藤村博孝，中瀬雄三，玉井靖彦，辻本　毅
(和歌山医大，第一生理)……229
37. 脳チューブリンの螢光に対する SH 試薬の影響．坂井朗子，会沢勝夫，大畑　進，
山尾満里子*（東京医大，第二生理・大妻女子大，生物*）……229
38. Amino 酸の配列順序とその機能に関する一考察．大畑　進，会沢勝夫，坂井朗子，
北原正夫，佐伯美登里，山尾満里子（東京医大，第二生理）……230
39. 高速顕微ラマン分光法による生体膜からの β カロチンの検出．会沢勝夫，大畑　進
(東京医大，第二生理)……230
40. クロマフィン顆粒の誘電分散．浅見耕司，小川正晴，入交昭彦（高知医大，第二生理）……230

4. 膜の生理学 (41—59)

41. 腸管壁通過に関する研究-粘膜細胞膜面障害による影響. 中野昭一，吉岡利忠，成沢三雄，永見邦篤（東海大，医，応用生理）……231
42. 小腸および腎刷子縁膜における共輸送担体の分離精製に関する研究. 鹿野亜砂子，大沢一爽，星　猛（東大，医，第二生理）……231
43. 腎尿細管における p-アミノ馬尿酸分泌の α-ケトグルタール酸による促進作用. 林　曠（東北大，医技短大）……231
44. モルモット回腸におけるペプチド誘発（輸送）電位の性質. 日向正義，河原克雅，星　猛（東大，医，第二生理）……232
45. カドミウムによる蛙皮ナトリウム能動輸送の促進：カルシウム，アミロライドとの拮抗. 高田真理，林　秀生（埼玉医大，第二生理）……232
46. 腎尿細管細胞膜に対する Ca 効果. 小寺邦彦，窪田隆裕，本田　稔，内藤和世，藤本　守（大阪医大，第二生理）……232
47. プロスタグランジンの Cl 能動輸送抑制作用と c-AMP, Ca の役割. 斎藤禎隆，渡辺忠雄*（東北大，医，生理・眼科*）……233
48. 胃小胞体膜中の transport ATPase. 柏倉　正，森井孫俊，竹口紀晃*（富山医薬大・薬*）……233
49. HeLa 細胞の細胞膜 Rb^+ 輸送におよぼす Phenazine Methosulfate の影響. 宮本博司，酒井鉄博，池原敏孝（近畿大，医，第二生理）……233
50. 腎 Na^+, K^+-ATPase および HCO_3^--ATPase への PMS+NADH の影響. 蟹池健一（近畿大，医，第二生理）……234
51. 海水ウナギ腸の塩および水輸送におよぼすウアバインの影響. 安藤正昭（広島大，総合科研，動物生理）……234
52. Ouabain による insulin-stimulated Na efflux の抑制. 北里　宏，丸中良典，村山公一，西尾恭介（滋賀医大，第二生理）……234
53. 膵酵素分泌におよぼすウアバインの影響. 斎藤俊之（鳥取大，農，家畜薬理）……235
54. ラット横隔膜におけるアドレナリン過分極の機序. 能見光雄，久場健司（佐賀医大，医，第二生理）……235
55. 液体イオン交換性二連 pH 電極による細胞内 pH 調節機序の解明. 松村　裕，青木繁幸，梶野興三，藤本　守（大阪医大，第二生理）……235
56. 無 Na^+ 液によるネコ副腎髄質ホルモン放出機構. 反町　勝，西村茂人，山神和比己，大西瑞男（鹿児島大，医，第一生理）……236
57. 唾液腺分泌時の組織インピーダンス変化. 今井雄介，中張隆司，村上政隆，森　博彦（大阪医大，第一生理）……236
58. マウス顎下腺 Esterase 分泌様式の雌雄における相違について. 和泉博之，青木　健（東北大，歯，生理）……236
59. 膵腺房細胞の分泌反応，redox state および膜電位におよぼすアセチルコリン濃度の効果. 菅野富夫，葉原芳昭，斎藤篤志，米沢秀利（北大，獣医，生理）……237

5. 興奮性膜 (60—84)

60. 非対称容量性電流による Na チャネルの不活性過程. 村山公一，北里　宏，西尾恭介，丸中良典（滋賀医大，第二生理）……238
61. ホヤ分裂停止胚における K チャネルの発達. 高橋国太郎，山下直秀，吉井光信*（東大，医，脳研生理・日医大，第二生理）……238

62. 細胞内かん流法による単一神経細胞の Ca-activated I_K. 赤池紀扶，西　勝英（熊本大，医，第二薬理）……238
63. ザリガニ内側巨大神経細胞体の過分極応答. 有田　彰，林　秀生（埼玉医大，第二生理）……239
64. イソアワモチ神経節細胞の膜電位に対する Na および Ca イオンの効果. 後藤　司，安楽三男，橋村三郎（鹿児島大，医，生理）……239
65. カタツムリ神経細胞 bursting activity と細胞内蛋白. 小野塚実，古市浩康，岩田太一，菅谷英一，津田　整*，菅谷愛子*，阿相皓晃**，平野修助**（神奈川歯大，生理・城西大，薬学*・東邦大，医，第二生理**）……239
66. カタツムリ神経細胞 bursting activity とカルシウム. 古市浩康，小野塚実，小堀敏子，山田清隆，菅谷英一，津田　整*，菅谷愛子*（神奈川歯大，生理・城西大，薬学*）……240
67. 細胞内 Ca, Mg, Mn イオンに誘発された神経興奮. 山岸俊一，古家喜四夫，久木田文夫（生理学研究所）……240
68. Aromatic amino acid 誘導体の巨大神経細胞興奮性に対する作用. 竹内　宏，田村泰子（岡山大，医，脳研，機能生化）……240
69. TTX の光親和性標識試薬の合成とイカ巨大神経膜への作用. 堀　英明，堀江秀典，竹中敏文，吉岡　亨（横浜市大，医，第一生理）……241
70. ^{3}H-NAP-TTX の電気ウナギ電気器官の形質膜に対する結合能. 上原政治，植村慶一（埼玉医大，第一生理）……241
71. 培養神経細胞に対する細胞内骨格形成阻害剤の作用と細胞膜の活動電位. 福田　潤，亀山正樹（東大，医，第一生理）……241
72. カエル筋紡錘神経末端における 2 種類の膜電位振動. 伊藤文雄，藤墳規明，金子亘弘（名大，医，第二生理）……242
73. アメフラシの神経の長さについて. 小池宏之（東京都神経研，神経生理）……242
74. 感覚神経線維の直径と絞輪間距離の部位による変化. 山本　哲，坂田三弥（東歯大，生理）……242
75. ^{31}P-NMR 法による興奮性膜リン脂質の ordered structure の解析. 西川弘恭，吉崎和男，森本武利，安里令人*（京府医大，第一生理・京大，医，脳外*）……243
76. Grayanotoxins (GTX) の構造活性相関について. 瀬山一正（広島大，医，第一生理）……243
77. 半波正弦波過渡電位および電位勾配による筋抵抗容量の解析. 斎藤忠義（日本歯大，生理）……243
78. 筋直流分極の二つの指数函数による解析. 斎藤忠義（日本歯大，生理）……244
79. 培養骨格筋における活動電位の発達に関与する神経性因子について. 加濃正明，山崎捨夫，佐藤諦吉，山本三恵（北里大，医，生理）……244
80. 線維芽細胞の過分極性膜応答における Ca チャネルの役割. 岡田泰伸，土屋和興，八尾　寛，矢田俊彦，佐々木貞雄*，中垣育子*，今井雄介*（京大，医，第二生理・大阪医大，第一生理*）……244
81. 培養大脳皮質ニューロンの膜特性変化. 森　順子，芦田　広，丸　栄一，辰濃治郎（防衛医大，第二生理）……245
82. ザリガニ神経膜の粘弾性変化と興奮性との関連. 市川　修，三好美智夫，日地康武，笠木　健*（鳥取大，医，第一生理・鳥取大，医，医療技術短大）……245
83. 灌流されたイカ巨大線維のおそい興奮過程に対する薬物の作用. 渡辺　昭，酒井哲郎（東京医歯大，医，生理）……245
84. 神経線維の活動電位と Impedance 変化の関係. 松本政雄，佐野正和（昭和大，歯，口腔生理）……246

6. シナプス (85—109)

85. 脊髄固有ニューロンの二つの違ったシナプス伝達機構について．島村宗夫，木暮いく子
(東京都神経科研，神経生理)……247
86. 軸索切断後の舌下神経運動ニューロンの IPSP．高田　充（徳島大，歯，口腔生理)……247
87. アミノピリジン急速冷却収縮と外液 Ca 濃度について．安楽満男，橋村三郎（鹿児島大，
医，第二生理）……247
88. ウシガエル心房筋マスカリン性受容器の脱感作．蓮尾　博，時政孝行，纐纈教三（久留米大，
医，第二生理）……248
89. アセチルコリン受容部位におよぼす DEP の効果．喜多孝子（福岡大，医，第二生理）……248
90. Benzalkonium chloride の神経筋接合部に対する伝達抑制作用．竹内宣子，滝川順子，
渋谷統寿*（順天堂大，医，第一生理・国立川棚病院，神経内科*）……248
91. マスカリン性作用による神経細胞の活動電位変化に見られる脱感作．赤須　崇，纐纈教三，
(久留米大，医，第二生理)……249
92. ウシガエル交感神経節細胞に対するカテコールアミンの作用．持田澄子，登坂恒夫
(東京医大，第一生理)……249
93. 交感神経節細胞における cyclic GMP 脱分極の発生機序．橋口利雄，小林春雄，伊藤順子
(東京医大，第一生理)……249
94. 交感神経節細胞のシナプス下膜に対する Caffeine と Ca^{2+} の作用．久場健司，簑田昇一，
加藤栄司*，森田喜一郎*（佐賀医大，第二生理・久留米大，第二生理*)……250
95. 感覚受容器における high-gain synapse．小原昭作，樋口孝城*（帝京大，医，第一生理・
東日本学園大，教養，生物*)……250
96. 電気受容器における求心性シナプスの伝達物質とその生物検定．梅北峻一，松本百合枝，
小原昭作（帝京大，医，第一生理）……250
97. 伝達物質放出に対し顕著な増強効果を示す薬物の作用機序．前野　巍，榎本浩一，
一ノ瀬充行（島根医大，生理）……251
98. 種々の浸透圧の無 Ca 溶液中における自発性伝達物質放出に対する反復刺激の効果．
喜多　弘，成田和彦（川崎医大，第一生理）……251
99. カエルのコリン作働性神経終末からの ACh 遊離に対する 5-HT の作用．平井恵二，
纐纈教三*（興和株，東京研究所・久留米大，医，第二生理*）……251
100. ザリガニ神経筋接合部からのグルタミン酸の遊離．竹内　昭，小野寺加代子，川越礼子
(順天堂大，医，第一生理)……252
101. 破傷風毒素の Ia シナプスに対する作用．神田健郎，豊田　敦（千葉大，医，生理)……252
102. 昆虫神経筋接合部に対するクラーレの作用．山元大輔，鷲尾　宏（三菱化成生命研，
脳神経生理）……252
103. テトロドトキシン耐性スパイク電位の方向性について．丹羽昭子，川合述史（東京都神経
科研，病態神経生理）……253
104. 隆起・ロー斗部神経分泌軸索のシナプス伝達．伴みつ子，八木欽治（自治医大，第二生理）……253
105. バルビタール誘導体と知覚神経細胞の GABA 電流．東　英穂，井口敏恵，西　彰五郎
(久留米大，医，第一生理)……253
106. 単一神経細胞の GABA, GAD グルタミン酸の局在とその意義．岡田安弘（東京都神経科
研，生化）……254
107. ニューロブラストーマ雑種細胞によるシナプス形成．東田陽博，三宅彰英*，田中恭子**，
田中達也**（名大環医研・岐大反射研*，愛知県がんセンター研，生物**)……254

108. マウスおよびニワトリ骨格筋培養細胞 ACh 受容体の等電点的比較．杉山博之（生理研）……254
109. Aplysia 神経節細胞の ACh-receptors と oniums との interacton．染井宏祐，佐々木和彦，松本光比古，佐藤　誠（岩手医大，医，第一生理）……255

7. 脊　髄（110—119）

110. 末梢神経刺激による単一筋線維活動．本間伊佐子，石山陽事，江部　充（虎の門病院，生理）……256
111. Substantia Gelatinosa の２種類の細胞の形態と生理学的性質．林　治秀，Dubner, R., Bennett, G. J., Abdelmoumene, M.（東京医歯大，歯，生理；NIH, NIDR）……256
112. ヒトの脊髄誘発電位の末梢起源．清水裕幸，丸山洋一，遠藤　裕，下地恒毅（新潟大，医，麻酔科）……256
113. サルの実験的振戦・脊髄内の群化放電．大江千広，今井周治，宮崎瑞穂，中島英雄，平井達夫，田崎　健，塚原由夫，松島忠夫（群馬大，医，脳神経外科）……257
114. ヒトの総指伸筋の筋紡錘感度とサーボ仮説．赤沢堅造，藤井克彦，彼末一之*（阪大，工，電気工・医，生理）……257
115. ２つの反射ループを含む生理的振戦のモデル．渡辺　瞭，斎藤正男（東大，医，医用電子研）……257
116. ランダム三角波による筋伸展と筋紡錘発射．本間三郎，林　謙二，中島祥夫（千葉大，医，生理）……258
117. 自転車ペダリング運動加速時の筋収縮特異性について．鈴木秀次，渡部士郎，本間三郎*（杏林大，医，生理・千葉大，医，生理*）……258
118. バブーン大脳運動領ニューロンの筋伸展に対する反応：経大脳皮質反射の根拠．堺　常雄，植村研一，James B. Preston*（浜松医大，脳神経外科・Dept. of Physiol., SUNY Upstate Med. Ctr., Syracuse, N. Y., U. S. A.*）……258
119. 咬合高径を変化させた時の筋活動持続時間について．坂井　尚，河野正勝，鴨川紘征（日大，歯，生理）……259

8. 神経連絡（中枢）（120—131）

120. 三叉神経脊髄路核尾側亜核辺縁層の歯髄ニューロン．西川泰央，大野　栄，覚道幸男，横田敏勝*（大阪歯大，生理・滋賀医大，第一生理*）……260
121. 家兎の小脳片葉に苔状線維性反応を誘発する視覚性信号の中脳中継核．前川杏二，木村　実（自治医大，第一生理）……260
122. HRP 法によるカエル舌咽神経ニューロン中枢路の検索．花森隆充，石河延貞（宮崎医大，第一生理）……260
123. 焦点調節系を支配する副交感動眼ニューロン．板東武彦，佃　健次，塚原仲晃（阪大，基礎工，生物工学）……261
124. 顔面神経核に対する中脳からの入力．田中　任，浅原俊弘，竹内義喜*（三重大，医，第二生理・広島大，歯，第二口腔解剖*）……261
125. カハル間質核細胞に対する入力機構の解析．福島菊郎，村上新治，大野幹夫，加藤正道（北大，医，第二生理）……261
126. 頸筋運動ニューロンに軸索を送る三叉神経知覚核ニューロン．角野隆二，加藤正衛（東京医歯大，歯，顎研生理）……262
127. 頸筋求心性線維刺激に応答する三叉神経脊髄路核ニューロン．横田敏勝（滋賀医大，第一生理）……262
128. 中心頸核の脊髄小脳路ニューロンに対する前庭入力の様式．本郷利憲，佐々木成人，

吉田　薫，平井直樹*（筑波大，基礎医，生理・杏林大，医，第一生理*）……262
129. 前庭脊髄路細胞に対する上部頸髄求心性線維からの影響．平井直樹*，Brink, E., Wilson, V. J.
（杏林大，医，第一生理*・The Rockefeller Univ.）……263
130. 前庭性眼振に関与する橋網様体ニューロン—活動様式，局在および軸索投射．中尾召三，
Markham, C. H.*（鳥取大，医，第二生理・カリフォルニア大，医，神経*）……263
131. 相関解析による大脳皮質運動野の興奮性および抑制性ニューロンの同定．遠藤克昭，
荒木辰之助（京大，医，第一生理）……263

9. 脳幹・間脳（132—141）

132. 並列入力による乳頭体の賦活．小林宣泰（金沢大，医療技術短大，臨床放射線科）……264
133. 甲殻類姿勢反射に関与する腹髄下行性介在神経の役割．高畑雅一，久田光彦（北大，
理，動物）……264
134. 咀嚼筋中の伸張受容器の応答特性に関する研究．井上仁史，森本俊文，目　岩男*（阪大，
歯，口腔生理・歯，第一補綴*）……264
135. 縫線核刺激によるラット開口反射の抑制．田中弘彦，戸田一雄*，入来篤史*，市岡正道*
（東京医歯大，医，麻酔・歯，生理*）……265
136. 単一および複数個のニューロン発火の変動傾向について．相川貞男，秋田久直，太田和子，
青木亨子，佐藤昭彦，小林　勝*（北里大，衛生，生理・精研，神経生理*）……265
137. 咀嚼リズムに一致する延髄網様体ニューロンの発射活動．榎本純男，加藤正衛，中村嘉男
（東京医歯大，歯，顎研生理）……265
138. 視床下部離断ラットにおけるニューロン活動について．斎藤英郎，藤田正範，牛越淳夫，
瀬戸勝男，川上正澄（高知医大，第一生理）……266
139. 唾液核単一ニューロンの反射性応答．村上俊樹，吉原正義，中静由利子，石塚健一（日歯大，
新潟，口腔生理）……266
140. 摂食および飲水行動下ラット摂食中枢ニューロンの応答様式．佐々木和男，福田正治，
村本健一郎，西野仁雄，小野武年（富山医薬大，医，第二生理）……266
141. 摂食行動下のサル運動野および眼窩前頭野ニューロンの活動．大村　裕，清水宣明，
喜多　均，石塚　智，粟生修司，吉松博信，山辺和俊（九大，医，第一生理）……267

10. 小　脳（142—147）

142. reeler ミュータントマウス小脳の発育神経化学的研究．御子柴克彦，長池一博，高坂新一，
高松　研，塚田裕三（慶応大，医，生理）……268
143. 視運動性眼球運動に関係する橋被蓋網様体核から小脳片葉への投射について．川崎　匡，
佐藤　悠，加藤　功*（富山医薬大，医，生理・山形大，医，耳鼻科*）……268
144. 力の継時変化とネコ歯状核のニューロン活動．山本健一，小田桐恵（東京都精神研，
神経生理）……268
145. 小脳表面刺激による Fastigial Nucleus への影響．横山徹夫，植村研一，George, W.
Dauth, Sid Gilman*（浜松医大，脳外科・ミシガン大，神経科*）……269
146. ネコ小脳皮質における群発陽性波の発現機構．下野登士男，尾崎昭弘，畑田耕司*，
三森康世**（京大，医，第一生理・脳研生理*・老年科**）……269
147. 末梢神経刺激によるプルキンエ（P）細胞応答は段階的か？．高比良英輔（東海大，医，
第一生理）……269

11. 終　脳 (148—155)

148. サルの運動野錐体路細胞の形態と軸索伝導速度. 浜田生馬，酒井正樹（京大，霊長類研，神経生理）……270
149. 運動反応に関係したサル前頭前野ニューロン活動. 船橋新太郎，久保田競（京大，霊長類研，神経生理）……270
150. 大脳補足運動野下肢支配領域のニューロン活動. 丹治　順（北大，医，第二生理）……270
151. 運動に先行する大脳皮質緩電位の研究. 玄番央恵，橋本修治，佐々木和夫（京大，医，脳研生理）……271
152. ネコの大脳皮質体性感覚野，視覚野，聴覚野における誘発応答の生後発達. 川口三郎，鮫島章郎，山本哲朗*，宮田啓史**（京大，医，脳研生理・三重大，医，第二生理*・和歌山医大，衛生）……271
153. ウサギ海馬錐体細胞における disfacilitation. 藤田安一郎（日本医大，第二生理）……271
154. 両側前庭半規管の皮質前庭野への投射 (II). 時々輪浩穏，渡辺　悟（岐阜大，医，反射研）……272
155. 痙攣波・血流・代謝関連—リドカイン痙攣をモデルとして—. 下地恒毅，松木美智子，羽柴正夫，丸山正則（新潟大，医，麻酔科）……272

12. 脳　波 (156—165)

156. アルファブロッキングの包絡線の勾配. 辰濃治郎，森　順子，芦田　広，丸　栄一（防衛医大，第二生理）……273
157. 脳波周波数成分の頭皮上分布の発達的特徴(2)—精神薄弱児脳波の部位間関係について—. 尾崎久記，鈴木宏哉，堅田明義*（茨城大，教，障害児生理・東京学芸大，教，生理心理）……273
158. ラット歯髄刺激強さと中枢誘発電位の大きさとの関係. 入来篤史，市岡正道，戸田一雄（東京医歯大，歯，生理）……273
159. 手各部の電気刺激によるヒトの体知覚性誘発電位. 及川俊彦，藤谷嘉子，T. アリスン*，W. R. ゴック*（鳥取大，医，第二生理・エール大，医，神経*）……274
160. Kindling 形成過程における光誘発電位. 小野憲爾，中塚和夫，馬場啓至（長崎大，医，第二生理）……274
161. 脳幹障害による聴覚性脳幹電位の頭皮上の変化について. 橋本　勲，石山陽事*，本間伊佐子*，江部　充*（都立府中病院脳外科・虎の門病院生理学科*）……274
162. 聴覚性脳幹電位記録における基準部位（耳朶）の電位活性について. 石山陽事，本間伊佐子，江部　充，橋本　勲*（虎の門病院生理学科・都立府中病院脳神経外科*）……275
163. 音刺激により誘発される眼瞼 MV 反応の基本的性質. 星名裕子，武尾照子，尾崎俊行，佐々木大輔*（弘前大，医・第一生理・第一内科*）……275
164. 閃光誘発眼瞼電位変動の性質—眼球運動との関連性の面から—. 佐々木世智子，尾崎俊行，五十嵐勝朗*（弘前大，医，第一生理・弘前大，医，小児科*）……275
165. 光眼輪筋反射の late component に関する実験的研究. 安原基弘，内藤博江，西浦公章，服部裕子（関西医大，第二生理）……276

13. 行　動 (166—175)

166. 飼育条件によるラットの行動特性の変容と脳グリアの細胞回転. 楠瀬　良，平尾武久（群馬大，医，行動生理）……277
167. Reaction time and inhibition behavior. 渡辺俊男（横浜国大，教育）……277
168. サル大脳連合野と視覚パターン弁別学習. 菊池礼司，靱負正雄，岩井栄一（東京都神経

研，医学心理）……277
169. MAM 小頭症と無処置ラットの明度弁別学習成績への 6-OHDA 投与の影響．松谷天星丸，永吉道子，田丸政男，中原　務，塚田裕三*（名保衛大，医，総医研，発達生理・慶大，医，生理*）……278
170. 脳内トリプトファン濃度の明度弁別学習におよぼす影響．野村正彦，永田　豊（名保衛大，医，生理）……278
171. 大脳—赤核シナプスを介する古典的条件応答．小田洋一，野津起人，塚原仲晃（阪大，基礎工，生物工学科）……278
172. 姿勢前傾に先行する抗重力筋活動の休止期．岩瀬善彦，内田　孝，高梨芳彰，鈴木直人，橋本真徳，山本由美，竹上　徹，小山秀樹（京府医大，第二生理）……279
173. 追跡動作における重心移動と下肢筋の活動性（II）．三宅彰英，林　良一，時々輪浩穏，渡辺　悟，山路兼生（岐阜大，医，反射研）……279
174. 眼球のサッケード運動の応答性と直立姿勢制御．橋本真徳，鈴木直人，竹上　徹，山本由美，高梨芳彰，小山秀樹，内田　孝，岩瀬善彦（京府医大，第二生理）……279
175. 中脳ネコにおける歩行の生起と Stage Setting．森　茂美，河原剛一，青木　藩，富山知隆*（旭川医大，第二生理・耳鼻咽喉科*）……280

14. 神経化学（176—179）

176. ^{14}C-デオキシグルコースによる単一培養神経節細胞の刺激依存性ラベリング．佐治真理，小幡邦彦*（群馬大，医，第一生理・群馬大，医，薬理*）……281
177. マウスの回避学習に伴う高分子合成におよぼすコルヒチン・ビンブラスチンの影響．土井昭孚，岸田　昭，山口隆昌，村上哲英（岡山大，医，第一生理）……281
178. ラットの発達脳切片における Chloride transport について．阿相皓晃，高木芳夫，金松知幸，平野修助（東邦大，医，第二生理）……281
179. 筋萎縮症マウス神経組織中のミエリン局在酵素（CNP 及び CEH）の活性変化．辻　繁勝，松下　宏（和歌山医大，第二生理）……282

15. 視　覚（180—217）

180. サル前頭前野における視覚性ニューロン分布とその受容野．鈴木寿夫，東　正夫，羽田隆吉（弘前大，医，第二生理）……283
181. 頭頂連合野の視覚性追跡ニューロンの前庭刺激に対する反応．河野憲二，佐々木光美，山下勝幸（東大，医，脳研生理）……283
182. 切片標本による大脳皮質視覚領の可塑性の研究．小松由紀夫（名大，医，第二生理）……283
183. 視覚領細胞への随伴性眼球運動入力．渋木克栄，外山敬介（東大，医，第一生理）……284
184. サル頭頂連合野の視覚ニューロンの奥行識別性．酒田英夫，渋谷英敏，河野憲二*，Harrington, T. L.**（東京都神経研，神経生理・東大，脳研生理*・Nevada大，心理**）……284
185. 視覚入力をもつ運動野ニューロンの形態と分布．小川哲朗，滝森　徹（秋田大，医，第一生理）……284
186. 図形刺激に対するサル下部側頭回ニューロンの応答性．佐藤孝行，河村　健，渡辺譲二，岩井栄一（東京都神経研，医学心理）……285
187. ネコ皮質視覚野における回帰性抑制回路の証明．加藤宏司，伊藤正省，小川哲朗（秋田大，医，第一生理）……285
188. 視覚領皮質—外側膝状核投射の生後発達．須田耕平，津本忠治（金沢大，医，第二生理）……285
189. 市松模様上下半視野刺激時の VECP vs. 反転頻度曲線．安達恵美子，千葉次郎（浜松医大，

第一生理) ……286
190. 時空間ランダムパタンを用いた視覚系ニューロンの受容野の分析. 梶　真寿, 山根　茂, 浜田隆史 (電子技術総合研究所, バイオニクス研究室) ……286
191. ハエ複眼視細胞の受容域の諸型. 三村珪一 (長崎大, 教養) ……286
192. アゲハチョウの幼虫の視野. 市川敏夫, 立田栄光 (九大, 理, 生物) ……287
193. コガネグモ単眼の応答の遠心性調節. 山下茂樹, 立田栄光 (九大, 理, 生物) ……287
194. TEA および EGTA 細胞内注入と昆虫光受容細胞の感度. 塚原保夫 (東北大, 応用情報学研究センター) ……287
195. 脈絡膜から網膜への riboflavin の移動. 藤下成周 (大教大, 保健)……288
196. サイクリックヌクレオチドの視細胞機能におよぼす影響. 松浦哲志, 塙　功* (近畿大, 医, 第一生理・神戸大, 医, 第二生理*)……288
197. ウシガエル網膜桿体の動特性. 山田雅弘, 田内雅規* (電総研, 応用化学・東京女子医大, 第二生理*)……288
198. 単一杆体の量子応答について. 田中一郎, 田内雅規* (国立身障者リハビリテーションセンター・東京女子医大, 第二生理*)……289
199. カメ網膜視細胞の配列. 大塚輝弥 (生理学研究所, 生体情報研究系, 神経情報) ……289
200. ラット網膜における化学伝達系関連酵素活性の成長に伴う動態. 大野拓夫 (愛媛大, 医, 第一生理) ……289
201. コイ網膜の水平細胞と視神経節細胞におよぼすカテコールアミンの影響. 菅原　清 (金沢大, 医, 神経情報伝達) ……290
202. 網膜内カリウムイオン注入による誘起電位. 藤本正昭, 冨田恒男* (聖マリアンナ医大, 第一生理・エール大, 医*)……290
203. 松果体神経節細胞にみられる膜電位のリズム変動に対する光の影響. 森田之大, 田畑満生, 中村孝文* (浜松医大, 第一生理・静岡大, 電子科研*) ……290
204. 明るさの感覚における Faraday 効果について. 附田　恵 (東大, 医, 第二生理) ……291
205. 網膜双極細胞における受容野構成. 御手洗玄洋, 榊原　学 (名大, 環境医研, 航空宇宙部門) ……291
206. コイ網膜の錐体および水平細胞に対する GABA 拮抗物質の効果. 宮地栄一, 霜田幸雄, 村上元彦 (慶大, 医, 生理) ……291
207. ウグイ網膜の双極細胞・アマクリン細胞・IP 細胞の応答と形態. 橋本葉子, 井口三重, 海野　修, 片桐康雄 (東女医大, 第一生理) ……292
208. 双極細胞における ON 型および OFF 型応答の発生機序. 金子章道, 田内雅規 (生理研, 神経情報) ……292
209. コイ網膜双極細胞の glutamate および aspartate 応答とその膜特性. 近藤博明, 豊田順一 (聖マリアンナ医大, 第一生理)……292
210. 甲殻類視葉ニューロンにみられる角感度の尖鋭化. 鈴木　均, 田崎京二 (東北大, 医, 第二生理) ……293
211. 視神経線維終末からの伝達物質の放出. 沢田さつき, 山本長三郎 (金沢大, 医, 第二生理)……293
212. 朝鮮シマリス外側膝状体の色覚ニューロン. 住友一次, 杉谷道男, 岩間吉也 (阪大, 医, 高次研, 生理) ……293
213. 光刺戟に対する外側膝状体細胞の時間特性. 武林正峯, 外池光雄, 栗岡　豊 (電子技術総研) ……294
214. 外側膝状体腹側核細胞の上丘刺激に対する反応性とその視覚特性. 永田　徹, 林　泰正, 森田文夫 (兵庫医大, 第二生理) ……294
215. ラット外側膝状体背側核細胞に対する青斑核電気刺激の効果. 根木哲朗, 杉谷道男, 岩間吉也 (阪大, 医, 高次神経研究施設, 神経生理)……294

216. ネコ視床網様核細胞の反応特性．秦　順一，林　泰正，矢島幸雄，永田　徹（兵庫医大，第二生理）……295
217. ネコの視運動性眼振における平均的視線方向の移動．浜田隆史（電子技術総研，バイオニクス研究室）……295

16. 聴　覚 (218—231)

218. ネコ聴覚領の帯域雑音ユニットについて．斎藤勝則，工藤雅治，丸山直滋（新潟大，脳研，神経生理）……296
219. 音声弁別の機序—フォルマント識別ニューロンについて—．丸山直滋，斎藤勝則，工藤雅治（新潟大，脳研，神経生理）……296
220. 大脳皮質から下丘への遠心性入力について．谷口郁雄（独協医大，第二生理）……296
221. 定常音から音刺激強度を低下させた際の聴神経活動の特性．久野みゆき，松裏修四，箕輪靖弘*（大阪市大，医，第一生理・耳鼻咽喉科*）……297
222. カナマイシン，フロセマイド連続投与時の聴性脳幹反応．時本孝行，松裏修四，箕輪靖弘*（大阪市大，医，第一生理・耳鼻咽喉科*）……297
223. 中央段注入2価陽イオンの蝸牛電位に対する作用．浅沼　厚，柳沢慧二，田中康夫*（鶴見大，歯，生理・独協医大，耳鼻科*）……297
224. ヒキガエル両生類乳頭支配神経の興奮性の変化．大山　浩，須貝外喜夫，矢野二郎，中条　正（金沢医大，第一生理）……298
225. カエル基底乳頭支配神経束における特徴周波数の部位的対応．矢野二郎，大山　浩，須貝外喜夫，中条　正（金沢医大，第一生理）……298
226. 音声情報の識別機構．橋本　享（東京医歯大，医用器材研，制御機器部門）……298
227. 脳幹聴覚伝導路の可塑性について．村田計一，堀川順生，船井洋光（東京医歯大，難研，神経生理）……299
228. CM 入・出力函数の音圧負荷速度依存性．内山平一（東京医歯大，難研，神経生理）……299
229. 有毛細胞器官における順応．古河太郎（東京医歯大，医，第一生理）……299
230. スナネズミの聴神経応答．鎌田　勉，米沢功至，亀田和夫（北大，歯，生理）……300
231. 筋力に対する音響作用の吟味．伊藤秀三郎，藤田佳弘（早大，教育，体育）……300

17. 味　覚 (232—240)

232. 魚類における味蕾の分布と形態．鬼頭純三，清原貞夫*，山下　智*（名大，医，解剖・鹿児島大，教養，生物*）……301
233. ほ乳動物味蕾のアデニルシクラーゼ活性．野村浩道，浅沼直和（松本歯大，口腔生理）……301
234. 味覚刺激に対するラット鼓索神経の初期応答の解析．原田秀逸，笠原泰夫（鹿児島大，歯，口腔生理）……301
235. 幼若ラットの糖に対する鼓索神経反応．山田妙子，梅津万里（日女大，生理）……302
236. 酸順応によるカエル味神経の塩反応の増強．杉本久美子，佐藤俊英，大草光高（東京医歯大，歯，生理）……302
237. 味覚一次ニューロンの時間的放電パターンの分類．上田一夫，長井孝紀*（東大，理，動物・帝京大，医，第一生理*）……302
238. Cyclic AMP の味覚受容への関与．下田平幸一，笠原泰夫（鹿児島大，歯，口腔生理）……303
239. カエル舌咽喉神経求心性応答の逆行性抑制．村山伸樹，石河延貞（宮崎医大，第一生理）……303
240. 孤束核ニューロンの味覚感受性と橋背側部への投射．小川　尚，井元敏明，羽山富雄（熊本大，医，第二生理）……303

18. 触　覚 (241—254)

241. 咬合時のゴム硬さ感覚におよぼす顎位の影響. 渡辺　誠，高藤道夫，鹿沼晶夫，刈田啓史郎*
(東北大，歯，第二補綴・東北大，歯，生理*) ……304
242. 口腔粘膜における小体様終末の振動刺激にたいする応答. 坂田三弥，飯塚正人，山崎　智
(東歯大，生理)……304
243. コオロギ産卵弁にみられる機械感覚毛とその求心性インパルス. 藍　尚礼，平村公代，
山口直巳 (東京学芸大，生物) ……304
245. 下位離断脳ネコにおける視床痛覚上行路の刺激効果. 池上司郎，川村　浩* (三菱化成生命
科学研，生理心理・脳神経生理*)……305
246. ヒトの皮膚機械受容器からの単一求心線維の発射活動について. 間野忠明，宮岡　徹*
(浜松医大，第二生理・心理*) ……305
247. ラット三叉神経中脳路核を経由する歯根膜神経情報. 天野仁一朗 (岐阜歯大，口腔生理) ……305
248. ラット慢性疼痛モデルについて. 山口雄三 (阪大，医療短大，臨床生理) ……306
249. 針刺激の受容器としての polymodal receptor の役割. 川喜多健司，船越正也 (岐阜歯大，
口腔生理) ……306
250. 中隔核—帯状束系と針鎮痛. 羅　昌平，久光　正，佐藤孝雄，小堀正雄，米良仁志，
武重千冬 (昭和大，医，第一生理) ……306
251. 中脳中心灰白質の刺激による鎮痛，モルヒネ鎮痛と針鎮痛の相互関係. 村居真琴，田中正明，
蜂須　貢，小麦弘子，武重千冬 (昭和大，医，第一生理) ……307
252. 口腔周辺からの触覚皮質投射. 平　孝清，松本範雄，佐藤　匡，鈴木　隆 (岩手医大，歯，
口腔生理) ……307
253. ネコの大脳皮質感覚領 SI の細胞特性と機能的円柱様構造. 松本範雄，平　孝清，林謙一郎，
佐藤　匡，鈴木　隆，高松隆常 (岩手医大，歯，口腔生理) ……307
254. サル体性感覚野各細胞構築領野への手指投射. 岩村吉晃，田中美智雄，彦坂興秀 (東邦大，
医，第一生理) ……308

19. 嗅　覚 (255—261)

255. コイ嗅球僧帽細胞における周期的放電の神経機構. 山口和彦，上田一夫，佐藤真彦 (東大，
理，動物) ……309
256. 酢酸エステル類匂い刺激に対する EOG 応答より見た食用ガエル嗅粘膜の性質. 飯島正治，
天貝裕地 (東北歯大，生理) ……309
257. 臭気濃度の稀釈法と臭気の与え方. 元木沢文昭，前沢利枝子 (奈良医大，第一生理) ……309
258. 前嗅核 (AON) の air pulse に対する temporal pattern. 小野田法彦 (群馬大，医，
第二生理) ……310
260. 各種ニオイ物質に対する嗅覚誘発電位の波形. 外池光雄，武林正峯，栗岡　豊
(電子技術総研)……310
261. 赤外線受容器への刺激と応答との関係. 寺嶋真一，ゴリス，R. C. (東京医歯大，医，
第一生理) ……310

20. 筋収縮 (262—275)

262. カブトガニ横紋筋の収縮機構について. 杉　晴夫，五味節子 (帝京大，医，第二生理) ……311
263. 昆虫飛行筋の張力過渡現象について. 土屋禎三 (帝京大，医，第二生理) ……311
264. 筋の熱産生と In Vitro 熱量変化の測定. 山田和広，米谷快男児 (大分医大，医，生理) ……311

265. 動力学的実験時における骨格筋力学的反応の均一性．小林孝和，上山章光，平尾紀子*，
杉晴夫*（帝京大，医，臨床生理・第二生理*）……312
266. 等尺性収縮時の骨格筋におけるミオシン突起の挙動．八木直人，松原一郎（東北大，
医，薬理）……312
267. 骨格筋における短縮時の高時間分解能X線回折．田中秀洋，為安　司，杉　晴夫*（帝京大，
医，中央機器室・第二生理*）……312
268. 骨格筋収縮中の筋節のゆらぎ．馬詰良樹，春日規克，吉岡利忠*（慈恵医大，第一生理・
東海大，医，生理*）……313
269. RCC における筋小胞体活性と抑制因子．酒井敏夫，碓井外幸，高橋　明，慈恵医大，
第二生理）……313
270. カエル縫工筋におけるT小管・終末槽間の結合に関する超微細構造的研究．藤野和宏，
有馬利昭，佐藤義昭，高井秀昭（防衛医大，第一生理）……313
271. 筋小胞体の膜電位変化と Ca ionflux の関連．越田　信，堀田　健（名市大，医，第一生理）……314
272. カエル単一筋線維における興奮収縮連関のホルムアルデヒドとアクロレインによる抑制．
藤野和宏，佐藤義昭，有馬利昭，高井秀昭（防衛医大，第一生理）……314
274. カエルの骨格筋における caffeine 拘縮の inactivation について．太田　勲，永井寅男，
永井　格（札幌医大，第一生理・口腔外科*）……314
275. Dantrolene-Na の骨格筋細胞に作用する部位について．山口俊夫（国際基督教大，教養，
生物）……315

21. 平滑筋（276—284）

276. モルモット胃の縦走筋と輪走筋標本の被刺激性の検討と力学定数の測定．森谷　恵，
石沢光郎，薮　英世，宮崎英策（札幌医大，第二生理）……316
277. 血管壁平滑筋の機能的走向に対する生理学的解析．福嶋孝義*，大橋俊夫，東　健彦
（信州大，医，心脈管病研究室*・第一生理）……316
278. 腸管平滑筋 Sr^{2+} 電流に対する Ca^{2+} の拮抗作用について．猪又八郎，丸山芳夫，三又知文
（東北大，医，応用生理）……316
279. 平滑筋に対するカテコールアミンの β 作用．那須康典，坂本康二，今永一成，富田忠雄*
（福岡大，医，第一生理・名大，医，第一生理*）……317
280. 胃平滑筋の Ca 動態におよぼす Phospholipase C および Ouabain の影響．坂井　泰，
吉田正英，市河三太（昭和大，医，第二生理）……317
281. ラット子宮縦走筋の収縮性および興奮性と卵巣ホルモン．加藤誠志，小笠原利保，長　琢朗
（山口大，医，第一生理）……317
282. 温度上昇時にみられる平滑筋の収縮．砂野　哲，宮崎英策（札幌医大，第二生理）……318
283. 環形動物ユムシ体壁筋の神経伝達候補物質に対する反応．宗岡洋二郎，柴　芳樹，菅野義信*
（広島大，総科，生理・歯，生理*）……318
284. モルモット taenia coli に対するイオノフオアの作用．中山雪麿（共立薬大）……318

22. 心　筋（285—302）

285. 膜電位の光学的検出による初期胚心細胞の自発興奮の空間的ひろがりの追跡．神野耕太郎，
広田秋彦，藤井志郎（東京医歯大，医，第二生理）……319
287. 低濃度塩類-Ringer 液灌流でおこした心室細動電位．加世田正和，熊谷祐二，円谷　豊*，
和田すみ*（防衛医大，生物・日大，医，第一生理*）……319
288. GIK 液のカエル心房筋膜電位，膜電流および張力要素におよぼす影響．木下和彦，

八谷アツ子*，後藤昌義*（九大，医，心臓外科・第二生理*）……319
289．カエル心房筋の単収縮および無 Na 拘縮に対する pH の効果．越智和典，松村幹郎
（川崎医大，第一生理）……320
290．カエル心房筋のK拘縮におよぼす高張液の増強効果．河田　溥，大場三栄，保利忠康，
岸　美恵子*（福岡大，医，第二生理・人間生物系総研*）……320
291．心外膜側心室筋の第二脱分極の大きさと収縮との関係．上山章光，柴山理恵（帝京大，
医，臨床生理）……320
292．拘縮心筋における等張性短縮について．三枝木泰丈，柴田利満*，山田恵美子（鶴見大，
歯，生理・横浜市大，医，小児科*）……321
293．連結橋説による心筋収縮モデル．真島英信，樺沢一之，赤沢堅造*（順天堂大，医，
第二生理・阪大，工，電気工学*）……321
294．房室結節の遅い電流系について．国分真一朗，小竹　寛，野間昭典，入沢　宏（生理研）……321
295．心室作業筋のKコンダクタンスに対する細胞内 Ca の効果．平岡昌和，岡本康孝，池田和郎
（東京医歯大，難研，循環器生理）……322
296．心筋の K^+ conductance に影響する物質について．柳沢輝行，平　則夫（東北大，医，
第二薬理）……322
297．モルモット心室筋細胞膜における Ca と Ba の拮抗作用．稲沢　実，頴原嗣尚（九大，
医，第二生理）……322
298．洞房結節におよぼすエピネフリン変時作用のイオン機序．野間昭典，小竹　寛，
入沢　宏（生理研）……323
299．アシドーシスにおける心室性不整脈，特に electrogenic Na pump の関与について．
沢登　徹，安谷屋均（東京医歯大，難研，循環器生理）……323
300．心室筋膜電流に対するゲンタマイシンの作用．日野直樹，大地陸男，柳沢輝行*（順天堂大，
医，第二生理・東北大，医，第二薬理*）……323
301．Pacemaker potential にみられる第2級の変動．後藤鹿島，宮前俊一，金田能子（金沢医大，
第二生理）……324
302．Adenosine と ACh の心房作用における相互干渉．後藤昌義，八谷アツ子，浦田百美，
藤野孝雄（九大，医，第二生理）……324

23．自律神経（303—326）

303．培養アウエルバッハ神経細胞の膜電位，膜抵抗について．丸山武夫，中井　洋，鈴木泰三
（東北大，医，応用生理）……325
304．交流刺激に対する平滑筋の収縮反応．高井　章，富田忠雄（名大，医，第一生理）……325
305．モルモット精嚢輪走筋におけるアドレナリン性神経支配．大川博通（山口大，医，第一生理）……325
306．内肛門括約筋の比較生理学的研究．中山　沃，水谷雅年（岡山大，医，第二生理）……326
307．直腸—直腸反射における交感神経性抑制．高木　都，祢屋俊昭，中山　沃（岡山大，医，
第二生理）……326
308．放射活性測定によるウサギの胃における迷走神経求心性繊維の走行，終末の分布．佐藤　実，
岩元　純，吉崎克明，古谷野速雄（秋田大，医，第二生理）……326
309．Slow ganglionic transmission におよぼすカテコールアミンの作用．牛島　久，片山芳文，
西　彰五郎（久留米大，医，第一生理）……327
310．エンケファリンのモルモット交感神経節に対する作用．柳下芳寛*，米村健一，田中育郎
（熊本大，医，麻酔*・第一生理）……327
311．腹腔神経節神経細胞におけるシナプス連絡．岩元　純，佐藤　実，吉崎克明，古谷野速雄

(秋田大，医，第二生理)……327
312. 交感神経刺激による PGE 遊離とその BAB に対する影響．山本宗平，伊藤嘉紀*（産業医総研・名大，医，第一生理*)……328
313. 胃酸分泌の神経—体液性促進機構における final common chemomediator について．藤井一元，高杉純好*（広島大，医，第二生理・第二外科*）……328
314. 中脳脳幹部電気刺激によるイヌの舌および鼻の血管拡張反応．永井正則，Pleschka, K.*（東京都老人研，第一生理・MPI für Physiol. und Klin. Forschung*)……328
315. ネコの脊髄心臓調節組織への上位中枢神経核からの投射：HRP 法（第一報)．尾内武志，岡田淳一，三浦光彦（群馬大，医，第一生理）……329
316. 心臓求心性神経刺激で誘発される心臓反射．佐藤昭夫，佐藤優子，中村はる江（東京都老人総研，基礎第二生理）……329
317. 減圧反応を起こす三叉神経：一次求心性線維．照井直人，沼尾嘉信，熊田衛（筑波大，基礎医学系）……329
318. イヌの遠側結腸支配の自律神経活動に対する咽頭腔刺激の効果．岡田博匡，深井喜代子(川崎医大，第二生理)……330
319. ラット喉頭水受容器の飲水および利尿における役割．真貝富夫，幾野　博（新潟大，歯，口腔生理）……330
320. 侵害刺激の涙腺活動におよぼす影響．新家信行，山本　隆，河村洋二郎（阪大，歯，口腔生理）……330
321. 皮膚刺激で副腎神経に誘発される反射．荒木忠夫，黒沢美枝子，佐藤昭夫*（お茶ノ水女子大，理，生物・東京都老人総研，基礎第二生理*)……331
322. 筋からの求心系による自律神経系への緊張性修飾作用．熊沢孝朗，只木英子，水村和枝，金　奇吾（名大，医，第一生理）……331
323. 視床下部と迷走および交感神経脾臓枝との機能的関係．大村　裕，新島　旭*，喜多　均，石塚　智，山辺和俊，吉松博信，粟生修司（九大，医，第一生理・新潟大，医，第一生理*)……331
324. 前庭交感神経反応に対する小脳の影響．石川友衛，宮沢多恵子，藤原孝之（日大，医，第一生理）……332
325. 脳血行遮断時の延髄呼吸性ニューロン活動．金井浩三，宮川　清（信州大，医，第二生理）……332
326. 体温調節時における交感神経および迷走神経の役割．宮本孝甫，安藤あけみ，木村祐子(埼玉県立衛生短大)……332

24. 循　環 (327—348)

327. 変形赤血球懸濁液の流動性．山下雄平，草地良作，小松　明（東女医大，第一生理）……333
328. 隆起動脈壁近傍の血流微細構造．新見英幸，山川隆司（国立循環器病センター研，脈管生理）……333
329. ウシガエルの脊髄加温冷却によるリンパ心臓への影響．山根正信（川崎医大，第二生理）……333
330. ガマの動脈系化学受容器の比較生理的研究．石井和子，石井公正，木村純子（福島医大，第一生理）……334
331. 意識および自由行動下動物における心臓交感神経活動と心拍数の解析．二宮石雄，西浦直亀，林　孝和，岡田芳和（国立循環器病センター研，心臓生理）……334
332. 低酸素状態における循環総合特性モデルの検討．岡井　治，渡辺　瞭*，斎藤正男*（杏林大，医，第二生理・東大，医，医用電子研*）……334
333. 中枢性血圧上昇時における心筋の収縮力および Po_2 の変化．清水　強，花井荘太郎，野村裕子（保健衛生大，医，生理）……335
334. 心室可変弾性模型のポテンシャルエネルギーと心臓酸素消費量との相関．菅　弘之，林　孝和

(国立循環器病センター，心臓生理)……335
335. 運動負荷後にみられる心電図T波増高について．中山　章，斎藤俊弘，村山　紘，杉山吉克，日野泰夫，水野　毅，外岡正英，諸岡信裕，鳩貝文彦，片桐　誠，湯村保夫，入江澄子，竹田　賢，出口不二夫，稲垣義明（千葉大，第三内科）……335
336. CT によるうっ血性心不全の肺内水分分布の検討．諸岡信裕，吉田秀夫，渡辺　滋，増田善昭，稲垣義明，木下安弘*（千葉大，第三内科・保健センター*）……336
337. コロトコフ音を記録できる新しい自動血圧計について．外岡正英，富谷久雄，竹田　賢，宿谷正毅，斎藤俊弘，増田善昭，稲垣義明，平井　昭*，富田光衛**（千葉大，第三内科・千葉市立病院*・パラマ**)……336
338. カメラ型小血管径測定装置とその生理学的応用．坂口正雄，大橋俊夫*，東　健彦*（長野高専，電気工・信州大，医，第一生理*）……336
339. 脂質負荷時のウサギにおける微細循環動態(1)急性変化について．浅野牧茂，沢登公勇（国立公衆衛生院，生理)……337
340. 腸間膜血管床に対するアミノ酸の作用．白鷹増男，奈良佳洋，佐藤登志郎*，池田憲昭**（北里大，医，生理・内科*・情報工**）……337
341. 血管壁適応反応と核酸含有量の変化．神谷　瞭（北大，応電研）……337
342. 骨格筋 ischemia における Hct, protein, K^+ および Osmolality の変動について．樋口雄三，福岡正和，伊藤寛志，竹宮　隆*，長嶋長節**（杏林大，医，第二生理・筑波大，体育，生理*・新生病院，微小循環研**)……338
343. 循環血変化よりみた血管透過性および間質圧．三木健寿，能勢　博，山田誠治，森本武利（京府医大，第一生理)……338
344. 内頸，外頸動脈間のスチール類似現象による脳血流量制御．河合康明，大橋俊夫，東　健彦（信州大，医，第一生理)……338
345. 交感神経の頭部および脳血管におよぼす作用について．畠山一平，島田純一，大久保順子（北里大，医，生理)……339
346. 血圧振動時における脾，腸，腎および皮膚血管床の reservoir 機能．竹内　亨，宮川　清（信州大，医，第二生理)……339
347. 寒冷血管規則波の成立機序．上田五雨，竹岡みち子，腰原由美（信州大，順応医研）……339
348. Transposition response の機序．入内島十郎，寺西泰弘，江口千恵子*（広島大，医，第二生理・鹿児島大，医，麻酔*)……340

25. 赤血球・酸塩基平衡 (349—357)

349. ヘモグロビンおよび血液の炭酸ガス平衡曲線．上田至宏，中馬一郎（阪大，医，第一生理）……341
350. 胎児ヘモグロビンと成人ヘモグロビンの O_2 平衡機能の比較研究．冨田　晋，榎　泰義，大賀好美，金子昌子（奈良医大，第二生理）……341
351. DPG 結合部位にアミノ酸置換をもつ異常 Hb 症．長井　潔，榎　泰義（奈良県医大，第二生理）……341
352. ピリドキサールリン酸誘導体の赤血球酸素運搬に対する影響．前田信治，昆　和典，須田武雄，志賀　健（愛媛大，医，第二生理）……342
353. 赤血球酸素化のその水素イオン緩衝能におよぼす影響．望月政司，新関久一，田村和一（山形大，医，第一生理)……342
354. 急性アシドーシスによるアンモニア産生の刺激と，尿中排出因子によるその抑制．寺尾統彦，Tannen, R.*（自治医大，循環器内科・ミシガン大，内科*）……342
355. 塩酸静注による急性代謝性アシドーシスにおける呼吸頻度調節について．安達智恵子

(新潟大，医，第二生理)……343
356. イヌ全血に CO_2 ガス通気する際の $[Na^+]$, $[HCO_3^-]$ の血漿中出現について．棚瀬邦雄，小川昭俊，朝日輝男，島袋盛一，平川千里（岐阜大，医，第二内科）……343
357. 鶏胚における呼吸性酸塩平衡障害とその代償．田沢　皓（山形大，医，第一生理）……343

26. 血液・腎・体液調節 (358—376)

358. クレアチニン負荷時のイヌ腎組織酸素分圧と尿・血液の性状．田中康夫，中屋重行，本庄良子，鹿嶋敬子（岩手医大，医，第二生理）……344
359. 疾走による Na 利尿と尿中成分の変動．小郷克敏，井本岳秋*（熊本大，教育，生理・体質医研，形態*)……344
360. Uremic toxins (neurotoxins) の毒性検出の試み．松本昭英，米村健一，田中育郎（熊本大，医，第一生理）……344
361. ラット腎の Ca-ATPase 活性におよぼす副甲状腺および甲状腺ホルモンの影響．草野英二，武田和司，浅野　泰（自治医大，循環器内科）……345
362. カエル膀胱膜上皮細胞アデニレートサイクレイスにおけるグアニンヌクレオチドの作用．三科孝夫，島田　肇，丸茂文昭（北里大，内科）……345
363. 毛細血管透過性と血中膠質滲透圧．垣内美弘，小山富康，三上智久*（北大，応電研，生理・生体制御*)……345
364. アドレナリンおよびピロカルピン投与による血中好中球の影響について．合志弐隆，大久保信一（衆議院歯科附属生理研）……346
365. Phenylhydrazine 投与ラットの赤血球変形能と浸透圧抵抗．長沢貴志，晒　明，小林　孝，木村英一（大阪市大，医，第二生理）……346
366. 高気圧環境 (31 ATA) における血球膜性状の変化．佐川寿栄子，今田育秀，白木啓三，Hong, S. K.*, 中山英明**, 松田源彦**（産業医大，第二生理・Dept. of Physiol. State Univ. of New York at Buffalo.*・海洋科学技術センター**)……346
367. 赤血球変形能におよぼす血漿蛋白，電解質の相乗効果．菊池佑二，堀本和志，垣内美弘，小山富康（北大，応電研，生理）……347
368. 赤血球の形態と膜流動性と浮遊液粘度の相互関係．須田武雄，昆　和典，前田信治，志賀　健（愛媛大，医，第二生理）……347
369. 播種性血管内凝固 (DIC) と赤血球破砕像．松田　保，横内正利，小河原　緑，三浦玲子，関　俊子（東京都老人総研，臨床第二生理）……347
370. ヒトおよび動物血小板凝集能の比較．谷本義文（実中研，血液化学）……348
371. 放射線照射ラット血小板におよぼす影響．大柴　進，今井英雄，遠藤英二，沢井洋子，有賀豊彦（日大，医，第二生理）……348
372. 肝胆系における線溶酵素系に関する研究（第11報)．大柴　進，有賀豊彦，沢井洋子，今井英雄（日大，医，第二生理）……348
373. ヒト脾のフィブリン分解因子 (SPF) の性質—エラスターゼとの比較．永松陽子，岡本歌子，山本順一郎，堀江　登，伊藤美智子（神戸学院大，栄養，生理）……349
374. ヒト血漿中 UK Inhibitor の性質について．山本紘靖，小枝祐子，椙江　勇（愛知医大，第一生理）……349
375. 哺乳動物の排卵における線溶系酵素の役割．美原　恒，小杉忠誠，松尾　理，赤沢憲治*，森　憲正*（宮崎医大，第二生理・産婦人科*)……349
376. 温度運動負荷および緊張による線溶系，カテコールアミンの動態．五十嵐紀子，浅田敏雄，大本美弥子*，古市　英*，柴　忠明**（東邦大，医，生化・衛生*・第二外科**)……350

27. 呼　吸 (377—388)

377. ネコ新皮質脳波における呼吸周期性変動. 宮川政昭, 西川嘉伸, 福原武彦 (慈恵医大, 第二薬理) ……351
378. 脳幹部呼吸性ニューロン単位発射活動の安定性. 後藤和利, 八反丸善文, 福原武彦 (慈恵医大, 第二薬理)……351
379. ネコ頸髄の呼吸性ニューロンの機能特性. 青木　藩, 河原剛一, 森　茂美 (旭川医大, 第二生理) ……351
380. 延髄腹側部化学感受性野におけるニューロンの周期性活動と H^+ 感受性. 福田康一郎, 本田良行 (千葉大, 医, 第二生理) ……352
381. ストリキニン投与による呼吸パターンの変化. 島田久八郎, 幾野　博, 北田泰之 (新潟大, 歯, 口腔生理) ……352
382. Doxapram の呼吸反射への影響. 西野　卓, S. Lahiri* (千葉大, 医, 第二生理・ペンシルバニア大, 生理*)……352
383. インピーダンスプレチスモグラフによる呼吸循環機能連続監視装置. 宮本嘉巳, 三上智久 (北大, 応電研, 生体制御)……353
384. 空手動作と呼吸曲線パターン. 上田五雨, 柳平坦徳, 竹岡みち子, 腰原由美, 米村　勇, 稲葉恒幸*, 丹下信吾* (信州大, 医・日本空手協会*)……353
385. ヒト横隔膜筋電図からみた呼吸リズム調節機構. 本間生夫, 小林啓三, 小林康孝, 永井　猛, 酒井敏夫 (慈恵医大, 第二生理) ……353
386. 低酸素および高炭酸ガスの局所投与がウシガエルの肺微小循環に与える影響. 堀本和志, 小山富康 (北大, 応電研, 生理) ……354
387. 登山家の低酸素および高炭酸ガスに対する換気応答. 宮村実晴, 島岡　清, 原　　真, 松井秀治 (名大, 総合保健体育科学センター) ……354
388. 女性性周期における肺胞 Pco_2 の変動と調節. 高野成子 (金沢大, 教育, 保健) ……354

28. 内分泌 (389—411)

389. イヌ・ネコの視床下部神経分泌細胞のリズム放電. 山下　博, 稲永清敏 (産業医大, 第一生理) ……355
390. 老齢ラットの性周期消失に伴う辺縁-視索前野-視床下部系投射の変化. 明間立雄, 川上正澄 (横浜市大, 医, 第二生理)……355
391. 内因性オピオイド・ペプチドのプロラクチン分泌促進機構. 家入蒼生夫, 鈴木　仁, 下田新一 (独協医大, 内分泌内科)……355
392. ゴナドトロピン分泌調節中枢機序と脳内オピオイド物質. 久保勝知 (熊本大, 体質医研, 生理) ……356
393. 種々の neuropeptides の LHA-gastrosecretory response に対する影響. 白石武昌, 井上敦郎*, 矢内原　昇* (東海大, 医, 第一生理・静岡薬大, 生物化学*)……356
394. LH, FSH およびプロラクチン分泌と脳内カテコールアミン代謝回転率. 本間研一, Wuttke, W.* (北大, 医, 第一生理・Max-Planck Inst. ゲッチンゲン, 西独*)……356
395. 耳下腺におけるカテコールアミンの cyclic AMP 増加作用の脱感作. 吉村啓一, 根津恵理子, 千葉晶子 (北大, 歯, 生理) ……357
396. ラットにおける迷走神経性インスリン分泌について. 坂口武夫, 平野鉄雄, 山口賢一, 福田昭子*, 新島　旭 (新潟大, 医, 第一・第二生理*) ……357
397. 膵臓ランゲルハンス氏島 (ラ氏島) の GABA の役割. 岡田安弘, 谷口　洋* (東京都神経研,

生化学・神戸大，医，第二内科*)……357
398. BK virus によるインスリノーマ（膵島腫）の性質．岡田安弘，安東民衛（東京都神経研)……358
399. イモリの精巣機能と Polyamine．松崎　茂，山本　清（群馬大，内分泌研，生理)……358
400. メチル水銀中毒ラットにおける下垂体一副腎皮質系機能の変化．安倍紀一郎，田中育郎*
（熊本大，医療短大・医，第一生理*）……358
401. PHA 刺激ヒトリンパ球に対する諸種ステロイドホルモンの単独および相互作用について．
小川克仁，末田香里，松井信夫（名大，環境医研，第二部門）……359
402. 内因性ヒスタミンによるアルドステロン分泌促進．相川忠臣，広瀬妙子，松本逸郎，鈴木達二
（長崎大，医，第一生理)……359
403. 浸透圧受容におけるアンギオテンシンの役割．赤石隆夫，根来英雄（新潟大，医，第二生理）……359
404. ラットの副腎髄質ホルモン分泌におよぼす橋および中脳刺激の影響．松井秀夫（長崎大，
医，第一生理）……360
405. カテコールアミン分泌細胞におけるアデノシンによるサイクリック AMP の上昇を介する
Feed-back 調節機構．小林和夫，黒田洋一郎（東京都神経研，神経生化学)……360
406. 松果体因子の LH 分泌抑制効果—とくに幼若時において．三重野政広，山下英理子，
山下一邦（長崎大，医，原研）……360
407. 下垂体前葉のホルモン分泌と Ca spike に対する Verapamil の影響．小沢瀞司，木村信子*，
（自治医大，第二生理・東京都神経研，医化学*）……361
408. TRH のラット12指腸平滑筋に対する作用機構．古川恭子，野本照子，渡植貞一郎
（東京女子医大，薬理)……361
409. 甲状腺による神経 GH 分泌の調節．鈴木光雄，掛川忠雄，宮原郷士*，大村　裕*（群馬大，
内分泌研，生理・九大，医，第一生理*)……361
410. Androgen insensitive (Tfm) マウス顎下腺における androgen-dependent esteroprotease
の T_3 による誘導．細井和雄，上羽隆夫（城西歯大，口腔生理)……362
411. 下垂体性小人症マウス大脳のミエリン形成不全におよぼす bGH の効果．杉崎哲朗，
野口鉄也，塚田裕三（慶大，医，生理）……362

29. 運　動 (412—425)

412. 幼若期ラット骨格筋における除神経の影響．成沢三雄，永見邦篤，吉岡利忠，中野昭一
（東海大，医，生理，応用生理)……363
413. 持久運動負荷による筋組織および脂肪組織の微細血管の消長．遊佐清有，里吉政子，
谷嶋二三男，小川義雄（横浜市大，体育医）……363
414. 健常者における容量変化の安静時および運動時心機能に与える影響．小林克也，石田健治郎，
田尻英一，韓　在哲，戸田常紀，福崎　恒（神戸大，医，第一内科）……363
415. 着地時筋放電に対する落下速度の影響．米田継武，石田絢子（順天堂大，体育，生理）……364
416. 運動性利尿現象と走負荷強度との関連性．井本岳秋，小郷克敏*（熊本大，体質医研，形態・
教育，生理衛生*)……364
417. 高尿酸血症者の運動時尿酸代謝．伊藤　朗，堀内利恭，杉浦崇夫，藤田定彦，山田哲雄，
角田　聡，井川幸雄*（筑波大，体育・慈恵医大，臨床検査医*）……364
418. 壮年者の長期トレーニングが血中物質の変化におよぼす影響．芝山秀太郎，江橋　博
（体力医研，生理)……365
419. Training による orthostatic tolerance の改変とその機序について．佐伯　欽，中家優幸，
須藤正道，阿部瑞穂（慈恵医大，宇宙医研）……365
420. 成人女子の生理機能におよぼす Circuit Weight Training の効果．木村靖夫，伊藤秀三郎・

山崎省一* (早稲田大，教育，体育生理・防衛医大，衛生*) ……365
421. 筋運動中の深部温と筋放電量との関係 (1)．菊地邦雄，川村　毅，岡田泰士*，和田　実**
(広島大，総合，保健体育・香川大，教育*・徳山工高専**) ……366
422. 運動単位の随意特性．倉田　博，小川芳徳，増田　允*，森本　茂* (慈恵医大，体力医研・
第一生理*)……366
423. 血漿レニン，アンギオテンシン，アルドステロン水準におよぼす運動の影響．井川幸雄，
鈴木政登，塩田正俊 (慈恵医大，臨床検査) ……366
424. 長距離選手と投擲選手の下腿温浴時の生理的反応．辻田純三，田中信雄，黛　誠，
綿貫　勝，堀　清記，荒木　勉* (兵庫医大，第一生理・神戸大，医，衛生*) ……367
425. 反射性の MT 応答に影響する消化管性の因子．野田憲一，副田博之，山本佳津枝，
鮫島千織，渡辺京子 (福岡歯大，口腔生理) ……367

30. 環境・エネルギー代謝 (426—437)

426. 16-21，26-31気圧の高圧暴露に際してのヒトの内分泌系の反応．松井信夫，田村好弘，
岡崎昭太郎，末田香里，小川克仁，山本昌弘，中山英明*，竹内久美*，大磯ユタカ**
(名大，環境医研，第二・海洋科学技術センター*・医，第一内科**) ……368
427. 高気圧環境 (31 ATA) における血液学的変化と体水分バランス．白木啓三，今田育秀，
佐川寿栄子，Hong, S. K.* 松田源彦** (産業医大，第二生理・Dept. of Physiol. State
Univ. of New York at Buffalo*・海洋科学技術センター**) ……368
428. 寒冷適応獲得過程における循環機能の役割り．平田耕造，菅野康幸，柴田裕行，永坂鉄夫
(金沢大，医，第一生理)……368
429. 運動時の汗量および体温上昇度と最大酸素摂取量との関係．堀　清記，飯塚平吉郎
(兵庫医大，第一生理)……369
430. 短い明暗周期下でのネズミの行動．磯部芳明，長谷川泰洋*，高羽祥三 (名古屋市立大，医，
第二生理・第一生理*)……369
431. 大動脈収縮時における糖原分解および解糖系酵素の活性と乳酸および ATP レベルについて．
橋本道男，橋本揚子，佐藤俊子，桝村純生 (島根医大，第一生理) ……369
432. 分界状破壊ウサギのブドウ糖代謝に対するストレス反復負荷の影響．藤田正範，牛越淳夫，
桃　秀人，斎藤英郎，瀬戸勝男，Meed, J. F.，明間立雄*，有田　順*，川上正澄*
(高知医大，第一生理・横浜市大，第二生理*) ……370
433. ラット顎下腺の活性時代謝におよぼすペントバルビタールの影響．遠藤司郎，坪井　実*，
駒林隆夫*，坂本清也** (京浜女子大，生理・東京薬大，生理*・昭和大，医，第二生理**) ……370
434. ラットの蛋白質摂取量におよぼす蛋白質の質の影響．岸　恭一，井上五郎 (徳島大，
医，栄養生理) ……370
435. ヒスタミンのイヌ血中脂質におよぼす影響．坪井　実，駒林隆夫，遠藤司郎，坂本清也*
(東京薬大，生理・昭和大，医，第二生理*) ……371
436. 幼児期における窒素出納とエネルギー利用について．北野隆雄，小石秀夫 (大阪市大，生活，
栄養生理) ……371
437. ヒトの体重の減少率について．樋口公男，井上美代子 (中村学園大，食物栄養) ……371

31. 体温調節 (438—458)

438. ラットにおける発熱と体温調節行動．村上　憲，坂田義行，森本昭生 (山口大，医，
第二生理) ……372
439. 環境温低下時の皮静脈血の特性．内野欽司，長谷川豪志，増田　允 (慈恵医大，第一生理) ……372

440. 各系統のラットの salivary cooling について．古山富士弥*，高羽祥三，大原孝吉*
(名古屋市大，医，病院・第二生理*) ……372
441. ラット陰のう皮膚加温による尾部皮膚温上昇と血圧上昇の関係．土屋勝彦（長崎大，
熱医研，環境生理) ……373
442. 気管バイパス呼吸時の家兎の熱出納．菅野康幸，柴田裕行，林　正男，永坂鉄夫（金沢大，
医，第一生理) ……373
443. 女子軽作業時における皮温変化と温度感覚．長田泰公，小川庄吉，吉田敬一*
(国立公衆衛生院，生理・昭和大，医，公衛*) ……373
444. 女子における体温調節反応の日周変動．丹羽健市，鶴谷知子，中山昭雄（阪大，医，
第二生理) ……374
445. 手冷水浸漬に関する研究．村上長雄，高島慎助，佐藤尚武，東　隆暢，舟橋明男（三重大，
医，第一生理) ……374
446. 視束前野温度感受性ニューロンに対する内側前脳束刺激の効果．清原寿一，堀　哲郎，
柴田政章，中島敏博（佐賀医大，第一生理) ……374
447. 視束前野薄切片から記録した温度感受性ニューロン活動．堀　哲郎，中島敏博，清原寿一，
柴田政章，堀　信顕*（佐賀医大，第一生理・九大，歯，薬理*) ……375
448. 発熱ウサギの視床下部温と局所脳血流の関係．小坂光男，大渡　伸，井元孝章（長崎大，
熱医研，環境生理) ……375
449. 脳幹の温度受容細胞に対する発熱物質の作用機序について．坂田義行，村上　嶌（山口大，
医，第二生理) ……375
450. 視束前野・視床下部温度感受性ニューロンの活動とラット尾血管反応．石川洋蔵，中山昭雄，
鶴谷知子（阪大，医，第二生理) ……376
451. Leg exercise による前腕血流量，前腕組織温度の変動について．田村俊世，戸川達男，
田中正敏*，吉田敬一*（東医歯大，医用器材，計測・昭和大，医，公衆衛生*) ……376
452. 発汗中枢活動の末梢汗腺発汗波への反映について．大原秀吉，奥田宣明，佐藤春彦（名市大，
医，第二生理) ……376
453. 腋窩発汗の特性について．菅屋潤壱，小川徳雄，伊藤路子，宮側敏明，朝山正巳（愛知医大，
第二生理) ……377
454. 温熱の周期変動に対する発汗特性．朝山正巳，小川徳雄，伊藤路子，宮側敏明，菅屋潤壱
(愛知医大，第二生理) ……377
455. 温度馴化の発現とカテコールアミン β 受容体の変化．倉橋昌司，黒島晨汎（旭川医大，
第一生理) ……377
456. 寒冷馴化とポリアミン．大野都美恵*，黒島晨汎，八幡剛浩（北海道教育大，栄養生理*・
旭川医大，第一生理) ……378
457. グルカゴンによる耐寒性の増強とその機序．八幡剛浩，黒島晨汎，大野都美恵*（旭川医大，
第一生理・北海道教育大，栄養生理*) ……378
458. ラット寒冷順化過程における膵消化酵素とインシュリン放出反応の変化．原田悦守，
葉原芳昭，米沢秀利，渋谷　泉，菅野富夫（北大，獣医，生理) ……378

32. サーカディアンリズム (459—467)

459. ラット外側膝状体シナプス伝達の日周リズム．花田安弘，川村　浩*（東大，文，心理・
三菱化成生命研，脳神経生理*) ……379
460. 脳内神経活動のサーカディアンリズムと視交叉上核の神経活動．井上慎一，川村　浩
(三菱化成生命研，脳神経生理) ……379

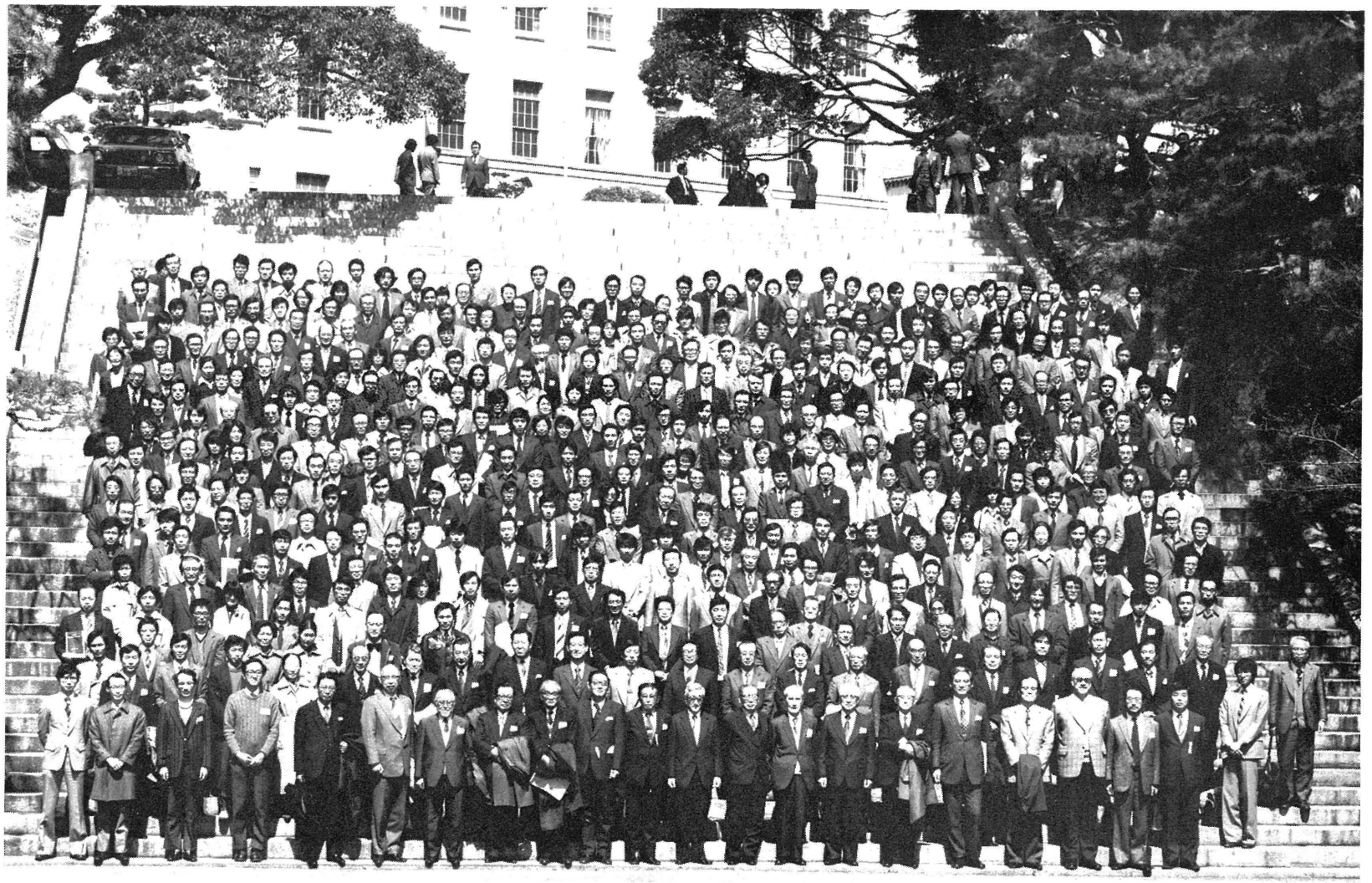
461. 思春期前メスラットにおけるプロラクチン分泌の半日周リズム．貴邑冨久子，川上正澄
(横浜市大，医，第二生理)……379
462. 睡眠リズムと性ホルモン（ラット間系統差)．山岡貞夫（埼玉医大，第一生理)……380
463. ラット血漿コルチコステロンリズムの個体発生—位相角の決定時期—．渡辺憲治，本間研一，
遠藤満智子，広重　力（北大，医，第一生理）……380
464. ホルモン概日リズムと Zeitgeber-給食サイクルと生物時計の結びつき．広重　力，渡辺憲治，
遠藤満智子（北大，医，第一生理）……380
465. アフリカマイマイの歩行活動に見られるサーカディアン・リズム．小笠原　卓，田崎京二
(東北大，医，第二生理)……381
466. ゾウリムシの生理時計機構におけるエネルギー代謝と生体膜の役割．長谷川建治，片倉　隆，
田中舘明博*，石川　広*（北里大，医，生理・生物物理*)……381
467. 腸管運動からみた体内時計の resetting．佐々木　隆，古閑利英子，続　修二（熊本大，
体質医研，生理）……381

33. 睡　眠 (468—471)

468. 正常ラットの睡眠—覚醒リズムと睡眠促進物質の効果．本多和樹，菰田泰夫*，井上昌次郎
(東京医歯大，医用研，制御・化学*)……382
469. 電撃痙攣のラットの睡眠におよぼす影響．長田　清，石川長英，台之尊啓次郎*，松本淳治
(徳島大，医，第二生理・久留米大，医，精神科*)……382
470. 蛋白質・核酸合成阻害と睡眠．上江洲栄子，佐野敦子，松本淳治（徳島大，医，第二生理）……382
471. クロラムフェニコールによる逆説睡眠阻害に対する睡眠促進物質の拮抗的作用．長崎紘明，
入来正躬（東京都老人総研，生理）……383

34. その他 (472—474)

472. 新生児からの性教育．高橋　誠（千葉短大，生物）……384
473. 有機陰イオンのいわゆる浸透圧性利胆作用の再検討．木谷健一（東京都老人総研，臨床
第一生理）……384
474. サリノマイシンの安全性試験（第2報)．浅羽　裕，渡辺哲郎，角谷隆司，福井正佳，
太田秀雄，関　園子（神奈川歯大，口腔生理）……384



第57回日本生理学会大会　　於：神戸大学　1980. 3

第57回日本生理学会大会を顧みて

第57回日本生理学会大会
当番幹事　岡　本　彰　祐・塙　　功

神戸大学で開催した第57回日本生理学会大会には，約1,400名の会員の方に御出席いただき，口演286題，ポスター・シンポジウム展示187題，計473題の発表がありました．会員の方々の御協力に厚く御礼申し上げます．

大会は昭和55年3月27日(木)，28日(金)，29日(土)の三日間，神戸大学の本部のあります六甲台学舎の大講堂および経済学部，経営学部，法学部の学舎において行われました．尚，大会にさき立ち，3月26日(水)，常任幹事会および委員会は神戸大学医学部基礎学舎で開催された次第です．

この大会の準備，運営にあたり，会員各位の御協力に深く感謝する次第であります．

尚，神戸における大会の準備ならびに運営にあたり，とくに問題となりました諸点につき，考えるところを記します．今後の大会のあり様をさぐる上の資料のひとつに役立てばとひそかに念願する次第であります．

Ⅰ

日本生理学会の大会のあり様も，あるいは曲り角に近づいているのではなかろうか，という気持を心のどこかにお持ちの方もおられるのではなかろうか．演題数の過大化，専門分野の拡大と細分化がその理由として考えられはじめている．

すでに国際生理学連合では，総会のあり方とサテライト学会との関連等にホットな討論が続いているときく．同じことが日本生理学会でも問題になりうるからである．

神戸学会の準備に当って，私どもは当然このような問題に慎重な考慮を払うこととなった．

Ⅱ

日本生理学会は，中央集権的民主主義というよりも，もっとリベラルな運営をその伝統としてきた．特別講演，学術シンポジウムなどは原則として採用されないまま今日に至った．他の学会に多い「宿題報告」なども，故戸塚日医大学教授の言葉を借りれば，「子供じゃあるまいし，宿題出されて勉強するものか」というように，学会による発表への何らかの規制を忌避するのが伝統であった．

しかし変化の兆しは慈恵における第56回大会においてすでにみられた．ポスターが採用され，シンポジウムが人々を集めた．

Ⅲ

神戸学会では，慎重な検討の結果，ポスター・シンポジウムを採用することとした．これには2つの原則がとられた．第一にむしろ優れた研究をできるだけポスターに廻した．第二にポスター発表のシステム化をはかった．すなわち，一定のテーマのもとにポスターを集め，議長を定め，十分な討論をお願いした．

この方法は，1978年パリの国際血液学会でカン教授の決断によって大規模に採用され，好評を博したものであった．しかし日本で成功するか否か，私どもはかなり懸念をもったが，大方の十二分の満足を得たように思えて胸をなでおろした次第である．ただし，この方法は，かなり多数の平面講堂を必要とするという難点が残る．

Ⅳ

神戸では教育シンポジウムの他に，「研究のあり方シンポジウム」を企画した．思いの他に多数の出席者があり，それなりの討論はあったが，「研究のあり方を研究する」ことは，未だしの感が残った．どのようにして創造的な研究をするか，などの具体的な問題にしぼって，今後検討をつづけられることを期待したい．

Ⅴ

船上懇親会では，参加者に「生理学会はひとつ」の実感をもっていただけた．国際学会がそうであるように，国内学会も懇親がやはり重要なファクターだとつくづく考えた次第であります．

THE 57th ANNUAL MEETING
OF
THE PHYSIOLOGICAL SOCIETY OF JAPAN

Titles and Authors

March 27—29, 1980

Kobe University School of Medicine, Kobe

1. Methodology (1—7)

1. Application of chromaticity coordinates for quantification of color reactions. Chichibu, S. (Dept. of Physiol., Kinki Univ. Sch. Med., Sayama, Osaka, 589) ····217
2. Reconsideration on convenient method for recording and measuring a tiny quantity of fluid. Inomata, K., Tamagawa, K., Ito, K. and Nakamura, H.* (Dept. of Physiol. Sch. of Dent., Higashi-Nippon-Gakuen Univ., Dept. of Oralphysiol., Sch. of Dent., Higashi-Nippon-Gakuen Univ.*, Ishikari-Tobetsu, Hokkaido, 061-02) ····217
3. A microprocessor controlled stimulator for generating complex pulse patterns. Hanai, S. (Dept. Physiol., Fujita-Gakuen Univ. Sch. Med., Toyoake, Aichi, 470-11) ····217
4. Application of a multi-microelectrode system for neurophysiological experiments. Aikawa, S., Kobayashi, S., Ohta, K.*, Aoki, K.*, Akita, H.* and Sato, A.* (Dept. of Neurophysiol. Seishin-Igaku Inst., Itabashi-ku, Tokyo., Dept. of Physiol. Sch. of Hygenic Sciences Kitasato Univ., Sagamihara-city, Kanagawa*) ····218
5. Estimation of the number of active motor units by statistical processing the surface electromyogram. Yoshida, M., Kanosue, K.*, Akazawa, K. and Fujii, K. (Fac. of Eng., Osaka Univ., Second Dept. of Physiol. Osaka Univ. Med. School*) ····218
6. Diffusion coefficients of intracellular molecules in muscle measured by pulsed-fleld gradient NMR. Yoshizaki, K., Seo, Y., Nishikawa, H. and Morimoto, T. (Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto, 602) ····218
7. Enzyme kinetics study by stedy-state dialisis method. Hasimoto, M., Uozumi, M. and Higasi, T. (Dept. of Physico-chemical Physiol., Med. Sch., Osaka Univ., 4-3-57 Nakanoshima, Kita-ku, Osaka) ····219

2. Molecular Physiology (8—16)

8. Rational Solution of the Nernst-Planck-Poisson Equations. Shinagawa, Y. (Dept. of Physiol., Kyoto Univ. Med. Sch. Sakyo-ku, Kyoto 606)····220
9. Physico-chemical properties of pancreatic zymogen granules studied by laser light scattering. Warashina, A. (Dept. Physiol., Niigata Univ. Sch. Med., Asahi-machi, Niigata, 951)····220
10. Nuclear Magnetic Relaxation of Spin-3/2 Nuclei in Heterogeneous Systems. Monoi, H. (Dept. Physiol., Tohoku Univ. Sch. Med., Sendai, 980)····220
11. Study on phospholipid in biomembrane by 31-phosphor nuclear magnetic resonance Watari, H., Nishikawa, H.* and Asato, R.** (Dept. of Molecular Physiol., National Inst. for Physiol. Sciences, Okazaki 444, Dept. of Physiol., Kyoto Prefect. Univ. of Med., Kyoto 602*, Dept. of Neurosurgery, Kyoto Univ. Med. Sch., Kyoto 606**)····221
12. Resonance Raman spectra of semiquinone forms of flavins bound to riboflavin binding protein. Nishina, Y., Shiga, K., Watari, H., Horiike, K.*, and Tojo, H.* (National Institute for Physiol. Sci., Okazaki, 444 and Dept. Biochem., Osaka, Univ. Sch. Med., Osaka, 530*)····221
13. The π-electronic structure of 8-amino-8-demethyl-D-riboflavin. Shiga, K., Nishina, Y., Watari, H., Horiike, K.* and Tojo, H.* (National Inst. for Physiol. Sci., Okazaki, 444 and Dept. Biochem., Osaka Univ. Sch. Med., Osaka, 530*) ····221
14. Effects of various protein inhibitors on albumin electrophoretic pattern. Kawaguchi, T.

and Matsushita, H. (Dept. of Physiol., Wakayama Med. College, Kyuban-cho, Wakayama) ····222

15. Intramolecular sulfhydryl disulfide exchange reaction of bovine plasma albumin (BPA) molecular ageing. Inouye, H., Era, S., Nagaoka, S. and Sogami, M. (Dept. of Physiol., Sch. of Med. Gifu Univ., Gifu 500)····222
16. Time-resolved fluoropolarimetric studies on reduced protin-sodium dodecyl sulfate complexes. Sogami, M., Nagaoka, S., Inouye, H., Era, S. and Ashida, H.* (Dept. of Physiol. Sch. of Med. Gifu Univ., Gifu 500 and Dept. of Physiol. Defence Med. Col., Tokorozawa, 359*) ····222

3. Cellular Physiology (17—40)

17. Establishment of Cell Lines (MC3T3) from Mouse Calvaria. Kodama, H., Amagai, Y. and Kasai, S. (Dept. of Physiol., Tohoku Dental Univ., Koriyama Fukushima 963)····223
18. Nerve growth factor (NGF)-induced fiber outgrowth and electrical excitability in cultured adrenal medullary cells. Ogawa, M., Asami, K., Irimajiri, A., Ishikawa, T.* and Seguchi, G.* (Dept. of Physiol. and Dept. of Anat., Kochi Med. Sch., Nankoku, Kochi, 781-51*) ····223
19. External calcium ion and mouse macrophage. Ori, M., Shiba, Y. and Kanno, Y. (Dept. Physiol., Hiroshima Univ. Sch. Dent., Hiroshima, 734) ····223
20. Effects of tetraethylammonium, 4-aminopyridine and local anesthetics on cell coupling formation. Enomoto, T., Shiba, Y. and Kanno, Y. (Dept. Physiol., Hiroshima Univ. Sch. Dent., Hiroshima, 734) ····224
21. Oligonucleotide-like cell proliferation inhibitory factors in rat liver supernatant. Hatase, O., Kuramitsu, M., Matsui, H., Tokuda, M., Takahashi, F. and Hori, Y. (Dept. Physiol., Okayama Univ. Med. Sch., Okayama) ····224
22. Induction of rat hepatocyte DNA synthesis in primary monolayer culture. Hasegawa, K., Ohtake, H. and Koga, M. (Dept. of Physiol., Dokkyo Univ. Sch. of Med. Mibu, Tochigi 321-02) ····224
23. On the aspects of intracellular ATP level and macromolecular syntheses in the cell cycle of L cells. Yamaguchi, H., Yonezu, T., Tanabe, S. and Oka, Y. (Dept. of Physiol., Sch. of Med., Tokushima Univ., Kuramoto-cho, Tokushima, 770)····225
24. New parameter reflecting T-cell-differentiation by thymus humoral factor (THF). Kinoshita, Y., Kimura, S., Kimura, E. and Nakamori, H.* (Dept. of Physiol. and Gynecol*., Osaka City Univ. Med. Sch., Abeno-ku, Osaka, 545)····225
25. Physiological aproach to spontaneous healing with cortisone-L-carnosine-system. Nagai, K. (Dept. of Physiol., Nihon Univ. Sch. of Dent. Tokyo, 101) ····225
26. Pancreatic acinar cells : The effect of L-amino acids on membrane potential and resistanse. Iwatsuki, N. and Nishiyama, A.* (Dept. Physiol., Dundee Univ., U. K. Dept. Applied Physiol., Tohoku Univ. Sch. Med., Sendai, 980. Dept. Physiol., Yamagata Univ. Sch. Med., Yamagata*) ····226
27. Elemental distribution in the pancreatic acinar cells determined by electron probe X-ray microanalysis. Nakagaki, I., Sasaki, S., Murakami, M., Mori, H., Imai, Y., Teranishi, S. and Shiguma, M. (Dept. of Physiol., Osaka Med. Coll., Takatsuki, Osaka 569) ····226

28. Dynamic changes of K net fluxes induced by stimulation of salivary glands in vitro. Katoh, K., Konno, K. and Nishiyama, A. (Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata City, Yamagata, 990-23) ····226
29. Influence of methylmercury on the tissue respiration and the net movement of Hg^{++} and K^{+} ions. Onishi, M. and Matsumoto, Y.* (Dept. Physiol., Kagoshima Univ. Sch. Med., Kagoshima, 890. National Inst. for Minamata Disease, Minamata, Kumamoto, 867*) ····227
30. The effects of external Cl^{-} and temperature on membrane potentials of newt red cells. Fukushima, M., Kawano, K. and Ibuki, C. (1st Dept. Physiol. Nippon Med. Sch. Bunkyoku, Tokyo, 113)····227
31. Protein phosphorylation in the stellate ganglion of the squid. Horie, H., Hori, H., Yoshioka, T. and Takenaka, T. (Dept. Physiol., Yokohama City Univ. Sch. Med., Minamiku, Yokohama, 232)····227
32. ^{31}P-NMR study on phosphorus compounds in nervous tissues of different species. Nishikawa, H., Yoshizaki, K., Morimoto, T. and Asato, R.* (Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto, Dept. of Neurosurgery, Kyoto Univ. Med. Sch., Sakyo-ku, Kyoto*) ····228
33. Different activations of adenylate cyclase by NaF and of guanylate cyclase by NaN_3 in neuronal and glial cell fractions from rat cerebral cortex. Nanba, T., Ando, M., Nagata, Y. and Nakazawa, K.* (Dept. of Physiol., Sch. of Med., Fujita-Gakuen Univ., Toyoake, Aichi 470-11, Dept. of Pharmacol., Fac. of Med., Kyoto Univ., kyoto 606*) ····228
34. Cyclic nucleotide phosphodiesterase in rat submandibular gland. Yokoyama, N., Abe, M. and Furuyama, S. (Dept. Physiol., Nihon Univ. Sch. Dent. at Matsudo, Matsudo, Chiba 271)····228
35. Biosynthesis of the rat hepatocyte receptor specific for serum asialoglycoproteins. Nakada, H., Sawamura, T. and Tashiro, Y. (Dept. of Physiol., Kansai Med. Univ., Moriguchi 570) ····229
36. Protein-lipid interaction in mitochondrial membrane. Fujimura, H., Nakase, Y., Tamai, Y. and Tsujimoto, T. (Dept. Physiol., Wakayama Med. Coll., Wakayama, 640)····229
37. Fluorescence quenching by SH reagents on brain tubulin. Sakai, S., Aizawa, K., O'hata, S. and Yamao, M.* (Dept. of Physiol. Tokyo Med. Coll., Shinjuku-ku, Tokyo 160. Dept. of Biol., O'tsuma Women's Univ. Chiyoda-ku, Tokyo 102*)····229
38. On the analysis of the relation between ordering arrangement of amino acids and their functions. O'hata, S., Aizawa, K., Sakai, S., Kitahara, M., Saeki, M. and Yamao, M. (Dept. of Physiol., Tokyo Med. Coll. Shinjuku-ku Tokyo, 160)····230
39. Measurement of carotenoid on membrane by the high speed micro Raman spectrometer. Aizawa, K. and O'hata, S. (Dept. Physiol., Tokyo Med. Coll. Shinjuku-ku Tokyo, 160)····230
40. Dielectric dispersion of isolated chromaffin granules. Asami, K., Ogawa, M. and Irimajiri, A. (Dept. Physiol., Kochi Med. Sch., Okoh-cho, Nankoku, Kochi, 781-51) ····230

4. Membrane Physiology (41—59)

41. Studies on penetration phenomena through intestinal membrane. Nakano, S., Yoshioka, T., Narusawa, M. and Nagami, K. (Dept. Physiol., The Tokai Univ. Sch. Med. Isehara, Kanagawa, 259-11)····231

42. Purification of renal and intestinal brush border membranes and reconstitution of sugar/Na^+ and amino acid/Na^+ cotransport systems. Kano, A., Ohsawa, K. and Hoshi, T. (Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo, 113)……231
43. α-ketoglutalate-induced stimulation of p-aminohippurate uptake by rat kidney coptex slices. Hayashi, H. (Tohoku Univ. Coll. of Med. Sci., Sendai.) ……231
44. Unique properties of electrical phenomena associated with glycylglycine transport by guinea pig small intestine. Himukai, M., Kawahara, K. and Hoshi, T. (Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo, 113) ……232
45. Cadmium-induced increase in the active transport of sodium : Counteraction of calcium and amiloride with cadmium. Takada, M. and Hayashi, H. (Dept. of Physiol., Saitama Med. Sch., Iruma-gun, Saitama, 350-04)……232
46. Effects of Ca ion on the proximal tubular cell membrane. Kotera, K., Kubota, T., Honda, M., Naito, K. and Fujimoto, M. (Dept. Physiol., Osaka Med. Coll., Takatsuki, Osaka, 569) ……232
47. Role of cellular c-AMP and Ca in the action of prostaglandin E_1 on active Cl transport across toad ciliary epithelium. Saito, Y. and Watanabe, T.* (Dept. of Physiol. and Ophthalmol., Tohoku Univ. Sch. Med., Sendai*)……233
48. Transport ATPase in gastric vesicle. Kashiwagura, T., Morii, M. and Takeguchi,N. (Fac. Pharmaceu. Sci., Toyama Med. and Pharmaceutical Univ., Sugitani, Toyama, 930-01) ……233
49. Effects of phenazine methosulfate on the membrane Rb^+ transport in HeLa cells. Miyamoto, H., Sakai, T. and Ikehara, T. (Dept. Physiol., Kinki Univ. Sch. Med., Sayama-cho, Osaka, 589) ……233
50. Effect of PMS+NADH on Na^+, K^+-ATPase and HCO_3^--ATPase from kidney of guinea pig. Kaniike, K. (Dept. Physiol., Kinki Univ. Sch. Med., Sayama, Minamikawachi, Osaka, 589) ……234
51. Effects of ouabain on NaCl and water transport across the seawater eel intestine. Ando, M. (Lab. Physiol., Fac. Integrated Arts and Sci., Hiroshima Univ., Higashisenda-machi, Hiroshima, 730) ……234
52. The inhibition of insulin-stimulated Na efflux by ouabain. Kitasato, H., Marunaka, Y., Murayama, K. and Nishio, K. (Dept. Physiol., Shiga Univ. of Med. Sci., Ohtsu, 520-21) ……234
53. Effect of ouabain on pancreatic enzyme release in the isolated rabbit pancreas. Saito, T. (Dept. Vet. Pharmacol., Fac. Agr., Tottori Univ., Koyama-cho, Tottori) ……235
54. The mechanism of adrenaline hyperpolarization in the rat diaphragm. Nohmi, M. and Kuba, K. (Dept. Physiol., Saga Med. Sch., Saga 840-01) ……235
55. Regulatory mechanism of cell pH in the renal proximal tubule. Matsumura, Y., Aoki, S., Kajino, K. and Fujimoto, M. (Dept. Physiol., Osaka Med. Coll., Takatsuki, Osaka, 569)……235
56. Excocytotic release of catecholamines from the perfused cat adrenal by Na^+-free media. Sorimachi, M., Nishimura, S., Yamagami, K. and Onishi, M. (Dept. Physiol.., Kagoshima Univ. Sch. Med., Usuki, Kagoshima, 890)……236
57. Impedance changes of salivary gland during secretion. Imai, Y., Nakahari, T., Murakami, M. and Mori, H. (Dept. of Physiol. Osaka Med. Coll. Takatsuki, Osaka) ……236
58. Sexual difference of secretory pattern of esterase in the mouse submandibular gland.

Izumi, H. and Aoki, T. (Dept. Physiol., Tohoku Univ. Sch. Den., Sendai 980) ····· 236

59. The effect of acetylcholine concentration on secretory responses, redox state and membrane potential of the pancreatic acinar cell. Kanno, T., Habara, Y., Saito, A. and Yonezawa, H. (Dept. of Physiol., Hokkaido Univ. Fac. Vet. Med. Kita-ku, Sapporo, 060) ····· 237

5. Excitable Membrane (60—84)

60. Asymmetrical capacitance currents and the inactivation of sodium channels. Murayama, K., Kitasato, H., Nishio, K. and Marunaka, Y. (Dept. Physiol., Shiga Univ. of Med. Sci., Ohtsu, 520-21) ····· 238

61. Differentiation of excitable cells in cleavage-arrested embryos of an ascidia. Takahashi, K., Yamashita, N. and Yoshii, M. (Dept. Neurophysiol., Inst. Brain Res., Sch. Med., Univ. Tokyo and Dept. Physiol., Nippon Med. Sch., Bunkyo-ku, Tokyo, 113) ····· 238

62. A Ca-activated transient K current in snail neurons. Akaike, N. and Nishi, K. (Dept. of Pharm., Kumamoto Univ. Med. Sch., Kumamoto 860) ····· 238

63. Hyperpolarizing response in the soma of crayfish median giant fiber. Arita, A. and Hayashi, H. (Dept. Physiol., Saitama Med. Sch., Moroyama, Iruma-gun, Saitama, 350-04) ····· 239

64. Effects of Na and Ca ions on the membrane potential of a *Onchidium* beating pacemaker neurone. Gotow, T., Anraku, M. and Hashimura, S. (Dept. of Physiol., Sch. of Med., Kagoshima Univ., Kagoshima, 890) ····· 239

65. Bursting activity and intracellular proteins in snail neurons. Onozuka, M., Furuichi, H., Iwata, T., Sugaya, E., Tsuda, T.*, Sugaya, A.*, Aso, H.** and Hirano, S.** (Dept. Physiol., Kanagawa Dental Coll., Yokosuka, 238, Faculty of Pharmaceutical Sci., Josai Univ., Sakado, Saitama, 350-02* and Dept. Physiol. Sch. Med. Toho Univ., Tokyo, 143**) ····· 239

66. Bursting activity and calcium in snail neurons. Furuichi, H., Onozuka, M., Kobori, T., Yamada, K., Sugaya, E., Tsuda, T.* and Sugaya, A.* (Dept. Physiol., Kanagawa Dental Coll., Yokosuka, 238, and Faculty of Pharmaceutical Sci., Josai Univ., Sakado, Saitama, 350-02*) ····· 240

67. Nerve excitation induced by intracellular perfusion of Ca, Mg and Mn inons in squid giant axons. Yamagishi, S., Furuya, K. and Kukita, F. (Dept. of Cell Physiol., Nat. Inst. Physiol. Sci., Myodaiji, Okazaki, 444) ····· 240

68. Effects of aromatic amino acid derivatives on the excitability of a giant neurone. Takeuchi, H. and Tamura, H. (Dept. Neurochem., Inst. Neurobiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama 700) ····· 240

69. Synthesis of photoaffinity labelling reagent of TTX derivatives and its effect on the squid giant axon. Hori, H., Horie, H., Takenaka, T. and Yoshioka, T. (Dept. of Physiol. Yokohama City Univ. Minami-ku, Yokohama) ····· 241

70. Photoaffinity labeling of the tetrodotoxin binding proteins in *Electophorus electricus* electroplax membranes. Uehara, S. and Uyemura, K. (Dept. of Physiol., Saitama, Med. Sch., Moroyama, Saitama 350-04) ····· 241

71. Changes in morphological and physiological properties of tissue-cultured nerve cells

associated with breakdown of cytoskeletons by cytochalasin B or colchicine. Fukuda, J. and Kameyame, M. (Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo 113) ····241

72. Two kinds of potential fluctuations in the sensory nerve terminal of the frog muscle spindle. Ito, F., Fujitsuka, N. and Kaneko, N. (Dept. of Physiol., Nagoya Univ. Sch. of Med., Nagoya)····242

73. The characteristics of Aplysia nerve on its stretching. Koike, H. (Dept. Neurophysiol., Tokyo Metropolitan Inst. for Neurosciences, Fuchu City, Tokyo)····242

74. Increase in length of internode of the sensory nerve fiber depending on the distance from the nerve ending. Yamamoto, T. and Sakada, S. (Dept. Physiol., Tokyo Dent. Coll., Chiyoda-ku, Tokyo, 101) ····242

75. ^{31}P-NMR study on ordered structure of phospholipids in excitable membranes. Nishikawa, H., Yoshizaki, K., Morimoto, T. and Asato, R.* (Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto, Dept. of Neurosurgery, Kyoto Univ. Med. Sch., Sakyo-ku, Kyoto) ····243

76. Structure-activity relationship of grayanotoxins. Seyama, I. (Dept. Physiol., Hiroshima Univ. Sch. Med., Hiroshima 734) ····243

77. Analysis of the muscle resistance and capacitance owing to the transient potential and inclination by a half sine current. Saito, T. (Dept. of Physiol., Nippon Dental Univ.)····243

78. Analysis of the muscle resistance and capacitance by two exponential function. Saito, T. (Dept. of Physiol., Nippon Dental Univ.)····244

79. A factor from nervous tissue promotes the development of tetrodotoxin-sensitive sodium channels on chick skeletal muscle cells in culture. Kano, M., Yamazaki, S., Sato, T. and Yamamoto, M. (Dept. of Physiol., Sch. of Med., Kitasato Univ., Sagamihara, Kanagawa, 228) ····244

80. Role of Ca channel in oscillating hyperpolarizing responses in L-strain fibroblasts. Okada, Y., Tsuchiya, W., Yawo, H., Yada, T., Sasaki, S.*, Nakagaki, I.* and Imai, Y.* Dept. Physiol., Kyoto Univ. Sch. Med., Sakyo-ku, Kyoto, 606 and Osaka Med. Coll., Takatsuki 569*) ····244

81. Development of electrical membrane properties in chick cortical neurons. Mori, J., Ashida, H., Maru, E. and Tatsuno, J. (Dept. Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama) ····245

82. Relationship between the variation of viscoelasticity and the excitation on the giant axon of the crayfish nerve. Ichikawa, O., Miyoshi, M., Kasagi, T.* and Hiji, Y. (Tottori Univ. Sch. of Med. Yonago and Dept. of Nursing, Tottori Univ. Col. of Med. Care Technol. Yonago*) ····245

83. Effect of tetrodotoxin and tetraethylammonium of the slow excitatin process in perfused squid giant axons. Watanabe A. and Sakai, T. (Dept. Physiol., Tokyo Med. and Dent. Univ., Sch. of Med., Bunkyo-ku, Tokyo, 113) ····245

84. Relation between the value of membrane potential and variability of membrane resistance due to stimulating current in nerve fiber. Matumoto, M. and Sano, M. (Dept. Oral Physiol., Showa Univ. Sch. of Dent., Shinagawa-ku, Tokyo) ····246

6. Synapse (85—109)

85. Some properties of spinal neurons underlying the spino-bulbo-spinal reflex of the cat. Shimamura, M. and Kogure, I. (Dept. of Neurophysiol., Tokyo Metro. Inst. for Neurosci., Musashidai, Fuchu, 183) ····247
86. Lingually-induced IPSPs in hypoglossal motoneurons after axotomy. Takata, M. (Dept. Oral Physiol., Tokushima Univ. Sch. Dent., Kuramoto-cho, Tokushima)····247
87. On the effect of Ca on the aminopyridine rapid cooling contraction. Anraku, M. and Hashimura, S. (Dept. of Physiol., Fac. of Med., Kagoshima Univ., Kagoshima) ····247
88. Desensitization of the muscarinic receptor in bullfrog's atrium. Hasuo, H., Tokimasa, T. and Koketsu, K. (Dept. Physiol., Kurume Univ. Sch. Med., Kurume, 830) ····248
89. Effect of diisopropylfluorophospate (DFP) on the frog neuromuscular junction. Kita, T. Dept. Physiol., Fukuoka Univ., Sch. of Med., Nishiku, Fukuoka, 814)····248
90. Effects of Benzalkonium chloride on the neuromuscular transmission. Takeuchi, N., Takikawa, Y. and Shibuya, N.* (Dept. Physiol., Sch. Med., Juntendo Univ., Bunkyo-ku, Hongo, Tokyo, Dept. Neurol. National Kawatana Hospital, Kawatanamachi, Nagasaki*) ····248
91. Desensitization of the changes in the action potentials of nerve cells by a muscarinic action of ACh. Akasu, T. and Koketsu, K. (Dept. Physiol., Kurume Univ. Sch. Med., Kurume, 830) ····249
92. Actions of catecholamines on the sympathetic ganglion cells of bullfrogs. Mochida, S. and Tosaka, T. (Dept. Physiol., Tokyo Med. Coll., Shinjuku-ku, Tokyo 160) ····249
93. Nature of depolarizing membrane potential changes induced by cyclic GMP in the sympathetic ganglion cells of rabbits. Hashiguchi, T., Mochida, S., Kobayashi, H. and Ito, J. (Dept. Physiol., Tokyo Med. Coll., Shinjuku-ku, Tokyo 160) ····249
94. Effects of Ca^{2+} and caffeine on the subsynaptic membrane of the nicotinic synapse in the sympathetic ganglion cell. Kuba, K., Minota, S., Kato, E.* and Morita, K.* Dept. Physiol., Saga Med. Sch., Saga 840-01 and Dept. Physiol., Kurume Univ. Sch. Med., Kurume 830*) ····250
95. High-gain synapse in the sensory transduction of the ampullary electroreceptors. Obara, S. and Higuchi, T.* (Dept. of Physiol., Teikyo Univ., Sch. of Med., Itabashi-ku, Tokyo, Dept. of Biol., Higashinihon-gakuen Univ., Onbetsu.*) ····250
96. Bioassay and chemical analysis of the afferent neurotransmitter in the ampullary electroreceptor. Umekita, S., Matsumoto, Y. and Obara, S. (Dept. of Physiol., Teikyo Univ., Sch. of Med., Itabashi-ku, Tokyo, 173) ····250
97. Kinetic analysis of drugs showing a large facilitatory action on the motor nerve terminal of the neuromuscular junction. Maeno, T., Enomoto, K. and Ichinose, M. (Dept. Physiol., Shimane Med. Univ., Izumo, Shimane, 693) ····251
98. Effects of tonicity and Na^{+} on tetanic rise in frequency of miniature end-plate potentials in low-Ca^{2+} solutions. Kita, H. and Narita, K. (Dept. Physiol., Kawasaki Med. Sch., Kurashiki, Okayama, 701-01)····251
99. Effect of 5-HT on transmitter release from amphibian cholinergic nerve terminals. Hirai, K. and Koketsu, K.* (Tokyo Res. Lab., Kowa Co. Ltd., Tokyo, 189 and Dept. Physiol., Kurume Univ. Sch. Med., Kurume, 830*)····251

100. Release of glutamate from neuromuscular junction of the crayfish. Takeuchi, A., Onodera, K. and Kawagoe, R. (Dept. of Physiol., Sch. of Med., Juntendo Univ., Hongo, Tokyo 113) ····252
101. The effect of tetanus toxin on the group Ia synapse on the cat motoneuron. Kanda, K. and Toyoda, A. (Dept. Physiol., Sch. Med., Chiba Univ., Chiba 280)····252
102. Voltage-dependent effect of curare at the insect neuromuscular junction. Yamamoto, D. and Washio, H. (Lab. of Neurophysiol., Mitsubishi-Kasei Inst. of Life Sci., Machida, Tokyo 194)····252
103. On the direction of the propagation of TTX-resistant spike in the nerve terminal of lobster. Niwa, A. and Kawai, N. (Dept. Neurobiol., Tokyo Metropolitan Inst. for Neurosciences, 2-6, Musashidai, Fuchu-City, Tokyo, 183)····253
104. Post-synaptic effects of iontophoretically applied LHRH and anti-LHRH antiserum in medial preoptic nucleus neurones in rats. Ban, M. and Yagi, K. (Dept. of Physiol., Jichi Med. Sch., Tochigi) ····253
105. Barbiturates and GABA-induced currents of primary afferent neurons. Higashi, H., Inokuchi, H. and Nishi, S. (Dept. Physiol., Kurume Univ. Sch. Med., Kurume) ····253
106. Fine localization of GABA (γ-aminobutyric acid), GAD (glutamate decarboxylase) and glutamate in a single Deiters' neuron. Okada, Y. (Dept. Neurochem., Tokyo Metropolitan Inst. for Neurosciences, Musashidai, Fuchu-shi, Tokyo 183)····254
107. Synapse formation by neuroblastoma X glioma hybrid cells. Higashida, H., Miyake, A.*, Kano-Tanaka, K.** and Tanaka, T.** (Res. Inst. of Environmental Med., Nagoya Univ., Nagoya 464, Inst. of Equilibrium Res., Gifu Univ., Gifu 500*, Lab. of Cell Biology, Aichi Cancer Center Inst., Nagoya 464**)····254
108. Isoelectric focusing analysis of acetylcholine receptors on the surface of mouse and chick muscle cells in culture. Sugiyama, H. (National Inst. for Physiol. Sci., Myodaiji, Okazaki, 444) ····254
109. Effects of various oniums on the different type of ACh-receptor activities observed in Aplysia ganglion cells. Somei, K., Sasaki, K., Matsumoto, M. and Sato, M. (Dept. Physiol., Iwate Med. Univ., Sch. Med., Morioka, Iwate-ken)····255

7. Spinal Cord (110—119)

110. Single muscle-fibre potentials in response to peripheral nerve stimulation. Homma, I., Ishiyama, Y. and Ebe, M. (Dept. Physiol.. Toranomon Hospital, Minato-ku, Tokyo, 105)····256
111. Neural function and morphology of substantia gelatinosa neurons in the spinal cord. Hayashi, H., Dubner, R. Bennett, G. J. and Abdelmoumene, M. (Dept. Physiol., Fac. Dent., Tokyo Med. Dent. Univ., Tokyo and National Inst. of Dental Res., National Inst. of Health, Bethesda, Maryland) ····256
112. Peripheral origins of human evoked electrospinograms. Shimizu, H., Maruyama, Y., Endo, H. and Shimoji, K. (Dept. Anesthesiol., Niigata Univ. Sch. Med., Asahi-machi 1, Niigata, 951)····256
113. Phythmic burst discharges of the spinal cord mediating the spontaneous tremor in monkeys with mesencephalic lesion. Ohye, C., Imai, S., Miyazaki, M., Nakajima, H., Hirai, T., Tasaki, K., Tsukahara, Y. and Matsushima, T. (Dept. Neurosurg., Gunma

Univ. Sch. Med., Maebashi, Gunma, 371) ……257
114. Muscle spindle sensitivity of human extensor digitorum communis muscle and servo hypothesis. Akazawa, K., Fujii, K. and Kanosue, K.* (Dept. Electrical Engineering, Fac. of Engineering, Dept. Physiol., Sch. Med., Osaka Univ., Suita, Osaka, 565*) ……257
115. A model of physiological tremor including two reflex loops. Watanabe, A. and Saito, M. (Inst. of Med. Electron., Univ. of Tokyo, Bunkyo-ku, Tokyo, 113)……257
116. Muscle spindle discharges elicited by random triangular waveform muscle stretches. Homma, S., Hayashi, K. and Nakajima, Y. (Dept. Physiol., Sch. Med., Chiba Univ., Chiba 280)……258
117. A shift of voluntary control of muscular activities observed during varied speed of pedalling movement. Suzuki, S., Watanabe, S. and Homma, S.* (Dept. Physiol., Kyorin Univ. Sch. Med., Mitaka, Tokyo, 181 and Dept. Physiol., Chiba Univ. Sch. Med., Chiba, 280*) ……258
118. Evidence for a transcortical reflex : responses of primate motor cortex neuron to ramp stretch of muscles. Sakai, T., Preston, J. B.* and Uemura, K. (Dept. of Neurosurg., Hamamatsu Univ. Sch. of Med., Hamamatsu and Dept. of Physiol., SUNY Upstate Med. Ctr., Syracuse, N. Y., U. S. A.*) ……258
119. A study on the duration time in chewing movement, being changed the vertical dimention. Sakai, T., Kono, M. and Kamogawa, H. (Dept. Physiol., Nihon Univ. Sch. Dent.)……259

8. Neural Connection (120—131)

120. Tooth pulp neurons in marginal layer of trigeminal subnucleus caudalis. Nishikawa, Y., Ohno, S., Kakudo, Y. and Yokota, T.* (Dept. of Physiol. Osaka Dental Univ., Kyobashi, Higashi-ku, Osaka, Dept. of Physiol., Med. Coll. of Shiga, Seta, Otsu*)……260
121. Midbrain neurons relaying optic signals which induce mossy fiber response in the cerebellar flocculus. Maekawa, K. and Kimura, M. (Dept. of Physiol., Jichi Med. Sch., Minamikawachi-machi, Tochigi-ken) ……260
122. Central pathways of the glossopharyngeal (IXth) nerve fibers in frogs studied by HRP method. Hanamori, T. and Ishiko, N. (Dept. Physiol., Miyazaki Med. Coll., Miyazaki, 889-16) ……260
123. Parasympathetic oculomotor neurons controlling lens accommodation in the cat. Bando, T., Tsukuda, K. and Tsukahara, N. (Dept. Biophysical Eng. Fac. Engineering Sci., Osaka Univ., Toyonaka, Osaka 560)……261
124. Mesencephalic inputs to the facial nucleus in the cat. Tanaka, T., Asahara, T. and Takeuchi, Y.* (Dept. Physiol., Sch. Med., Mie Univ., Tsu, Mie-ken, Dept. Oral Anat., Sch. Dent., Hiroshima Univ., Hiroshima*) ……261
125. Responses of interstitiospinal neurons to tectal, cortical and peripheral stimuli. Fukushima, K., Murakami, S., Ohno, M. and Kato, M. (Dept. Physiol., Hokkaido Univ. Sch. Med., Sapporo, 060) ……261
126. Neurons in the trigeminal sensory nuclei sending axons to neck motoneurons in cats. Sumino, R. and Kato, M. (Sec. Physiol., Inst. Stomatognathic Sci., Sch. Dent., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo, 113) ……262
127. Neck muscle afferent projection onto trigeminal subnucleus caudalis. Yokota, T. (Dept.

of Physiol., Med. Coll. of Shiga, Seta, Otsu 520-21) ····262
128. Vestibular inputs to spinocerebellar tract cells of the central cervical nucleus in the cat. Hirai, N.*, Hongo, T., Sasaki, S. and Yoshida, K. (Dept. of Physiol., Inst. of Basic Med. Sci., Univ. of Tsukuba and Dept. of Physiol., Kyorin Univ. Sch. Med.*)····262
129. Interaction of vestibular and neck afferents in vestibulospinal tract neurons. Hirai, N.*, Brink, E. and Wilson, V. J. (The Rockefeller Univ., and Dept. of Physiol., Kyorin Univ. Sch. Med.*) ····263
130. Cat medial pontine reticular neurons related to vestibular nystagmus : firing pattern, location and projection. Nakao, S. and Markham, C. H.* (Dept. Physiol., Tottori Univ. Sch. Med., Yonago, 683, Dept. Neurol., UCLA Sch. Med., Los Angeles, California, 90024*) ····263
131. An analysis of neuronal connections in the motor cortex of the cat by the cross-correlation method. Endo, K. and Araki, T. (Dept. of Physiol., Fac. of Med., Kyoto Univ., Sakyo-ku, Kyoto 606) ····263

9. Brain Stem and Diencephalon (132—141)

132. Dual pathways mediating mammillary body responses to fornical and septal stimulation. Kobayashi, N. (Dept. Radiological Technol., Kanazawa Univ., Sch. Paramed., Kanazawa, 920) ····264
133. Neuronal mechanisms in releasing the uropod steering movement in crayfish. Takahata, M. and Hisada, M. (Zool. Inst., Fac. of Sci., Hokkaido Univ., Sapporo) ····264
134. Responses of afferents from the stretch receptors in cat masseter muscle. Inouye, H., Sakan, I. and Morimoto, T. (Dept. Oral Physiol., Osaka Univ. Dent. Sch., Kita-ku, Osaka, 530) ····264
135. Suppression of jaw opening reflex induced by rat raphe stimulation. Tanaka, H., Toda, K.*, Iriki, A.* and Ichioka, M.* (Dept. Anesthesiol., Fac. Med., Dept. Physiol., Fac. Dent., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo, 113*)····265
136. Coefficient of trend on spontaneous single units discharge in the ventrobasal complex. Aikawa, S., Akita, H., Ohta, K., Aoki, K., Sato, A. and Kobayashi, S.* (Dept. of Physiol. Sch. of Hygenic Sci. Kitasato Univ., Sagamihara-city, Kanagawa, Dept. of Neurophysiol. Seishin-Igaku Inst., Itabashi-ku, Tokyo*) ····265
137. Rhythmical burst activity in bulbar reticular neurons related to orbital cortically induced masticatory rhythm in immobilized cats. Enomoto, S., Kato, M. and Nakamura, Y. (Sec. Physiol., Inst. Stomatognathic Sci., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo, 113) ····265
138. Specific unit activity in the diafferented hypothalamic island. Saito, H., Fujita, M., Ushikoshi, A., Seto, K. and Kawakami, M. (Dept. Physiol., Kochi Med. Sch., Nankoku, 781-51) ····266
139. The reflex response of salivary single neuron in cat. Murakami, T., Yoshihara, M., Nakashizu, Y. and Ishizuka, K. (Dept. Oral Physiol., Nippon Dental Univ., Niigata, Niigata, 951) ····266
140. Relations between lateral hypothalamic neuron activity and feeding behavior in chronic rats. Sasaki, K., Fukuda, M., Muramoto, K., Nishino, H. and Ono, T. (Dept. Physiol., Fac. Med., Toyama Med. and Pharmaceutical Univ. Toyama 930-01) ····266

141. Monkey orbitofrontal cortex activity in high fixed ratio (FR) schedules for food intake. Oomura, Y., Shimuzu, N., Kita, H., Ishizuka, S., Aou, S., Yoshimatsu, H. and Yamabe, K. (Dept. of Physiol. Fac. Med. Kyushu Univ. 60, Fukuoka, 812) ·····267

10. Cerebellum (142—147)

142. Neurochemical studies on the development of the cerebellum from reeler mutant mice. Mikoshiba, K., Nagaike, K., Kohsaka, S., Takamatsu, K. and Tsukada, Y. (Dept. Physiol., Keio Univ. Sch. of Med.) ·····268
143. Afferent projection from the nucleus reticularis tegmenti pontis to the cerebellar flocculus relevant to optokinetic response in cats. Kawasaki, T., Sato, Y. and Kato, I.* (Dept. Physiol., Toyama Med. and Pharmaceutical Univ., Fac. Med., Sugitani, Toyama and Dept., Otolaryngol., Sch. Med., Yamagata Univ., Zao-Iida, Yamagata*)·····268
144. Derivative action of the dentate neuron in cats. Yamamoto, K. and Odagiri, M. (Div. of Neurophysiol., Psychiatric Res. Inst. of Tokyo, 2-1-8, Kamikitazawa, Setagaya-ku, Tokyo, 156) ·····268
145. The effects of cerebellar surface stimulation upon fastigial neurons. Yokoyama, T., Uemura, K., Dauth, G. W.* and Gilman, S.* (Hamamatsu Med. Univ., Univ. of Michigan, U. S. A*) ·····269
146. Spindle-like positive waves in the cerebellar cortex of the cat. Shimono, T., Hatada, K.*, Ozaki, A. and Mimori, Y.** (Dept. of Physiol. and Dept. of Physiol., Inst. for Brain Res*., Dept. of Geriat.**, Fac. of Med., Kyoto Univ., Kyoto, 606) ·····269
147. Input duality of cerebellar cortex and ungradability of Purkinje cell response. Takahira, H. (Dept. of Physiol., Tokai Univ. Sch. of Med, Bohseidai, Isehara, 259-11) ·····269

11. Telencephalon (148—155)

148. Morphology of physiologically identified monkey pyramidal tract neurons and axon conduction velocity. Hamada, I. and Sakai, M. (Dept. Neurophysiol., Primate Res. Inst., Kyoto Univ., Inuyama City, Aichi, 484) ·····270
149. Prefrontal neuron activities during spatial delayed response and color discrimination with delay. Funahashi, S. and Kubota, K. (Dept. Neurophysiol., Primate Res. Inst., Kyoto Univ., Inuyama, Aichi, 484) ·····270
150. Neuronal activity in the hindlimb area of the supplementary motor cortex. Tanji, J. (Dept. of Physiol., Hokkaido Univ. Sch. Med.,) ·····270
151. Comparison of the cortical potentials preceding self-paced and visually triggered hand movements in monkeys. Gemba, H., Hashimoto, S. and Sasaki, K. (Dept. Physiol., Inst. Brain Res., Fac. Med., Kyoto Univ., Sakyo-ku, Kyoto, 606) ·····271
152. Postnatal development of evoked responses in somatosensory, visual and auditory cortex of the cat. Kawaguchi, S., Yamamoto, T.*, Samejima, A. and Miyata, H.** (Dept. Physiol., Inst. Brain Res., Fac Med., Kyoto Univ., Sakyoku, Kyoto, 606, Dept. Physiol., Mie Univ. Med. Sch., Tsu, 514*, Dept. Hygiene, Wakayama Med. Coll., Wakayama, 640**) ·····271
153. Disfacilitation in pyramidal cells of rabbit hippocampus. Fujita, Y. (Dept. Physiol., Nippon Med. Sch., 1-1-5, Sendagi, Bunkyo-ku, Tokyo 113)·····271
154. Bilateral semicircular canal Inputs to the vestibular cortical neurons of the cat (II).

Jijiwa, H. and Watanabe, S. (Inst. Equilibrium Res., Gifu Univ. Sch. Med., Tsukasa-machi, Gifu, 500)……272

155. Coupling among electrocorticogram, cortical blood flow and cerebral metabolism during lidocaine seizure. Shimoji, K., Matsuki, M., Hashiba, M. and Maruyama, M. (Dept. Anesthesiol., Niigata Univ. Sch. Med., Asahi-machi 1, Niigata, 951)……272

12. Electroencephalogram (156—165)

156. Slope of alpha envelope during alpha blocking. Tatsuno, J., Mori, J., Ashida, H. and Maru, E. (Dept. Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama) ……273

157. Developmental characteristics of the EEG frequency components on the scalp (2). —Interregional relationships of the mentally retarded children's EEG— Ozaki, H., Suzuki, H. and Katada, A.* (Lab. of Physiol., Ibaraki Univ., Mito, Ibaraki, 310, Dept. of Physiol. and Psychol., Tokyo Gakugei Univ., Koganei, Tokyo, 184*) ……273

158. Stimulus-response relation in rat tooth pulp-evoked central responses. Iriki, A., Ichioka, M. and Toda, K. (Dept. Physiol., Fac. Dent., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo, 113) ……273

159. Human somatosensory evoked potentials elicited by electrical skin stimulation of various parts of the hand. Oikawa, T., Fujitani, Y., Allison, T.* and Goff, W. R.* (Dept. of Physiol., Tottori Univ. Sch. of Med., Yonago, Veterans Adm. Hospital and Dept. of Neurol., Yale Univ. Sch. of Med., New Haven*)……274

160. Visually evoked potentials during kindling. Ono, K., Nakatsuka, K. and Baba, H. (Dept. of Physiol., Nagasaki Univ. Sch. of Med.)……274

161. Alterations of spatial distribution of brainstem auditory evoked potentials in lesions of the VIIIth nerve and brainstem. Hashimoto, I., Ishiyama, Y.*, Honma, I.* and Ebe, M.* (Dept. of Neurosurgery, Tokyo Metropolitan Hospital of Fuchu, Tokyo., Dept. of Physiol., Toranomon Hospital, Tokyo)……274

162. Electrical activation of reference electrode on recording of auditory brainstem-responses. Ishiyama, Y., Honma, I., Ebe, M. and Hashimoto, I.* (Dept. Physiol., Toranomon Hospital, Minato-ku, Tokyo, Dept. Neurosurgery, Tokyo Metroporitan Hospital of Fuchu-shi, Tokyo*)……275

163. Fundamental properties of the MV responses in the eyelid caused by acoustic stimulation. Hoshina, Y., Takeo, T., Ozaki, T. and Sasaki, D.* (Dept. Physiol., Hirosaki Univ. Sch. of Med., Hirosaki and Dept. of Internal Med., Hirosaki Univ. Sch. of Med., Hirosaki*) ……275

164. Properties of the potential changes caused in the eyelid by flash stimulation, with special reference to the eye movement. Sasaki, S., Ozaki, T. and Igarashi, K. (Dept. of Physiol., Hirosaki Univ. Sch. of Med., Hirosaki and Dept. of Pediat., Hirosaki Univ. Sch. of Med., Hirosaki)……275

165. Electrophysiological study on the mechanism of the late components of photopalpebral reflex. Yasuhara, M., Naito, H., Nishiura, K. and Hattori, H. (Dept. of Physiol., Kansai Med. Univ., Moriguchi City, Osaka) ……276

13. Behavior (166—175)

166. The change of the behavior trait and the turnover of the glial cell in the rat reared

in the various conditions. Kusunose, R. and Hirao, T. (Dept. Behav. Physiol., Gunma Univ. Sch. Med., Maebashi, 371) ····277

167. Reaction time and inhibition in the motion behavior. Watanabe, T. (Dept. of Physical Education, Yokohama National Univ.)····277

168. Relative contribution to visual pattern discrimination learning of association cortices in the rhesus monkey. Kikuchi, R., Yukie, M. and Iwai, E. (Dept. Behavioral Physiol., Tokyo Metropolitan Inst. for Neurosciences, Fuchu-City, Tokyo, 183)····277

169. Effect of 6-OHDA-treatment on brightness discriminative learning ability in rats with methylazoxymethanol (MAM)-induced microencephaly. Matsutani, T., Nagayoshi, M., Tamaru, M., Nakahara, T. and Tsukada, Y.* (Dept. of Dev. Physiol., Inst. for Comprehensive Med. Sci., Fujita-Gakuen Univ., Sch. of Med., Toyoake, Aichi Dept. of Physiol., Keio Univ., Sch. of Med., Shinjukuku, Tokyo) ····278

170. Effects of tryptophan concentration on the brightness discrimination learning test. Nomura, M. and Nagata, Y. (Dept. Physiol., Sch. of Med., Fujita-Gakuen Univ. Toyoake, Aichi 470-11)····278

171. Associative conditioning mediated by the cortico-rubral synapses in the cat. Oda, Y., Notsu, T. and Tsukahara, N. (Dept. of Biophysical Eng., Fac. of Engineering Sci., Osaka Univ., Toyonaka, Osaka, 560)····278

172. A silent period in the calf muscles prior to the voluntary forward leaning. Iwase, Y., Uchida, T., Takanashi, Y., Suzuki, N., Hashimoto, M., Yamamoto, Y., Takegami, T. and Koyama, H. (Dept. Physiol., Kyoto Pref. Univ. Med., Kamigyoku, Kyoto, 602)····279

173. Characteristics of pursuit tracking movement by displacement of center of gravity (II). Miyake, A., Hayashi, R., Jijiwa, H., Watanabe, S. and Yamaji, K. (Inst. Equilibrium Res. Gifu Univ. Sch. Med., Gifu, 500)····279

174. The relation between the maintenance of the upright posture and the responsiveness of the saccadic eye movements. Hashimoto, M., Suzuki, N., Takegami, T., Yamamoto, Y., Takanashi, Y., Koyama, H., Uchida, T. and Iwase, Y. (Dept. Physiol., Kyoto Pref. Univ. Med., Kamigyoku, Kyoto, 602) ····279

175. Initiation of locomotion related to excitability setting of the brain stem and the spinal cord in the mesencephalic cat. Mori, S., Kawahara, K., Aoki, M. and Tomiyama, T.* (Dept. Physiol., Asahikawa Med. Coll., Asahikawa, 078-11 ; Dept. Otolaryngol., Asahikawa Med. Coll., Asahikawa, 078-11*)····280

14. Neurochemistry (176—179)

176. Stimulus-dependent labelling of single cultured ganglionic cell with ^{14}C-deoxyglucose. Saji, M. and Obata, K.* (Dept. of Physiol., lst Div., Sch. Med., Gunma Univ., Gunma and Dept. of Pharmacol., Sch. Med., Gunma Univ., Gunma*)····281

177. Effect of colchicine and vinblastine on macromolecular synthesis in mouse brain during learning process. Doi, A., Kishida, A., Yamaguchi, T. and Murakami, T. H. (Dept. Physiol., Okayama Univ. Med. Sch., Okayama, 700)····281

178. Transport of chloride in developing rat brain. Aso, H., Takagi, Y., Kanamatue, T. and Hirano, S. (Dept. Physiol., Toho Univ. Sch. Med., Ohmori, Tokyo, 143)····281

179. Activity changes of myelin associated enzymes in the nervous system of the mouse with muscular dystrophy. Tsuji, S. and Matsushita, H. (Dept. Physiol., Wakayama

Med. Col., 9-bancho, Wakayama, 640)……282

15. Vision (180—217)

180. Activities during gazing and visual receptive-field of monkey prefrontal neurons. Suzuki, H., Azuma, M. and Hada, R. (Dept. of Physiol., Hirosaki Univ. Facul. of Med., Hirosaki, 036) ……283

181. Discharge modulation of visual tracking neurons in the monkey posterior parietal association cortex by natural vestibular stimulation. Kawano, K., Sasaki, M. and Yamashita, M. (Dept. Neurophysiol., Inst. Brain Res., Sch. Med., Univ. Tokyo., Bunkyo-ku, Tokyo, 113) ……283

182. Plasticity in kitten striate cortex studied by slice preparations. Komatsu, Y. (Dept. Physiol., Nagoya Univ., Sch. Med., Tsuruma-cho, Nagoya, 466)……283

183. Corollary inputs to cat's striate cells ; effect of ablation of Clare-Bishop area. Shibuki, K. and Toyama, K. (Dept. Physiol., Fac. Med., Univ. Tokyo, Bunkyoku, Tokyo, 113) ……284

184. Depth selectivity of "visual" neurons of the posterior parietal association cortex (area 7a) of the monkey. Sakata, H., Shibutani, H., Kawano, K.* and Harrington, T. L.** (Dept. of Neurophysiol., Tokyo Metropol. Inst. Neurosciences, 2-6 Musashidai, Fuchu City, Tokyo, 183, Dept. of Physiol., Brain Res. Inst. Tokyo Univ.*, Dept. of Psychol, Univ. Nevada, Reno**)……284

185. Laminar distribution of morphologically identified neurons of the motor cortex which receive visual input in the cat. Ogawa, T. and Takimori, T. (Dept. Physiol., Akita Univ. Sch. Med., Akita 010) ……284

186. Responsiveness of inferotemporal cortex neurons to visual pattern stimuli in awake monkeys. Sato, T., Kawamura, T., Watanabe, J. and Iwai, E. (Dept. of Behavioral Physiol., Tokyo Metropolitan Inst., 2-6 Musashidai, Fuchu-city, Tokyo 183) ……285

187. Recurrent inhibitory circuit as revealed in in vitro slices of cat's visual cortex. Kato, H., Ito, S. and Ogawa, T. (Dept. Physiol., Akita Univ. Sch. Med., Hondo 1-1, Akita City, Akita, 010)……285

188. Postnatal development of striate cortical neurons projecting to the lateral geniculate nucleus in kittens. Suda, K. and Tsumoto, T. (Dept. Physiol., Kanazawa Univ. Sch. Med., Takaramachi, Kanazawa, 920)……285

189. Amplitude vs. reversal frequency curves obtained with checkerboard pattern VECPs to upper and lower half field stimulation. Adachi-Usami, E. and Chiba, J. (First Dept. Physiol., Hamamatsu Univ. Sch. Med., Hamamatsu, 431-31)……286

190. Analysis of the receptive field of visual neuron using spatiotemporal random pattern. Kaji, S., Yamane, S. and Hamada, T. (Bionics, Electrotechnical Lab., Umezono, Sakura-mura, Niihari-gun, Ibaraki, 305)……286

191. Patterns of receptive field in the retinula cells of the fly's compound eye. Mimura, K. (Fac. Liberal Arts, Nagasaki Univ., Nagasaki, 852)……286

192. Visual field of stemmata in the swallowtail butterfly, *Papilio xuthus L.* Ichikawa, T. and Tateda, H. (Dept. Biol., Fac. Sci., Kyushu Univ., Fukuoka, 812) ……287

193. Efferent control on orb web spider eyes. Yamashita, S. and Tateda, H. (Dept. Biol., Fac. Sci., Kyushu Univ., Fukuoka, 812) ……287

194. Effect of intracellular injection of EGTA and TEA on the sensitivity of locust retinula cells. Tsukahara, Y. (Res. Ctr. for Appl. Inf. Sci., Tohoku Univ., Katahira-cho, Sendai, 980)……287
195. Conversion of riboflavin in the choroid to FMN in the retina of frogs. Fujishita, S. (Dept. of Sch. Nurse, Osaka Kyoiku Univ., Hirano-ku, Osaka, 547)……288
196. Effects of cyclic nucleotide on the visual cell function. Matsuura, T. and Hanawa, I.* (Dept. Physiol., Kinki Univ. Sch. Med. Minamikawachi-gun, Osaka, 589 and Dept. Physiol. Kobe Univ. Sch. Med., Ikutaku, Kobe, 650*) ……288
197. Light induced oscillatory response in rods of the bullfrog. Yamada, M. and Tauchi, M.* (Applied Optics Sect., Electrotechnical Lab., Ministry of International Trade and Industry, Umezono, Sakura-mura, Niihari-gun, Ibaraki 305 and Dept. of Physiol., Tokyo Women's Med. Coll., Shinjuku-ku, Tokyo 162*)……288
198. Quantum sensitivity of single rods. Tanaka, I. and Tauchi, M.* (Nat. Rehab. Center for the Disabled., Tokorozawa, Saitama-ken, 359 and Dept. of Physiol., Tokyo Women's Med. Coll., Sinjuku-ku, Tokyo, 162*) ……289
199. Quantitative studies of the cone mosaic in the turtle retina. Ohtsuka, T. (Dept. Inform. Physiol., Nat'l Inst. Physiol. Sci., Okazaki)……289
200. Activities of enzymes relating to synthesis of putative transmitter substances in developing retina. Ohno, T. (Dept. Physiol., Ehime Univ. Sch. Med., Shigenobu, Ehime 791-02) ……289
201. Effects of catecholamines on horizontal and ganglion cells in the carp retina. Sugawara, K. (Dept. Neurophysiol., Neuroinformation Res. Inst., Kanazawa Univ. Sch. Med., Kanazawa 920)……290
202. Field potentials induced by intraretinal K^+ injection. Fujimoto, M. and Tomita, T.* (Dept. Physiol., St. Marianna Univ. Sch. Med., Takatsu-ku, Kawasaki, 213 and Dept. Ophthalmol. and Visual Sci., Yale Univ. Sch. Med., New Haven, CT, 06510 USA*) ……290
203. Oscillation of membrane potential in the ganglion cells of photosensory pineal. Morita, Y., Tabata, M. and Nakamura, Y.* (lst Dept. Physiol., Hamamatsu Univ. Sch. Med., Grad. Sch. Electr. Sci. Technol., Shizuoka Univ., Handa-cho, Hamamatsu, 431-31*)……290
204. Faraday effect of brightness sensation. Tsukeda, K. (Dept. of Physiol. Fac. of Med., Univ. of Tokyo, Tokyo) ……291
205. Receptive field organization of color-opponent bipolar cells in the carp retina. Mitarai, G. and Sakakibara, M. (Dept. of Aerospace Physiol., Res. Inst. Environment. Med., Nagoya Univ.)……291
206. Effects of GABA-antagonists on neuronal activities in the distal retina of the carp. Miyachi, E. -I., Shimoda, Y. and Murakami, M. (Dept. Physiol., Keio Univ. Sch. Med., Shinjuku-ku, Tokyo 160)……291
207. Bipolar, amacrine and IP cells in the dace retina : —Physiology and morphology—. Hashimoto, Y., Inokuchi, M., Umino, O. and Katagiri, Y. (Dept. of Physiol., Tokyo Women's Med. Coll., Shinjuku-ku, Tokyo 162)……292
208. Ionic mechanisms underlying the depolarizing photoresponse of on-center bipolar cells in the carp retina. Kaneko, A. and Tauchi, M. (Dept. Inform. Physiol., Nat'l Inst. Physiol. Sci. Okazaki, 444) ……292

209. Electrical properties of bipolar cell responses to glutamate and aspartate in the carp retina. Kondo, H. and Toyoda, J. (Dept. Physiol., St. Marianna Univ. Sch. Med., Takatsu-ku, Kawasaki, 213)·····292
210. Sharpening of the angular sensitivity in the higher order neurons of the compound eye of crayfish. Suzuki, H. and Tasaki, K. (Dept. Physiol., Tohoku Univ. Sch. Med., Seiryo-cho, Sendai, 980) ·····293
211. Release of transmitter from optic nerve terminals. Sawada, S. and Yamamoto, C. (Dept. Physiol., Fac. Med., Kanazawa Univ., Kanazawa, 920) ·····293
212. Opponent-color cells of the chipmunk dorsal lateral geniculate nucleus. Sumitomo, I., Sugitani, M. and Iwama, K. (Dept. Neurophysiol., Inst. Higher Nervous Activity, Osaka Univ. Med. Sch., Nakanoshima, Osaka, 530)·····293
213. Temporal characteristics of the LGB cells in monkey for monochromatic light stimuli. Takebayashi, M., Tonoike, M. and Kurioka, Y. (Electrotechnical Lab., Nakoji, Amagasaki, 661) ·····294
214. Visual response properties of rat ventral lateral geniculate neurons responding to electrical stimulation of the superior colliculus. Nagata, T., Hayashi, Y. and Morita, F. (Dept. Physiol., Hyogo Coll. of Med., 1-1 Mukogawa-cho, Nishinomiya, Hyogo, 663)·····294
215. Noradrenergic influence of locus coeruleus stimulation on lateral geniculate neurons in rats. Negi, T., Sugitani, M. and Iwama, K. (Dept. Neurophysiol., Inst. Higher Nervous Activity, Osaka Univ. Med. Sch., Kitaku, Osaka 530) ·····294
216. Response properties of thalamic reticular cells in cats. Hada, J., Hayashi, Y., Yajima, Y. and Nagata, T. (Dept. Physiol., Hyogo Coll. of Med., Nishinomiya, Hyogo, 663) ·····295
217. Deviation of average eye positions in optokinetic nystagmus of cats. Hamada, T. (Bionics Sec., Electrotechnical Lab., Umezono 1-1-4, Sakura-mura, Niiharigun, Ibaraki, 305)·····295

16. Audition (218—231)

218. Band of noise units in the cat auditory cortex. Saitoh, K., Kudoh, M. and Maruyama, N. (Dept. Neurophysiol., Brain Res. Inst., Niigata Univ., Niigata, 951)·····296
219. A study on the mechanism of voice discrimination. —Formant detectors in the auditory cortex—. Maruyama, N., Saitoh, K. and Kudoh, M. (Dept. of Neurophysiol., Brain Res. Inst., Niigata Univ., Niigata, 951) ·····296
220. A suppressive function of the corticofugal projection upon the inferior colliculus studied by the [^{14}C] deoxyglucose technique. Taniguchi, I. (Dept. Physiol., Dokkyo Univ. Sch. Med., Mibu, Tochigi, 321-02) ·····296
221. Origin of the decrement response in the auditory nerve fiber. Kuno, M., Matsuura, S. and Minowa, Y.* (Dept. of Physiol. and Dept. of Otorhinolaryngol. Osaka City Univ. Med. Sch. Abeno-ku, Osaka, 545*) ·····297
222. Effects of combined application of kanamycin and furosemide on the auditory brain stem responses. Tokimoto, T., Matsuura, S. and Minowa, Y.* (Dept. Physiol. and Dept. Otorhinolaryngol. Osaka City Univ. Med. Sch., Abeno-ku, Osaka, 545*)·····297
223. Action of divalent cations injected into the scala media on cochlear potentials. Asanuma, A., Yanagisawa, K. and Tanaka, Y.* (Dept. of Physiol., Tsurumi Univ. Sch.

of Dent. Med., Tsurumi-ku, Yokohama, Dept. of Otolaryng., Dokkyo Univ. Sch. Med., Mibu, Tochigi*) ····297
224. Excitability changes following a single cycle sound wave of the amphibian papilla nerve fibers of the frog or toad. Ooyama, H. Sugai, T., Yano, J. and Chujo, T. (Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa)····298
225. Absence of tonotopic organization of basilar papilla nerve bundle in bullfrog. Yano, J., Ooyama, H., Sugai, T. and Chujo, T. (Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa) ····298
226. Neural representation of speech parameters. Hashimoto, T. (Div. of Biocybernetics, Inst. Med. and Dent. Eng., Tokyo Med. and Dent. Univ., Kanda, Chiyoda-ku, Tokyo, 101)····298
227. Changes of activities in the brain stem auditory pathway of the rat after cochlear destruction. Murata, K., Horikawa, J. and Funai, H. (Dept. Neurophysiol., Med. Res. Inst., Tokyo Med. and Dent. Univ., Tokyo, 101)····299
228. Dependence of CM input-output function on sound-pressure loading rate. Uchiyama, H. (Dept. of Neurophysiol., Med. Res. Inst., Tokyo Med. and Dent. Univ., Kanda Surugadai, Chiyoda-ku, Tokyo, 101)····299
229. Adaptation in hair cell organs. Furukawa, T. (Dept. of Physiol., Tokyo Med. and Dent. Univ., Sch. of Med., Bunkyo-ku, Tokyo 113)····299
230. Peripheral response of mongolian gerbil to ultrasonics. Kamada, T., Yonezawa, N. and Kameda, K. (Dept. Physiol., Hokkaido Univ. Sch. Dent., Kita-ku, Sapporo, 060)····300
231. An investigation of sound effect on the physical strength. Itow, H. and Fujita, Y. (Physical Education, Education, Waseda Univ., Tokyo) ····300

17. Gustation (232—240)

232. Distribution and fine structure of taste buds in fish. Kitoh, J., Kiyohara, S.* and Yamashita, S.* (Dept. Anat., Sch. Med., Nagoya Univ., Nagoya, Biol. Inst., Lib. Arts Col., Kagoshima Univ., Kagoshima*)····301
233. Adenylate cyclase activity in some mammalian taste buds. Nomura, H. and Asanuma, N. (Dept. Oral Physiol., Matsumoto Dental Coll., Shiojiri, 399-07) ····301
234. Analysis of the initial chorda tympani response to gustatory stimuli. Harada, S. and Kasahara, Y. (Dept. Oral Physiol., Kagoshima Uni. Dentv. Sch., Kagoshima, 890) ····301
235. Influence of experience of sucrose intake on gustatory nerve responses to various sugars in preweaning rats. Yamada, T. and Umezu, M. (Physiol. Lab., Japan Women's Univ., Bunkyo-ku, Tokyo, 112) ····302
236. Enhancement of frog gustatory nerve response to salt stimuli after adaptation to acid solution. Sugimoto, K., Sato, T. and Ohkusa, M. (Dept. Physiol., Fac. Dent., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo, 113) ····302
237. Temporal patterns of the gustatory impulse trains—a classification of unit types. Ueda, K. and Nagai, T.* (Zool. Inst., Fac. Sci., Univ. Tokyo., Bunkyo-ku, Tokyo 113 and Dept. Physiol., Teikyo Univ., Sch. Med., Itabashi-ku, Tokyo 173*)····302
238. Cyclic AMP-norepinephrine concerning with taste receptor mechanism. Shimotahira, K. and Kasahara, Y. (Dept. of Oral Physiol., Kagoshima Univ. Dent. Sch., Kagoshima)····303
239. Antidromic inhibition on afferent responses in the glossopharyngeal (IXth) nerve in

frogs. Murayama, N. and Ishiko, N. (Dept. Physiol., Miyazaki Med. Coll., Miyazaki, 889-16) ····303

240. Responsiveness to taste stimuli of the solitary tract nucleus neurons and their projections to the dorsal pons. Ogawa, H., Imoto, T. and Hayama, T. (Dept. of Physiol., Kumamoto Univ. Med. Sch.)····303

18. Touch (241—254)

241. Perception of hardness as a factor of biting force and mouth opening size. Watanabe, M., Takafuji, M., Karita, K.* and Kanuma, A. (Dept. of Prosthet., Tohoku Univ. Sch. of Dent., Dept. of Physiol., Tohoku Univ. Sch. of Dent*. Sendai, 980)····304

242. Response of encapsulated endings in the cat oral mucosa to vibratory stimulation. Sakada, S., Iizuka, M. and Yamazaki, S. (Dept. Physiol., Tokyo Dent. Coll., Chiyodaku, Tokyo, 101)····304

243. Mechanical sensory hairs located in the tip surface of the ovipositor and their roles to oviposition in crickets. Ai, N., Hiramura, K. and Yamaguchi, N. (Dept. Biol., Tokyo Gakugei Univ. Koganei-shi, Tokyo, 184) ····304

245. Inhibition of self-stimulation of ventralis posteromedialis in the encéphale isolé cat. Ikegami, S. and Kawamura, H.* (Lab. of Physiol. Psychol. and Lab. of Neurophysiol*., Mitsubishi-Kasei Institute of Life Sciences, Machida-shi, Tokyo 194)····305

246. Single unit discharges of glabrous skin mechanoreceptors in man. Mano, T. and Miyaoka, T.* (Dept. of Physiol. and Dept. of Psychol*., Handa-cho, Hamamatsu, 431-31) ····305

247. Periodontal mechanoreceptive responses in the mesencephalic nucleus V of the rat. Amano, N. (Dept. Oral Physiol., Gifu Coll. Dent, Gifu, 501-02)····305

248. A possible rat model for chronic pain. Yamaguchi, Y. (Lab. of Clin. Physiol., Coll. of Biomedical Technol. Osaka Univ., Toyonaka, Osaka)····306

249. Participation of polymodal receptors in acupuncture analgesia. Kawakita, K. and Funakoshi, M. (Dept. Oral Physiol., Gifu Coll. of Dent., Hozumi, Gifu, 501-02) ····306

250. Central afferent pathways of acupuncture analgesia. Luo, C. P., Hisamitsu, T., Sato, T., Kobori, M., Mera, H. and Takeshige, C. (Dept. Physiol., Sch. Med., Showa Univ., Shinagawa-ku, Tokyo, 142)····306

251. Relationship between acupuncture, morphine and periaqueduct central gray stimulation-produced analgesia. Murai, M., Tanaka, M., Hachisu, M., Komugi, H. and Takeshige, C. (Dept. Physiol., Sch. Med., Showa Univ., Shinagawa-ku, Tokyo, 142)····307

252. Topographic cortical representation of the oral cavity and the lip of the cat. Taira, K., Matsumoto, N., Sato, T. and Suzuki, T. A. (Dept. of Oral Physiol., Sch. of Dent., Iwate Med. Univ., Morioka, Iwate 020) ····307

253. Response characteristics of the pulpal neurons and its functional columnar arrangement in the somatosensory cortex (I) of the cat. Matsumoto, N., Taira, K., Takamatsu, T., Hayashi, K., Sato, H. and Suzuki, T. A. (Dept. of Oral-physiol., Sch. of Dent., Iwate Med. Univ., Morioka, Iwate, 020)····307

254. Representation of hand and fingers in different cytoarchitectonic areas of the monkey somatosensory cortex. Iwamura, Y., Tanaka, M. and Hikosaka, O. (Dept. of Physiol., Toho Univ. Sch. of Med., Ota-ku, Tokyo)····308

19. Olfaction (255—261)

255. Neuronal mechanisms for the rhythmic discharge of the mitral cell in the carp olfactory bulb. Yamaguchi, K., Satou, M. and Ueda, K. (Zool. Inst., Fac. Sci., Univ. of Tokyo, Bunkyo-ku, Tokyo 113)……309
256. The some properties of Rana olfactory mucosa to the stimulations of acetic esters. Iijima, M. and Amagai, Y. (Dept. of Physiol., Tohoku Dental Univ., Koriyama, Fukushima, 963) ……309
257. Effects of the methods of stimulus preparation and stimulus delivery to the receptor on the threshold concentration to detect odor. Motokizawa, F. and Maezawa, R. (Dept. Physiol., Nara Med. Coll., Kashihara, Nara, 634) ……309
258. The temporal firing pattern of anterior olfactory nucleus neurons in rabbits. Onoda, N. (Dept. Physiol., Gunma Univ. Sch. Med., Maebashi, Gunma, 371)……310
260. Waveforms of olfactory evoked potentials for various types of odorants. Tonoike, M., Takebayashi, M. and Kurioka, Y. (Electrotechnical Lab., Nakoji, Amagasaki, 661)……310
261. Properties of on-burst and off-silence of the infrared receptors of crotaline snakes. Terashima, S. and Goris, R. C. (Dept. Physiol., Sch. of Med., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo, 113) ……310

20. Muscle Contraction (262—275)

262. Mechanism of contraction in horseshoe crab striated muscle. Sugi, H. and Gomi, S. (Dept. of Physiol., Sch. of Med., Teikyo Univ., Itabashi-ku, Tokyo 173) ……311
263. Stiffness and tension transients in insect flight muscle. Tsuchiya, T. (Dept. of Physiol., Sch. of Med., Teikyo Univ., Itabashi-ku, Tokyo 173) ……311
264. Components of the heat of binding of Ca^{2+} to troponin-C relating to the activation heat production of muscle. Yamada, K. and Kometani, K. (Dept. of Physiol., Med. Coll. of Oita, P. O. Box 37, Oita 870-91) ……311
265. Uniformity of mechanical response in each elementary part of skeletal muscle during experiments on muscle mechanics. Kobayashi, T., Kamiyama, A., Hirao, N.* and Sugi, H.* (Dept. of Clin. Physiol., Sch. of Med., Teikyo Univ., Dept. of Physiol., Sch. of Med., Teikyo Univ*. Itabashi-ku, Tokyo 173)……312
266. Behaviour of myosin projections in frog striated muscle during isometric contraction. Yagi, N. and Matsubara, I. (Dept. Pharmacol., Univ. of Tohoku Sch. Med., Seiryo-machi, Sendai, 980)……312
267. Time-resolved X-ray diffraction of contracting skeletal muscle. Tanaka, H., Tameyasu, T.* and Sugi, H.* (Central Lab., Sch. of Med., Teikyo Univ. Itabashi-ku, Tokyo, Dept. of Physiol., Sch. of Med., Teikyo Univ*. Itabashi-ku, Tokyo 173)……312
268. Sarcomere disorder in skinned fibers during contraction. Umazume, Y., Kasuga, N. and Yoshioka, T. (Dept. Physiol., The Jikei Univ. Sch. Med., Tokyo, 105 and Dept. Physiol., Tokai Univ. Sch. Med., Kanagawa, 259-11)……313
269. Activation of SR and inhibiting factors on rapid cooling contracture (RCC). Sakai, T., Usui, S. and Takahashi, A. (Dept. Physiol., The Jikei Univ. Sch. Med., Minatoku, Tokyo 105)……313
270. Ultrastructural studies on coupling between T-tubules (T) and lateral sac (LS) in

frog sartorius muscle. Fujino, M., Arima, T., Sato, Y. and Takai, H. (1. Dept. Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama) ····313

271. Relationship between membrane potential and calcium ion fluxes in the fragmented sarcoplasmic reticulum. Koshita, M. and Hotta, K. (Dept. Physiol., Nagoya City Univ. Med. Sch., Mizuho-ku, Nagoya, 467) ····314

272. Excitation-contraction (E-C) uncoupling due to formamide (FAM) and acrolein in single muscle fibers of Xenopus laevis. Fujino, M., Sato, Y., Arima, T. and Takai, H. (Ist Dept. Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama) ····314

274. Inactivation of caffeine contracture in twitch muscle fibers of the frog. Oota, I., Nagai, T. and Nagai, I.* (Dept. Physiol. and Dept. Oral Surgery*, Sapporo Med. Coll., Chuoku, Sapporo, 060) ····314

275. Affected site of the skeletal muscle cell by dantrolene-Na. Yamaguchi, T. (Dept. Biol. ICU, Coll. Lib. Arts, Mitaka, Tokyo 181) ····315

21. Smooth Muscle (276—284)

276. Contractile responses to A-C field stimulations and the dynamic constants of the longitudinal and circular muscles of guinea pig stomach. Moriya, M., Ishizawa, M., Yabu, H. and Miyazaki, E. (Dept. of Physiol., Sapporo Med. Coll., Chuo-ku, Sapporo 060)····316

277. A new physiological method for determing functional orientation of aretrial smooth muscles. Fukushima, T., Ohhashi, T. and Azuma, T. (Res. Lab. Cardiovasc. Dis. and Dep. Physiol., Shinshu Univ. Med. Sch., Matsumoto, 390) ····316

278. Antagonistic action of external calcium ions on the membrane currents of strontium ions in the intestinal smooth muscle. Inomata, H., Maruyama, Y. and Mimata, T. (Dept. of Applied Physiol., Tohoku Univ. Sch. Med., Sendai, 980) ····316

279. Relaxation by isoprenaline in smooth muscle of guinea-pig taenia coli and stomach. Nasu, Y., Sakamoto, Y., Imanaga, I. and Tomita, T.* (Dept. Physiol., Fukuoka Univ. Sch. Med., Nishiku, Fukuoka, 814, Dept. Physiol., Nagoya Univ. Sch. Med., Showaku, Nagoya, 466*) ····317

280. Effects of Phospholipase C and Ouabain on Ca movement of stomach smooth muscle. Sakai, Y., Yoshida, M. and Ichikawa, S. (Dept. Physiol., Showa Univ. Sch. Med., Shinagawaku, Tokyo, 142) ····317

281. Effects of estradiol-17β on the membrane response and K-contracture in the uterine longitudinal muscle of ovariectomized rats. Kato, S., Ogasawara, T. and Osa, T. (Dept. Physiol., Yamaguchi Univ. Sch. Med., Kogushi, Ube, 755)····317

282. Contraction by warming in depolarized smooth muscle. Sunano, S. and Miyazaki, E. (Dept. of Physiol., Sapporo Med. Coll., Chu-o-ku, Sapporo) ····318

283. Mechanical responses of the body wall muscles of an annelid, *Urechis unicinctus*, to postulated neurotransmitters. Muneoka, Y., Shiba, Y. and Kanno, Y. (Lab. Physiol., Facul. Integrated Arts Sci., Hiroshima Univ. Hiroshima 730, and Dept. Physiol., Hiroshima Univ. Sch. Dent., Hiroshima 734)····318

284. Effect of ionophore on the guinea pig taenia coli. Nakayama, Y. (Dept. of Anat. and Physiol., Kyoritsu Coll. of Pharm., 1-5-30, Shiba-koen, Minato-ku, Tokyo 105) ····318

22. Cardiac Muscle (285—302)

285. Optical recording of excitation spread in very early embryonic chick heart. Kamino, K., Hirota, A. and Fujii, S. (Dept. Physiol., Tokyo Med. and Dent. Univ., Sch. Med., Bunkyo-ku, Tokyo 113)……319

287. The ventricular fibrillation potentials indused by reduced salts-Ringer's solution perfusion. Kaseda, M., Kumagai, Y., Tsumuraya, Y.* and Wada, S.* (Dept. Biol., National Defese Med. Coll., Tokorozawashi, Saitama, 359, Dept. Physiol., Nihon Univ. Sch. Med., Itabashiku, Tokyo, 173*)……319

288. Influences of GIK on the membrane current and tension components of bullfrog atrium. Kinoshita, K., Yatani, A.* and Goto, M.* (Dept. cardiovasc. Surg. and Dept. Physiol*., Fac. Med., Kyushu Univ., Fukuoka 812)……319

289. Effects of pH on twitch and Na-withdrawal contracture in the bullfrog atrium. Ochi, K. and Matsumura, M. (Dept. Physiol., Kawasaki Med. Sch., Kurashiki, 701-01)……320

290. The potentiating effect of hypertonic solution on the potassium contracture in the bullfrog's atria. Kawata, H., Ohba, M., Hori, T. and Kishi, M.* (Dept. Physiol., and Lab. Human Biol*., Fukuoka Univ., Sch. Med., Nishi-ku, Fukuoka, 814)……320

291. Second depolarization of action potential of canine subepicardial muscle and contraction in the low Ca^{++} medium. Kamiyama, A. and Shibayama, R. (Dept. Physiol., Teikyo Univ. Sch. Med., Itabashi-ku, Tokyo, 173) ……320

292. Isotonic shortening of heart muscle in contracture. Saeki, Y., Shibata, T.* and Yamada, E. (Dept. of Physiol., Tsurumi Univ. Sch. of Dent. Med., Yokohama and Dept. of Pediat., Sch. of Med. Yokohama City Univ., Yokohama*) ……321

293. Modeling of cardiac muscle contraction based on the cross-bridge theory. Mashima, H., Kabasawa, K. and Akazawa, K.* (Dept. of Physiol., Sch. of Med., Juntendo Univ., Bunkyo-ku Hongo, Tokyo 113 and Dept. of Elec. Engr., Fac. of Engr., Osaka Univ., Suita-shi, Osaka 565*) ……321

294. Slow current systems in the atrioventricular node of the rabbit heart. Kokubun, S. Kotake, H., Noma, A. and Irisawa, H. (National Inst. for Physiol. Sci., Myodaiji, Okazaki, 444) ……321

295. Effects of internal Ca^{++} on K conductance of ventricular muscle fibers. Hiraoka, M., Okamoto, Y. and Ikeda, K. (Inst. for Cardiovasc. Dis., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo)……322

296. Effect of amiloride on the membrane potential of ventricular muscle fibers of the dog. Yanagisawa, T. and Taira, N. (Dept. Pharmacol., Tohoku Univ. Sch. Med., 2-1 Seiryo-machi, Sendai, 980) ……322

297. The interaction between calcium and barium on the membrane slow channel in guinea pig ventricular myocardium. Inazawa, M. and Ehara, T. (Dept. Physiol., Fac. Med., Kyushu Univ., Fukuoka 812)……322

298. Ionic Mechanism for the chronotropic effect of epinephrine on the rabbit sinoatrial node cell. Noma, A., Kotake, H. and Irisawa, H. (National Inst. for Physiol. Sci., Myodaiji, Okazaki 444)……323

299. Contribution of electrogenic Na pump on ventricular arrhythmia in acidosis. Sawanobori, T. and Adaniya, H. (Inst. for Cardiovasc. Dis., Tokyo Med. and Dent.

Univ., Bunkyo-ku, Tokyo 113) ····323
300. Gentamicin blockades of the slow inward current and the time-dependent outward current in mammalian ventricular muscle. Hino, H., Ochi, R. and Yanagisawa, T.* (Dept. Physiol., Sch. Med., Juntendo Univ., Bunkyo-ku, Tokyo, Dept. Pharmacol., Tohoku Univ. Sch. Med., Sendai*) ····323
301. The secondary fluctuation of pacemaker potential. Goto, K., Miyamae, S. and Kaneda, T. (Dept. Physiol., Kanazawa Med. Univ. Ishikawa)····324
302. Interaction between the effects of adenosine and acetylcholine on the bullfrog atrium. Goto, M., Yatani, A., Urata, M. and Fujino, T. (Dept. Physiol., Fac. Med., Kyushu Univ., Fukuoka 812) ····324

23. Autonomic Nervous System (303—326)

303. The membrane potential and membrane resistance of Auerbacher's plexus cells of human small intestine in culture. Maruyama. T., Nakai, Y. and Suzuki, T. (Dept. of Applied Physiol., Tohoku Univ. Sch. of Med., Sendai)····325
304. Contractions of smooth muscle produced by AC stimulation. Takai, A. and Tomita, T. (Dept. Physiol., Nagoya Univ., Sch. Med. Showa-ku, Nagoya 466)····325
305. Adrenergic innervation of the circular smooth muscles of the guinea-pig seminal vesicle. Ohkawa, H. (Dept. Physiol. Yamaguchi Univ. Sch. Med., Ube 755)····325
306. Comparative physiology of the internal anal sphincter. Nakayama, S. and Mizutani, M. (Dept. Physiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama, 700) ····326
307. Sympathetic activity in recto-rectal reflex. Takaki, M., Neya, T. and Nakayama, S. (Dept. Physiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama, 700) ····326
308. The distribution of vagal afferent terminals and fibers in rabbit stomach by radioactive analysis. Sato, M., Iwamoto, J., Yoshizaki, K. and Koyano, H. (Dept. of Physiol., Akita Univ. Sch. of Med. Akita 010) ····326
309. The effect of catecholamines on the slow ganglionic transmission. Ushijima, H., Katayama, Y. and Nishi, S. (Dept. Physiol., Kurume Univ. Sch. Med. Kurume)····327
310. Effects of methionine-enkephalin on the guinea-pig sympathetic ganglia. Yagishita, Y.*, Yonemura, K. and Tanaka, I. (Dept. of Anesthesiol. *, and Physiol., Kumamoto Univ. Med. Sch., Kumamoto, 860) ····327
311. Synaptic connections on celiac ganglion neurons. Iwamoto, J., Sato, M., Yoshizaki, K. and Koyano, H. (Dept. of Physiol., Akita Univ. Sch. of Med., Akita 010) ····327
312. Effect of prostaglandin E released into the aqueous humor by sympathetic stimulation in the rabbit eye. Yamamoto, S. and Itoh, Y.* (National Inst. of Industrial Health, Kawasaki, 213, Dept. Physiol., Sch. Med., Nagoya Univ., Nagoya, 466)····328
313. Influence of cimetidine and cepharanthine in neuro-humoral excitatory response of gastric acid secretion in dog. Fujii, K. and Takasugi, S.* (Dept. Physiol. and Dept. Surg.*, Hiroshima Univ. Sch. Med. Kasumi, Hiroshima, 734)····328
314. Vasodilator responses in the tongue and nose to electrical stimulation of the brainstem in the dog. Nagai, M. and Pleschka, K.* (Dept. Physiol., Tokyo Metropolitan Inst. Gerontol., Tokyo, MPI für Physiol. und Klin. Forschung, Bad Nauheim, BRD*)····328

315. Projections of supraspinal nuclei to the spinal cardioregulatory structures : HRP study in the cat (the first report). Onai, T., Okada, J. and Miura, M. (Dept. of Physiol., lst Div., Sch. of Med., Gunma Univ. Maebashi, 371) ····329
316. The cardio-cardiac reflexes. Sato, A., Sato, Y. and Nakamura, H. (2nd Dept. of Physiol, Tokyo Metro. Inst. Gerontol., Itabashi-ku, Tokyo) ····329
317. Identification of afferent fiber group and adequate stimulus initiating the trigeminal depressor response (TDR). Terui, N., Numao, Y. and Kumada, M. (Inst. Basic Med. Sci, Univ. Tsukuba, Ibaraki-ken, 305) ····329
318. Effects of pharyngeal stimulation on autonomic nerve activities to the distal colon in dogs. Okada, H. and Fukai, K. (Dept. of Physiol. (2nd), Kawasaki Med. Sch. Kurashiki 701-01) ····330
319. Roles of laryngeal water fibers in water intake and urine flow in rats. Shingai, T. and Ikuno, H. (Dept. of Physiol., Niigata Univ. Sch. of Dent., Niigata 951) ····330
320. Neuromechanisms of lacrimation induced by noxious stimulation of the cornea. Araie, N., Yamamoto, T. and Kawamura, Y. (Dept. Oral Physiol., Osaka Univ. Sch. Dent., Kitaku, Osaka, 530) ····330
321. The cutaneo-adrenal meduliary reflexes. Araki, I., Kurosawa, M., and Sato, A. (Dept. of Biology, Ochanomizu Univ., Bunkyo-ku, Tokyo and 2nd Dept. of Physiol, Tokyo Metro. Inst. Gerontol., Itabashi-ku, Tokyo) ····331
322. Tonic modulation effects of thin-fiber muscular afferents on the respiratory outputs. Kumazawa, T., Tadaki, E., Mizumura, K. and Kim, K. (Dept. Physiol., Sch. Med., Nagoya Univ., Shōwaku, Nagoya, 466) ····331
323. Functional correlations between the hypothalamus and autonomic branches to the pancreas. Oomura, Y., Niijima, A.*, Kita, H., Ishizuka, S., Yamabe, K., Yoshimatsu, H. and Aou, S. (Dept. of Physiol., Fac. Med. Kyushu Univ. 60, Fukuoka, Dept. of Physiol., Fac. Med. Niigata Univ. Niigata*) ····331
324. Vestibulo-sympathetic nerve response after decerebration and decerebellation. Ishikawa, T., Miyazawa, T. and Fujiwara, T. (Dept. Physiol., Nihon Univ. Sch. Med, Itabashi, Tokyo, 173) ····332
325. Activities of reticular respiratory neurons during interruption of blood supply to the brain in rabbits. Kanai, K. and Miyakawa, K. (Dept. Physiol., Shinshu Univ. Sch. Med., Matsumoto, 390)····332
326. Cervical sympathetic and vagal efferent discharges during the thermoregulatory response. Miyamoto, J. K., Ando, A. and Kimura, Y. (Dept. of Physiol., Saitama Coll. of Health, Kami-Okubo 519, Urawa-shi, 338)····332

24. Circulation (327—348)

327. Flow behavior of shape transformed porcine red cell suspensions. Yamashita, Y., Kusachi, R. and Komatsu, A. (Dept. Physiol. Tokyo Wom. Med. Coll., Shinjuku-ku, Tokyo, 162) ····333
328. Fine structure of blood flow near an atherosclerotic plaque-like wall. Niimi, H. and Yamakawa, T. (Dept. of Vascular Physiol., National Cardiovascular Center Res. Inst., Suita, Osaka, 565) ····333
329. Effects of spinal temperature change on the lymph-hearts and anterior lymph-cardiac

spinal center in the bullfrog. Yamane, M. (Dept. of Physiol. (2nd), Kawasaki Med. Sch., Kurashiki, 701-01) ····333

330. Comparative study of arterial chemoreceptor of the toad. Ishii, K., Ishii, K. and Kimura, J. (Dept. Physiol., Fukushima Med. Coll., Fukushima, 960) ····334

331. Analysis of cardiac sympathetic nerve activity and heart rate in conscious and freely moving animals. Ninomiya, I., Nishiura, N., Hayashi, T. and Okada, Y. (Dept. of Card. Physiol., Res. Inst., National Cardiovascular ctr. Suita, Osaka) ····334

332. A study of overall model for blood circulation under anoxic condition. Okai, O., Watanabe, A.* and Saito, M.* (Dept. Physiol., Kyorin Univ. Sch. Med., Inst. Med. Electron., Univ. Tokyo*) ····334

333. Changes of myocardial oxygen tension and contractile force during the brain ischemic hypertension in rabbits. Shimizu, T., Hanai, S. and Nomura, H. (Dept. Physiol., Fujita-Gakuen Univ. Sch. of Med. Toyoake, Aichi, 470-11) ····335

334. Correlation between potential energy of ventricular time-varying elastance model and cardiac oxygen consumption. Suga, H. and Hayashi, T. (Dept. Cardiac Physiol., National Cardiovascular Center, Suita, Osaka, 565) ····335

335. Increased post-exercise T wave amplitude in electrocardiography. Nakayama, A., Saito, T., Murayama, H., Sugiyama, Y., Hino, Y., Mizuno, T., Tonooka, M., Morooka, N., Hatogai, H., Katagiri, M., Yumura, Y., Irie, S., Takeda, K., Deguchi, F. and Inagaki, Y. (3rd Dept. Intern. Med., Chiba Univ. Sch. Med., Inohana, Chiba, 280) ····335

336. Pulmonary water distribution in patients with congestive heart failure studied by computed tomography. Morooka, N., Yoshida, H., Watanabe, S., Masuda, Y., Inagaki, Y. and Kinoshita, Y.* (The Third Dept. Int. Med., Chiba Univ. Sch. Med., Chiba ; Dept. Health Care, Health Sci, Center, Chiba Univ. Chiba*) ····336

337. New sphygmomanometer and its clinical utility. Tonooka, M., Tomiya, H., Takeda, K., Shukuya, M., Saito, T., Masuda, Y., Inagaki, Y., Hirai, A.*, and Tomita, M.**(The Third Dept. Int. Med., Chiba Univ. Sch. Med., Chiba ; The Chiba Municipal Hosp.*, Chiba ; Parama Ind., Tokyo**) ····336

338. Application of image sensor to the measurement of arteriolar, venular, or lymphatic diameter. Sakaguchi, M.*, Ohhashi, T. and Azuma, T. (Dept. of Elec. Eng., Nagano Tech. Coll., Nagano,* Dept. of Physiol., Schinshu Univ. Sch. Med., Matsumoto) ····336

339. Microcirculatory changes related to dietary induced hypercholesterolemia in rabbits. (1) Acute changes. Asano, M. and Sawanobori, K. (Dept. of Physiol. Hyg., the Inst. of Publ. Health, Minato-ku, Tokyo 108) ····337

340. The effect of amino acids on the mesenteric vascular bed. Shirataka, M., Nara, Y., Sato, T. and Ikeda, N. (Depts. Physiol., Int. Med. and Information Sci., Sch. of Med., Kitasato Univ., Sagamihara-shi, Kanagawa) ····337

341. The changes in nucleic acid activity in the vascular adaptive response to wall shear stress. Kamiya, A. (Res. Inst. of Appl. Elect., Hokkaido Univ.)····337

342. Osmolality and K^+ concentration of the blood from the skeletal muscle during arterial occlusion. Higuchi, Y., Fukuoka, M., Ito, H., Takemiya, T.* and Nagashima, Ch.** (Dept. of Physiol., Kyorin Univ. Sch. Med., Tokyo, Div. of Physiol., Inst. of Health and Sport Sci., The Univ. of Tsukuba, Ibaraki,* Inst. of Microvasc. Res., Shisei Hosp., Nagano**) ····338

343. Estimation of perivascular pressure from effective capillary pressure and net filtration pressure during hemorrhage in dogs. Miki, K., Nose, H., Yamada, S. and Morimoto, T. (Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto 602)……338
344. Regulation of cerebral blood flow : Steal-like phenomenon between the internal and external carotid arteries. Kawai, Y., Ohhashi, T. and Azuma, T. (Dept. of Physiol., Shinshu Univ. Sch. Med., Matsumoto) ……338
345. The action of sympathetic nerve on blood vessel of head and brain. Hatakeyama, I., Simada, Z. and Okubo, J. (Dept. Physiol. Kitasato Univ. Sch. Med., Kitasato, Sagamihara, 228)……339
346. Reservoir function of peripheral vascular beds during a blood pressure oscillation. Takeuchi, T. and Miyakawa, K. (Dept. Physiol., Shinshu Univ. Sch. Med., Matsumoto, 390) ……339
347. Mechanism of cold vasomotor regular oscillations. Ueda, G., Takeoka, M. and Koshihara, Y. (Inst. of Adapt. Med., Shinshu Univ., Matsumoto, 390) ……339
348. Mechanism of transposition response. Iriuchijima, J., Teranishi, Y. and Eguchi, C.* (Dept. Physiol., Univ. Hiroshima, Sch. Med., Kasumi, Minamiku, Hiroshima, 734 and Dept. Anesth., Univ. Kagoshima, Usukicho, Kagoshima, 890*) ……340

25. Red Cell and Acid-Base Balance (349—357)

349. The CO_2 equilibration curve of hemoglobin solution and whole blood. Ueda, Y. and Tyuma, I. (Dept. Physicochem. Physiol., Osaka Univ. Sch. Med., Osaka) ……341
350. A comparative study on oxygen equilibria of fetal and adult hemoglobins. Tomita, S., Enoki, Y., Ohga, Y. and Kaneko, M. (2nd Dept. Physiol., Nara Med. Univ., Kashihara, Nara 634) ……341
351. Abnormal hemoglobins with an amino acid substitution at the 2, 3-DPG binding site. Nagai, K. and Enoki, Y. (2nd Dept. of Physiol., Nara Med. Univ., Kashihara 634, Nara)……341
352. Effect of pyridoxal phosphate derivatives on the oxygen transport function of stored erythrocytes. Maeda, N., Kon, K., Suda, T. and Shiga, T. (Dept. Physiol. Sch. Med., Ehime Univ., Onsen-gun, Ehime, 791-02) ……342
353. The influence of red cell oxygenation on CO_2 transport capacity of plasma in hypercapnia. Mochizuki, M., Niizeki, K. and Tamura, M. (Dept. Physiol., Yamagata Univ. Sch. Med., 990-23 Yamagata) ……342
354. Stimulation of ammoniagenesis by acute acidosis : evidence for a urinary inhibitor. Terao, N. and Tannen, R.* (Dept. of Med., Jichi Med. Sch., and Dept. of Med., Univ. of Michigan*) ……342
355. Effect of excessive acidemia induced by intravenous infusion of HCL upon the respiratory frequency. Adachi, C. (Dept. Physiol., Niigata Univ. Sch. Med., Asahimachi, Niigata, 951)……343
356. Appearance of Na^+ and HCO_3^- ions in the plasma of dog's whole blood exposed to CO_2 gas. Tanase, K., Ogawa, A., Asahi, T., Shimabukuro, S. and Hirakawa, S. (2nd Dept. Internal. Med., Gifu Univ. Sch. Med., Tsukasa-machi, Gifu, 500)……343
357. Compensation for the respiratory disturbances of acid-base balance in the chick embryo. Tazawa, H. (Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata

990-23) ……343

26. Blood, Kidney and Body Fluid (358—376)

358. Changes in kidney functions and blood constituents of dog with a load of exogenous creatinine. Tanaka, Y., Nakaya, S., Honjo, R. and Kashima, K. (Dept. Physiol. II, Med. Sch. of Iwate Med. Univ., Morioka)……344

359. Effects of full speed running on sodium diuresis and changes of urinary substances. Ogo, K. and Inomoto, T.*, (Dept. Physiol., Fac. Educ., Kumamoto Univ., Kumamoto, Dept. Morphol., Inst. Const. Med., Kumamoto Univ. Kumamoto*) ……344

360. An attempt to clarify uremic toxins in blood plasma of an anephric rabbit and of uremic patients. Matsumoto, A., Yonemura, K. and Tanaka, I. (Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto, 860) ……344

361. Effects of parathyroid hormone and thyroid hormone on Ca-ATPase activity in the plasma membrane of rat kidney. Kusano, E., Takeda, K. and Asano, Y. (Dept. of Cardiol., Jichi Med. Sch., Minamikawachi, Tochigi, 329-04) ……345

362. Effect of guanine nucleotide on adenylate cyclase activity in the bullfrog bladder epithelial cells. Mishina, T., Shimada, H. and Marumo, F. (Dept. of Med., Kitasato Univ., Kanagawa) ……345

363. Plasma colloid osmometry for assessing capillary wall permeability. Kakiuchi, Y., Koyama, T. and Mikami, T. (Div. Physiol. and Div. Biomedical Controls, R. I. A. E., Hokkaido Univ. Kita-ku, Sapporo, 060) ……345

364. Effect of administration of adrenaline and pilocarpine upon neutrophils Goshi, K. and Okubo, S. (Dept. of Physiol, Dental-Clinic House of Representatives, Nagata-cho, Chiyoda-ku, Tokyo) ……346

365. The red cell deformability and osmotic fragility of phenylhydrazine injected rats measured by ektacytometer and coil planet centrifuge. Nagasawa, T., Sarashi, A., Kobayashi, T. and Kimura, E. (Dept. Physiol., Osaka City Univ. Med. Sch., Abenoku, Osaka, 545) ……346

366. Hematological changes during a 14-day dry saturation dive at 31 ATA. Sagawa, S., Konda, N., Shiraki, K., Hong, S. K.*, Nakayama, H.** and Matsuda, M.** (Dept. of Physiol., Sch. of Med., Univ. Occup. and Environm. Hlth., Kitakyushu, Dept. of Physiol., State Univ. of N. Y. at Buffalo,* Japan Marine Sci, and Technology Center, Yokosuka**) ……346

367. Combined effects of plasma proteins and electrolytes on red cell deformability. Kikuchi, Y., Horimoto, M., Kakiuchi, Y. and Koyama, T. (Div. of Physiol., RES. Inst. Appl. Electr., Hokkaido Univ., Sapporo 060) ……347

368. The correlation among blood viscosity, the shape of erythrocyte and membrane fluidity. Suda, T., Kon, K. Maeda, N. Shiga, T. (Dept. Physiol., Sch. of Med., Ehime Univ., Shigenobu-cho, Onsen-gun, Ehime, 791-02)……347

369. Significance of erythrocytes fragmentation in cases of disseminated intravascular coagulation (DIC). Matsuda, T., Yokouchi, M., Ogawara, M., Miura, R. and Seki, T. (Dept. Clin. Physiol. (II), Div. Physiol., Tokyo Metropolitan Inst. of Gerontology, Itabashiku, Tokyo, 173)……347

370. Comparison of platelet aggregability in man and certain animal species. Tanimoto, Y.

(Dept. of Hematochem., Cent. Inst. Exp. Anim., Takatsu-ku, Kawasaki, 213) ……348
371. Effect of whole body gamma ray irradiation on rat platelets. Oshiba, S., Imai, H. Endoh, E., Sawai, H. and Ariga, T. (Dept. Physiol., Nihon Univ. Sch. Med., Itabashi-ku, Tokyo, 173) ……348
372. Studies on the fibrinolytic enzyme system in hepatobiliary system (XI) —Immunological properties of Bilokinase—. Oshiba, S., Ariga, T., Sawai, H. and Imai, H. (Dept. of Physiol. Nihon Univ. Sch. of Med., Itabashi-ku, Tokyo, 173) ……348
373. Properties of fibrinolytic proteinase (SPF) of human spleen—Comparison with elastase. Nagamatsu, Y., Okamoto, U., Yamamoto, J., Horie, N. and Ito, M. (Lab. Physiol. Fac. Nutri., Kobe-Gakuin Univ., Tarumi-ku, Kobe, 673) ……349
374. Studies on inhibitors of Urokinase present in human plasma. Yamamoto, H., Saeda, Y. and Sugie, I. (lst Dept. Physiol., Aichi Med. Univ. Nagakute-cho, Aichi, 480-11)……349
375. The role of fibrinolysis in ovulation. Mihara, H., Kosugi, T., Matsuo, O., Akazawa, K.* and Mori, N.* (Dept. of Physiol., Dept. of Obstetrics and Gynecology, Miyazaki Medical College, Kiyokake-cho, Miyazaki, 889-16*) ……349
376. Change of FDP and catecholamine under various works. Igarashi, M., Asada, T., Omoto, M.*, Furuichi, T.* and Shiba, T.** (Dept. of Biochem., Dept. of Hygiene.*, Dept. of Surg.**, Toho Univ. Sch. of Med. Omorinishi, Otaku, Tokyo)……350

27. Respiration (377—388)

377. Spontaneous periodic fluctuation with respiratory rhythms in neocortical EEG in cats. Miyakawa, M., Nishikawa, Y. and Hukuhara, T. Jr. (Dept. Pharmacol. II, Jikei Univ. Sch. Med., Minatoku, Tokyo, 105) ……351
378. Different stabilities of spontaneous unit activity of reticular respiratory neurons in the brain stem of the rabbit. Goto, K., Hattanmaru, Y. and Hukuhara, T., Jr. (Dept. of Pharmacol. II, Jikei Univ. Sch. Med., Minato-ku, Tokyo) ……351
379. Respiratory neuronal activities in the upper cervical cord of the cat. Aoki, M., Kawahara, K. and Mori, S. (Dept. Physiol., Asahikawa Med. Coll., Asahikawa, 078-11)……351
380. H^+-sensitivity and phasic activity of neurons in the respiratory chemosensitive area of the rat ventral medulla oblongata in vitro. Fukuda, Y. and Honda, Y. (Dept. Physiol., Chiba Univ. Sch. Med., Inohana, Chiba, 280)……352
381. Changes of phrenic discharge pattern induced with strychnine. Shimada, K., Ikuno, H. and Kitada, Y. (Dept. of Oral Physiol., Niigata Univ. Sch. Dent., Gakkocho, Niigata, 951)……352
382. The effect of doxapram on respiratory chemoreflexes. Nishino, T. and Lahiri, S.* (Dept. of Physiol. Sch. Med. Chiba Univ., Inohanacho, Chiba 280, and Univ. of Penn*.)……352
383. An on-line computer system for assessing cardiorespiratory function during exercise, Miyamoto, Y. and Mikami, T. (Biomedical Control, Res. Inst. Appl. Elect. Hokkaido Univ., Sapporo 060) ……353
384. Pneumogram patterns associated with Karate actions. Ueda, G., Yanagidaira, Y., Inaba, T.*, Tange, S.*, Takeoka, M., Koshihara, Y. and Yonemura, I.** (Inst. of Adapt. Med., Dept. of Legal Med.**, Shinshu Univ., Matsumoto, 390, The Branch of Japan Karate Assoc.*, Nagano, 380) ……353
385. Diaphragmatic EMG activity in man. Homma, I., Kobayashi, K., Kobayashi, Y.,

Nagai, T. and Sakai, T. (Dept. Physiol. The Jikei Univ. Sch. of Med., Minatoku, Tokyo, 105) ····353

386. Effects of regionally applied hypoxia and hypercapnia on pulmonary microcirculation of bullfrog. Horimoto, M. and Koyama, T. (Div. Physiol., Res. Inst. Appl. Electr., Hokkaido Univ. Sapporo, 060)····354

387. Ventilatory responses to hypoxia and hypercapnia in mountaineer. Miyamura, M., Shimaoka, K., Hara, M. and Matsui, H. (Res. Cent. Phys. Fit. Sports, Nagoya Univ., Chikusa-ku, Nagoya, 464) ····354

388. Analysis of alveolar P_{CO_2} control during the menstrual cycle. Takano, N. (Dept. of Sch. Health, Fac. of Education, Kanazawa univ., Marunouchi 1-1, Kanazawa 920) ····354

28. Internal Secretion (389—411)

389. Rhythmic patterns of discharge in hypothalamic neurosecretory neurons of cats and dogs. Yamashita, H. and Inenaga, K. (Dept. Physiol., Univ. of Occup. Environ. Health, Japan, Sch. Med., Yahatanishiku, Kitakyushu, 807) ····355

390. Electrophysiological changes in the limbic-preoptic-arcuate projections accompanied with the loss and reinitiation of estrous cycles in rats. Akema, T. and Kawakami, M. (Dept. Physiol., Yokohama City Univ. Sch. Med., Urafune-cho, Minami-ku, Yokohama, 232)····355

391. A role of the arcuate nucleus median eminence-dopamine system in morphine-induced prolactin rise of the rat. Ieiri, T., Suzuki, H. and Shimoda, S. (Dept. of Endocrinology, Dokkyo Univ., Mibu, Tochigi, 321-02) ····355

392. Neuroendocrinological significance of opioid action on medial septo-preoptic neurones in female rats. Kubo, K. (Dept. Physiol., Kumamoto Univ., Inst. Const. Med., Kumamoto 862) ····356

393. Lateral hypothalamic and gastric secretory responses to various neuropeptides in the rat. Shiraishi, T., Inoue, A.* and Yanaihara, N.* (Dept. Physiol., Tokai Univ. Sch. Med., Isehara 259-11 and Bioorganic-chem. Lab. Shizuoka Pharm. Coll. Shizuoka 422*)····356

394. Role of catecholamines turnover rates in the rat brain in LH, FSH or prolactin release. Honma, K. and Wuttke, W.* (Dept. of Physiol., Hokkaido Univ. Sch. of Med., Sapporo 060, Max-Planck Inst. for Biophy. Chemistry, 3400 Göttingen, West Germany)····356

395. Agonist-induced desensitization of β-adrenergic receptor in rat parotid slices. Yoshimura, K., Nezu, E. and Chiba, A. (Dept. Physiol., Hokkaido Univ., Sch. Dent., Kitaku, Sapporo, 060) ····357

396. Vagal modulation of insulin secretion in the rat. Sakaguchi, T., Hirano, T., Yamaguchi, K., Fukuda, A. and Niijima, A. (Dept. of Physiol., Niigata Univ. Sch. Med., Niigata 951)····357

397. Role of GABA (γ-aminobutyric acid) in the rat pancreatic islets (II). Okada, Y. and Taniguchi, H. (Dept. Neurochemistry, Tokyo Metropolitan Inst. for Neurosciences, Musashidai Fuchu-shi, Tokyo 183 and 2nd Dept. Internal Med. Sch. Med. Kobe Univ. Ikutaku, Kobe) ····357

398. Properties of hamster insulinoma cell (In-111 R). Okada, Y. and Ando, T. (Dept. Neurochem. and Microbiol., Tokyo Metropolitan Inst. for Neurosciences, Musashidai, Fuchu-shi, Tokyo, 183) ····358

399. The testicular activity and polyamines in the Japanese newt. Matsuzaki, S. and Yamamoto, K. (Dept. Physiol., Inst. Endocrinol., Gunma Univ., Maebashi 371) ·····358
400. Changes in pituitary-adrenal function in rats intoxicated with methylmercuric chloride. Abe, K. and Tanaka, I. (Dept. of Physiol., Kumamoto Univ. Med. Sch., Kumamoto) ·····358
401. Effects of cortisol, progesterone and transcortin on ^{3}H-thymidine incorporation into PHA-stimulated human lymphocyte and their interaction. Ogawa, K., Sueda, K. and Matsui, N. (IInd Div. of The Res. Inst. of Environmental Med., Nagoya Univ., Chikusa-ku, Nagoya)·····359
402. The effect of histamine liberation on the adrenal secretion of aldosterone in hypophysectomized-nephrectomized dogs. Aikawa, T., Hirose, T., Matsumoto, I. and Suzuki, T. (Dept. Physiol., Nagasaki Univ. Sch. Med., Nagasaki, 852)·····359
403. Microelectrophoretic study on the osmotic control of the neurosecretory neurone in the paraventricular nucleus (PVN). Akaishi, T. and Negoro, H. (Dept. Physiol., Niigata Univ. Sch. Med., Niigata)·····359
404. Adrenal medullary secretory response to pontine and mesencephalic stimulation in the rat. Matsui, H. (Dept. of Physiol., Nagasaki Univ. Sch. of Med., Nagasaki) ·····360
405. Increase of cyclic AMP levels by adenosine in rat pheochromocytoma cells (PC 12). Kobayashi, K. and Kuroda, Y. (Dept. of Neurochem., Tokyo Metropolitan Inst. for Neurosciences, Fuchu-shi, Tokyo 183)·····360
406. Suppression of the luteinizing hormone releasing effect of luteinizing hormone releasing hormone by arginine-vasotocin in immature male dogs. Mieno, M., Yamashita, Er. and Yamashita, K. (Dept. Pathophysiol. Atom. Dis. Inst., Nagasaki Univ. Sch. Med. Nagasaki 852) ·····360
407. Effects of verapamil on Ca action potentials and hormone release in rat anterior pituitary cells. Ozawa, S. and Kimura, N. (Dept. Physiol., Jichi Med. Sch., Tochigi., and Dept. Med. Chem., Tokyo Metropolitan Inst. for Neurosciences, Fuchu, Tokyo)·····361
408. The mode of action of thyrotropin-releasing hormone (TRH) on the smooth muscle of rat duodenum. Furukawa, K., Nomoto, T. and Tonoue, T. (Dept. Pharmacol. Tokyo Women's Med. Coll. Shinjuku-ku, Tokyo, 162)·····361
409. The effect of the thyroid on neural control of rat growth hormone secretion. Suzuki, M., Kakegawa, T., Miyahara, S. and Oomura, Y. (Dept. of Physiol., Inst. of Endocrinol., Gunma Univ., Maebashi, and Dept. of Physiol., Fac. of Med., Kyushu Univ., Fukuoka) ·····361
410. Induction of androgen-dependent esteroproteases by T_3 in the submandibular gland of androgen insensitive (Tfm) mice. Hosoi, K. and Ueha, T. (Dept. of Oral Physiol., Josai Dental Univ., Sakado-shi, Saitama) ·····362
411. Effect of bovine growth hormone on the retarded myelinogenesis of pituitary dwarf mice. Sugisaki, T., Noguchi, T. and Tsukada, Y. (Dept. of Physiol., Sch. of Med., Keio Univ. Tokyo)·····362

29. Exercise (412—425)

412. Effect of denervation on postnatal rat skeletal muscle. Narusawa, M., Nagami, K., Yoshioka, T. and Nakano, S. (Dept. Physiol., Tokai Univ. Sch. Med., Isehara,

Kanagawa, 259-11)……363
413. The changes of the vascularization of muscle and fat tissue due to long-term endurance exercise. Yusa, S., Satoyoshi, M., Tanishima, F. and Ogawa, Y. (Inst. Sports Med., Yokohama City Univ., Kanazawaku, Yokohama, 236)……363
414. Effects of volume change on the cardiac function at rest on exertion in the normal subjects. Kobayashi, K., Ishida, K., Tajiri, E., Kan, Z., Toda, T. and Fukuzaki, H. (Dept. of Internal Med. Div. I, Kobe Univ. Sch. of Med. Ikuta-ku, Kobe) ……363
415. Effects of fall speeds on the muscular activity of lower limb during controlled fall in man. Yoneda, T. and Ishida, A. (Dept. Physiol., Juntendo Univ., Sch. Physical Edu. Narashino, Chiba, 275) ……364
416. Relation between excercise diuresis and running road. Inomoto, T. and Ogo, K. (Dept. Morphol., Inst. Med., Kumamoto Univ. and Dept. Physiol., Facul. Educ., Kumamoto Univ.)……364
417. Uric acid metabolism at exercise in hyperuricemia men. Ito, A., Horiuchi, T., Sugiura, T., Fujita, S., Yamada, T., Sumida, S. and Ikawa, Y.* (Inst. of Health and Sport Sci., Tsukuba Univ., Sakura-mura, Ibaraki. Clinical Laboratories, Jikei Univ. Hospital, Minato-ku, Tokyo.*) ……364
418. Effect of long-term physical training in adult men on the changes in blood constituents due to exercise. Shibayama, H. and Ebashi, H. (Dept. Physiol., Physical Fitness Res. Inst., Minato-ku, Tokyo, 108)……365
419. On the modification of orthostatic tolerance by athletic training and its mechanism. Saiki, H., Nakaya, M., Sudoh, M. and Abe, M. (Space Med. Lab., The Jikei Univ. Sch. of Med., Minato-ku, Tokyo, 105)……365
420. Physiological effects on adult women of circuit weight training. Kimura, Y., Itow, H. and Yamazaki, S.* (Lab. of Physical Physiol., Pedago. Facul., Waseda Univ., Shinjuku-ku, Tokyo, 160, Dept. of Hygiene, Natl. Defense Med. Coll., Tokorozawa-shi, Saitama, 359*)……365
421. The relationship between deep body temparature and i-EMG during exercise. Kikuchi, K., Kawamura, T., Okada, Y. and Wada, M. (Dept. Health and Physical Edu., Hiroshima Univ., Hiroshima-city, 730)……366
422. Characteristics of voluntary single human motor units. Kurata, H., Ogawa, Y., Masuda, M.* and Morimoto, S.* (Lab. Sports Med., Jikei Univ. Sch. Med., Chofu, Tokyo, 182, Dept. Physiol., Jikei Univ. Sch. Med., Minatoku, Tokyo, 105*)……366
423. Effects of physical exercise on levels of plasma renine activities, angiotensin and aldosterone. Ikawa, S., Suzuki, M. and Shiota, M. (Dept. of Lab. Med., Jikei Univ. Sch. Med., Minato-ku, Tokyo) ……366
424. Physiological responses of distance runners and thrower during immersion of both legs in hot water bath. Tsujita, J., Tanaka, N., Mayuzumi, M., Araki, T.*, Watanuki, M., and Hori, S. (Dept. of Physiol., Hyogo Coll. of Med., Nishinomiya, Dept. of Hygiene, Kobe Univ., Sch. of Med., Ikutaku, Kobe*)……367
425. Gastric factor modifying the cutanogenic reflexible change of human thenar minor tremor (MT). Noda, K., Soeda, H., Yamamoto, K., Samejima, C. and Watanabe, K. (Dept. Physiol., Fukuoka Dent. Coll., Nishi-ku, Fukuoka, 814) ……367

30. Environment and Metabolism (426—437)

426. Responses of endocrine systems in men exposed to 16-21 and 26-31 ATA heliox environments. Matsui, N., Tamura, Y., Okazaki, S., Sueda, K., Ogawa, K., Yamamoto, M., Nakayama, H.*, Takeuchi, H.* and Oiso, Y.** (2nd Div., Res. Inst. Environ. Med., Nagoya Univ., Chikusa-ku, Nagoya, 464, Marine Sci. and Technol. Center, Yokosuka, 237*, lst Dep. Int. Med., Nagoya Univ. Sch. Med., Showa-ku, Nagoya, 466**)·····368

427. Energy and body fluid balance during a 14-day dry saturation dive at 31 ATA. Shiraki, K., Konda, N., Sagawa, S., Hong, S. K.* and Matsuda, M.** (Dept. of Physiol., Sch. of Med., Univ. Occup. and Environm. Hlth, Yahatanishi-ku, Kitakyushu, 807, Dept. of Physiol., Sch. of Med. and Dent., State Univ. New York at Buffalo, Buffalo, N. Y.*, Japan Marine Sci. and Technology, Yokosuka, 237**) ·····368

428. Maintenance of higher blood flow to calorigenic organs in cold acclimated rats. Hirata, K., Sugano, Y., Shibata, H. and Nagasaka, T. (Dept. of Physiol., Kanazawa Univ. Sch. of Med., Takara-machi, Kanazawa 920)·····368

429. Correlation between sweat volume and rise in rectal temperature during exercise and maximal oxygen intake. Hori, S. and Ihzuka, H. (Dept. Physiol., Hyogo Coll. of Med., Nishinomiya, 663) ·····369

430. Effect of short light-dark cycle on running activity in rats. Isobe, Y., Hasegawa, Y.* and Takaba, S. (Dept. Physiol., Nagoya City Univ. Sch. Med., Mizuhoku, Nagoya, 467*) ·····369

431. Levels of glycogenolytic and glycolytic enzymes, lactate and ATP in different parts of rabbit aorta during contraction. Masumura, S., Hashimoto, M., Hashimoto, Y. and Sato, T. (Dept. Physiol., Shimane Med. Univ. Izumo, Shimane)·····369

432. The influence of repeated stress on glucose metabolism in liver slices of rabbit with lesioned stria teminalis. Fujita, M., Ushikoshi, A., Kaba, H., Saito, H., Seto, K., Meed, J. F., Akema, T.*, Arita, J.* and Kawakami, M.* (Dept. Physiol., Kochi Med. Sch., Nankoku, 781-51, Dept. Physiol., Yokohama City Univ. Sch. Med., Yokohama, 232*)·····370

433. Effect of pentobarbital on stimulated respiration in rat's submandibular glands. Endoh, S., Tsuboi, M.*, Komabayashi, T.* and Sakamoto, S.** (Dept. Physiol., Keihin Women's Coll., Kamakura-shi, Kanagawa, Dept. Physiol., Tokyo Coll. Pharm. Hachioji-shi, Tokyo*, Dept. Physiol., Showa Univ., Sch. Med., Shinagawa-ku, Tokyo**) ·····370

434. The effect of protein qualities on protein intake in rats. Kishi, K. and Inoue, G. (Dept. Nutr., Sch. Med., Tokushima Univ., Kuramotocho, Tokushima, 770) ·····370

435. Effect of histamine on the blood lipids in dogs. Tsuboi, M., Komabayashi, T., Endoh, S. and Sakamoto, S.* (Dept. Physiol., Tokyo Coll. Pharm., Hachioji-shi, Tokyo, Dept. Physiol. Showa Univ., Sch. Med., Shinagawa-ku, Tokyo*) ·····371

436. Nitrogen balance and energy availability on little children. Kitano, T. and Koishi, H. (Lab. Food and Nutri., Fac. Sci. Living, Osaka City Univ., Sumiyoshi-ku, Osaka, 558)·····371

437. Measurement of the insensible weight loss in man. Higuti, K. and Inoue, M. (Div. Food Nutr., Nakamura Gakuen Coll. Fukuoka)·····371

31. Body Temperature (438—458)

438. Pyretic response and thermoregulatory behavior in the rat. Murakami, N., Sakata, Y. and Morimoto, A. (Dept. of Physiol., Yamaguchi Univ. Sch. of Med., Kogushi, Ube, 755)……372

439. Temperature changes of cutaneous superficial vein blood during external cooling. Uchino, K., Hasegawa, H. and Masuda, M. (Dept. Physiol. Jikei Univ. Sch. Med., Minatoku, Tokyo, 105)……372

440. Salivary cooling in various strains of rats. Furuyama, F., Takaba, S. and Ohara, K. (Dept. Physiol., Nagoya City Univ. Med. Sch., Mizuho-ku, Nagoya 467)……372

441. Relationship between increase of tail skin temperature and change of blood pressure during scrotal heating in anesthetized rats. Tsuchiya, K. (Dept. of Environment Physiol. and Epidemiol., Inst. for Tropical Med., Nagasaki Univ., Sakamoto-machi, Nagasaki)……373

442. Effects of tracheal bypass breathing on heat balance in rabbits. Sugano, Y., Shibata, H., Hayashi, M. and Nagasaka, T. (Dept. of Physiol. Kanazawa Univ. Sch. Med., Kanazawa 920)……373

443. Thermal sensation and changes in skin temperature during a light exercise in women. Osada, Y., Ogawa, S. and Yoshida, K.* (Dept. Physiol. Hyg., Inst. Publ. Health, Minatoku, Tokyo, 108 and Dept. Publ. Health, Sch. Med., Showa Univ., Shinagawaku, Tokyo, 142*)……373

444. Circadian variation of thermoregulatory responses in woman. Niwa, K., Tsurutani, T. and Nakayama, T. (Dept. of Physiol., Osaka Univ. Sch. of Med., Nakanoshima, Kita-ku, Osaka, 530)……374

445. Effects of one hand immersion in cold water on the finger tip temperature, especially in vibration exposed. Murakami, N., Takashima, S., Sato, S., Azuma, T. and Funahashi, A. (Dept. Physiol. Mie Univ. Sch. Med. Edobashi, Tsu, 514)……374

446. Neural connections between preoptic thermo-sensitive neurons and the medial forebrain bundle in the rat. Kiyohara, T., Hori, T., Shibata, M. and Nakashima, T. (Dept. Physiol., Saga Med. Coll., Saga 840-01)……374

447. Effect of calcium removal on thermosensitivity of preoptic neurons in vitro. Hori, T., Nakashima, T., Hori, N., Kiyohara, T. and Shibata, M. (Dept. Physiol., Saga Med. Coll., Saga 840-01 and (N. H.) Dept. Pharmacol., Kyushu Univ. Sch. of Dent., Fukuoka 812)……375

448. Blood flow changes in the hypothalamus, reticular formation and spinal cord during pyrogen induced fever in heat accimated rabbits. Kosaka, M., Ohwatari, N. and Inomoto, T. (Dept. of Environment. Physiol. and Epidemiol., Inst. for Tropical Med., Nagasaki Univ., Sakomoto-machi, Nagasaki)……375

449. Mode of action of endogenous pyrogen in the rabbits brain. Sakata, Y. and Murakami, N. (Dept. of Physiol., Yamaguchi Univ. Sch. of Med., Kogushi, Ube, 755)……375

450. Activities of preoptic-hypothalamic thermosensitive neurons and tail vasomotor response to thermal stimulation of scrotal skin in rats. Ishikawa, Y., Nakayama, T. and Tsurutani, T. (Dept. Physiol. Osaka Univ. Sch. Med., Kitaku, Osaka, 530)……376

451. Estimation of forearm blood flow change by thermal measurement during and after

leg exercise. Tamura, T., Togawa, T., Tanaka, M.* and Yoshida, K.* (Inst. for Med. and Dent. Eng., Tokyo Med. and Dent. U., Dept. of Pub. Health, Showa U.*)……376
452. Sweat expulsion waves as the indicator of the sweat center activity. Ohara, K., Okuda, N. and Sato, H. (Dept. Physiol., Nagoya City Univ. Sch. Med., Mizuhoku, Nagoya, 467)……376
453. On the characteristics of axillary sweating. Sugenoya, J., Ogawa, T., Ito, M., Miyagawa, T. and Asayama, M. (Dept. Physiol., Aichi Med. Univ., Nagakute, Aichi, 480-11) ……377
454. Dynamic properties of sweating activity. Asayama, M., Ogawa, T., Ito, M., Miyagawa, T. and Sugenoya, J. (Dept. Physiol., Aichi Med. Univ., Nagakute, Aichi 480-11) ……377
455. Temperature acclimation and changes in β-adrenergic receptor. Kurahashi, M. and Kuroshima, A. (Dept. Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa, 078-11) ……377
456. Role of polyamines in temperature acclimation. Ohno, T.*, Kuroshima, A. and Yahata, T. (Div. of Nuturition Physiol., Hokkaido Educational Coll.*, Hokumoncho 9, Asahikawa, 070 and Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa, 078-11) ……378
457. Improved cold tolerance and its mechanism in glucagon-treated rats. Yahata, T., Kuroshima, A. and Ohno, T.* (Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa, 078-11 and Div. of Nutr. Physiol., Hokkaido Educat. Coll., Hokumon-cho 9, Asahikawa, 070*)……378
458. Changes in secretory responses of the exocrine and endocrine pancreas in the course of cold acclimation of rat. Harada, E., Habara, Y., Yonezawa, H., Shibuya, I. and Kanno, T. (Dept. Physiol., Hokkaido Univ. Fac. Vet. Med. Kita-ku, Sapporo, 060)……378

32. Circadian Rhythm (459—467)

459. A circadian rhythm of the lateral geniculate synaptic transmissions in the rat. Hanada, Y. and Kawamura, H. (Dept. Physiol., Univ. of Tokyo, Bunkyo-ku, Tokyo and Lab. of Neurophysiol., Mitsubishi-Kasei Inst. of Life Sci., Machida, Tokyo 194)……379
460. Circadian rhythm in neural activity of the suprachiasmatic nucleus. Inouye, S. T. and Kawamura, H. (Neurophysiol. Lab., Mitsubishi-Kasei Inst. of Life Sci., Machida-shi, Tokyo 194) ……379
461. Two daily surges of prolactin secretion in the immature female rat. Kimura, F. and Kawakami, M. (Dept. Physiol., Yokohama City Univ. Sch. Med., 2-33 Urafune-cho, Minami-ku, Yokohama 232)……379
462. Sex steroids modification of sleep circadian rhythm in the female rats ; strain differences. Yamaoka, S. (Dept. Physiol., Saitama Med. Sch., Moroyama, Saitama, 350-04) ……380
463. Critical period for setting the phase angle of circadian rhythm of plasma corticosterone in perinatal pups. Watanabe, K., Honma, K., Endo, M. and Hiroshige, T. (Dept. of Physiol., Hokkaido Univ. Sch. of Med., Kita-ku, Sapporo 060) ……380
464. Is feeding-inducible plasma corticosterone peak associated with an independent oscillator in rats? Hiroshige, T., Watanabe, K. and Endo, M. (Dept. of Physiol., Hokkaido Univ. Sch. of Med., Kita-ku, Sapporo 060)……380

465. A circadian rhythm in the locomotor behavior of a African giant snail, *Achatina fulica*. Ogasawara, T. and Tasaki, K. (Dept. Physiol., Tohoku Univ. Sch. Med., Seiryocho, Sendai, 980)……381

466. Role of energy metabolism and membrane function in the circadian rhythm of motility in *Paramecium*. Hasegawa, K., Katakura, T., Tanakadate, A., and Ishikawa, H. (Dept. Physiol., Kitasato Univ., Sch. Med., Sagamihara, Kanagawa) ……381

467. Resetting of biological clocks and bowel movements. Sasaki, T., Koga, R. and Tsuzuki, S. (Dept. Physiol., Inst. Const. Med., Kumamoto Univ., Kumamoto 862)……381

33. Sleep (468—471)

468. Effects of sleep-promoting substance on sleep-waking rhythms of normal male rats. Honda, K., Komoda, Y. and Inoué, S. (Inst. Med. Dent. Engineering, Tokyo Med. Dent. Univ., 2-3-10 Kanda-Surugadai, Chiyoda-ku, Tokyo 101)……382

469. The effects of electroconvulsive shock on sleep of rats. Nagata, K., Ishikawa, N., Dainoson, K.* and Matsumoto, J. (Dept. Physiol. Tokushima Univ. Sch. Med., 3-Kuramoto, Tokushima, 770, Dept. Neuropsychiatry Kurume Univ. Sch. Med., Asahi-cho, Kurume, Fukuoka, 830*)……382

470. Sleep and inhibition of protein and RNA synthesis. Uezu, E., Sano, A. and Matsumoto, J. (Dept. of Physiol., Sch. Med. Tokushima Univ., Kuramoto, Tokushima, 770) ……382

471. The antagonistic effect of the sleep promoting substance on chloramphenicol induced PS suppression. Nagasaki, H. and Iriki, M. (Dept. Physiol., Tokyo Metropolitan Inst. Gerontology) ……383

34. Miscellanea (472—474)

472. Sex education for newly-born babies. Takahashi, M. (Bio., Chiba Juni)……384

473. The evaluation of the mechanism of bile production by organic anion in the rat. Kitani, K. (First Lab. of Clinical Physiol., Tokyo Metropolitan Inst. of Gerontology) ……384

474. Studies of safety of salinomycin in chickens (2nd report). Asaba, H., Watanabe, N., Kadoya, T., Fukui, M., Oota, H. and Seki, S. (Dept. Oral Physiol., Kanagawa Dent. Coll., Yokosuka) ……384

1

APPLICATION OF CHROMATICITY COORDINATES FOR QUANTIFICATION OF COLOR REACTIONS. CHICHIBU, S. Dept. of Physiol., Kinki Univ. Sch. Med., Sayama, Osaka, 589

The microscopical spectrophotometry is a useful tool for detection of a certain substance in a very minute localization in biological structures. Except the comparison of absorbances among materials, the lightness, Y' in the x, y, Y' chromaticity coordinate system, gave a sufficient linear relationship to concentrations. The coordinate values, x nad y, also useful for identification of colors produced by histochemical reactions. The chromophore concentrations for Weigert's elastin stain were compared on the native, and the purified elastins. The purified elastins after Lansing's and Partridge's method showed lesser color deviations than that of the native one. The lightness changes in accordance to thickness were more linear in these purified preparations. This method applied to Mg analysis, revealed the localization spot of 10 to 20 mM in the crayfish aesthetasc hair. The limitation is that this method gives concentration of the reacted chromophores and not the substance itself.

2

RECONSINLERATION ON CONVENIENT METHOD FOR RECORDING AND MEASURING A TINY QUANTITY OF FLUID. INOMATA, K., TAMAGAWA, K., ITO, K. and NAKAMURA, H.* Dep. of Physiol., Sch. of Dent., Higashi-Nippon-Gakuen Univ., Dep. of Oral-physiol., Sch. of Dent., Higashi-Nippon-Gakuen Univ.* Ishikari-Tobetsu, Hokkaido, 061-02

Recording and measuring method for a tiny quantity of fluid which Inomata had reported using optical apparatus is high sensitive and it detects about 0.2μl, but its adjustment (light-intensity, optical axis setting place, etc.) is not so easy. Then we try to simplify the operation for above equipments using strain-gauge and electronic-balance, accordingly we know three types strain-gauges and one electronic-balance are useful for detecting the flow of secretion from parotid gland as well as above optical equipments. And one of three strain-gauges detects enough 3μl (3mg). If we can use more sensitive strain-gauge and high gain preamplifier and low noise relay (connected with HIIA), we consider that we can record and measure more tiny fluid (e.g. tear, sweat, etc.) without trouble.

3

A MICROPROCESSOR CONTROLLED STIMULATOR FOR GENERATING COMPLEX PULSE PATTERNS
S. HANAI, Dept. of Physiol., Fujita-Gakuen Univ. Sch. of Med., Toyoake, Aichi

A microprocessor controlled stimulator was designed and manufactured for electrophysiological experiments in which complex pulse pattern stimulation is employed. This stimulator consists of an 8-bit microprocessor, a programmable timer module, a timing generator circuit, a digital-to-analog converter, MOS memories and peripheral input-output devices.

Stimulation patterns are determined mainly by the control program modules previously loaded into read-only-memory, rather than hardware design. Providing operator commands to video terminal, an operator can select one of program modules corresponding to a desired pulse pattern and can set or alter stimulus parameters defined by the selected pattern at any time. This stimulator can deliver actually unlimited stimulation patterns, because the interval, the voltage and the duration of any stimulus pulse can be programmed independently. Besides stimulus pulse generation, peripheral instruments, such as an oscilloscope, a signal analyzer and a data recorder, are simultaneously operated under microprocessor control.

It is supposed that stimulators of this type have the great advantage of utilizing complex stimulation patterns, as compared with conventional ones which consist of randam logic circuits.

4

APPLICATION OF A MULTI-MICROELECTRODE SYSTEM FOR NEUROPHYSIOLOGICAL EXPERIMENTS.

AIKAWA, S., KOBAYASHI, S., OHTA, K.,* AOKI, K.,* AKITA, H.,* SATO, A.* Dept. of neurophysiol. Seishin-Igaku Inst., Itabashi-ku, Tokyo. Dept. of Physiol. Sch. of Hygenic Sciences Kitasato Univ., Sagamihara-city, Kanagawa.*

A multi-microelectrode system, which was suitable for a simultaneous recording of neural electrical activities of adjacent neurons in a central nervous system, was developed by Kono & Niki (Electrotechnical Lab.) and us. Our study of the multi-microelectrode system was performed following subjects;

(1) development of a electrode coating system and manufacture of the electrodes,
(2) development of a 4-channel oil-manipulator system,
(3) application of the electrodes for simultaneous extracellular recording of several thalamic ventrobasal neurons of cat,
(4) histological check of the electrode tracks with aid Nissel staining.

The multi-unit recordings were succeeded in VB of cat, total 83 unit discharges for 30 minutes or more in 24 penetrations. Differences between the index of oil manipulator and the vertical location of electrode tracks were from 0.5mm to 1.0mm. We will improve on the electrodes and the manipulator for exactly indicating a position of a electrode by oil-manipulator.

5

ESTIMATION OF THE NUMBER OF ACTIVE MOTOR UNITS BY STATISTICAL PROCESSING THE SURFACE ELECTROMYOGRAM.,

M. YOSHIDA, K. KANOSUE*, K. AKAZAWA, K. FUJII, Electrical Engineering, Fac. of Eng., OSAKA Univ., Suita, OSAKA, * Second Dept. of Physiol., OSAKA Univ. Med. School, Kitaku, OSAKA.

A new method of estimating the number and the size of active motor units by statistical processing the surface electromyogram (EMG) is devised. Force range is divided into many segments, and segment j expands from P_{j-1} to P_j. Some motor units recruited in segment j, and their number is denoted N_j and their size is K_j. The number N_j and the size K_j of active motor units are shown as a function of the second m_2 and the fourth m_4 moments of the surface EMG and the firing rate $f_j(P_i)$. This estimation starts from the lowest force segment and ends at the highest force segment by using m_2 , m_4 , and $f_j(P_i)$. The estimation results agree to the physiological knowdge of the relation between the size of motor units and the threshold force and the relation between the number of active motor units and force. Therefore the propriety of this method is confirmed.

6

DIFFUSION COEFFICIENTS OF INTRACELLULAR MOLECULES IN MUSCLE MEASURED BY PULSED-FIELD GRADIENT NMR.

YOSHIZAKI, K., SEO, Y., NISHIKAWA, H., and MORIMOTO, T. Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto

The diffusion coefficients of intracellular molecules, i.e., creatine phosphate, inorganic phosphate, and water in frog muscle were measured by pulsed-field gradient nuclear magnetic resonance. The strength of the pulsed-magnetic field gradient (g) used was about 40 Gauss/cm, generated with the modulation coil built in the cross-coil probe of the JEOL PFT-100 NMR spectrometer. The connection of the coil was changed into appropriate polarity to produce z-field gradient. A series of 90°-g-180°-g pulse sequence was applied to obtain the diffusion coefficients. As the results, the diffusion coefficients of these molecules in muscle were reduced by a factor of about 2 from the respective values in aqueous solution. Thus, the diffusion velocities of these molecules in cell are slower than those in aqueous solution.

7

ENZYME KINETICS STUDY BY STEADY-STATE DIALYSIS METHOD.
M.Hashimoto M.Uozumi,T.Higashi. Dep. of Physico-chemical Physiology, Medical School, Osaka Univ., 4-3-57 Nakanoshima, Kita-ku, Osaka.

The reactor, which comprised the enzyme solution sandwiched in two pieces of semi-permeable membrane and its substrate solution counter-flowing on the outside surface of each membrane, where the substrate reacted with the enzyme through the membrane, was designed. We before reported how did the substrate react with the enzyme in this reactor by the simple expression on the assumption that the substrate concentration was homogeneous in the enzyme solution. In the present case, from the experimental results and the theoretical calculations, we got the general expression to the function of the reactor, the substrate, and the enzyme , which was free from that assumption.

$$So/f(So-S)=(So+Km)/VmVi + 1/2kA + 1/2f + kA/4ff$$

So and S : influent and effluent substrate concentration, Km : Michaelis constant, VmVi : total activity of the enzyme, f : flow rate of the substrate solution, k and 2A : substrate permeability and area of the semi-permiable membrane.

8

RATIONAL SOLUTION OF THE NERNST-PLANCK-POISSON EQUATIONS

SHINAGAWA, Y. Dept. of Physiol., Kyoto Univ. Med. Sch. Sakyo-ku, Kyoto 606

The exact solution of the Nernst-Planck-Poisson equations is obtained by means of power series expansion method. The equations are the fundamental equations for ion transport across membranes. It is demonstrated that the assumptions of constant field (Goldman) and parabolical potential (Mauro) are incompatible with the homogeneously charged membrane in the stationary state, referring to the exact solution. The assumption of the local electric neutrality and the Henderson equation are incompatible to the homogeneous membrane in the stationary state. The compatibility of an assumption of electric field with given conditions of membrane can be tested by means of the exact solution of the Nernst-Planck equation system. The Taylor series expansion method readily provides the exact solution as general solution. The special solution is obtained as rational function solution by means of this method in the special cases of the boundary condition of the system.

9

PHYSICO-CHEMICAL PROPERTIES OF PANCREATIC ZYMOGEN GRANULES STUDIED BY LASER LIGHT SCATTERING.

WARASHINA,A. Dept. of Physiol., Niigata Univ. Sch. Med., Niigata

Quasi-elastic light scattering was used to study physico-chemical nature of the zymogen granules isolated from the mouse pancreatic homogenate by differential centrifugation. A beam of He-Ne laser was introduced into a condenser lens of microscope at a point off from the center axis so that only the scattered light was observed with a objective lens. Intensity fluctuations of the scattered light were analyzed by measuring autocorrelation functions of the noise. The average size of the granules in 0.3 M sucrose was determined to be 1.1 ± 0.1 μm from the correlation time. About 16 % reduction of the average radius of the granules was detected by elevating sucrose content in the medium from 0.3 to 0.8 M. The aggregation of the zymogen granules due to the increase of Ca or the decrease of pH in the medium was also effectively detected by this method. The aggregation started critically at a Ca level of 1 mM or a pH level of 5.4. The method seems applicable to the study on the stimulation-secretion coupling through analyzing the movement of granules in cells in secretory glands.

10

NUCLEAR MAGNETIC RELAXATION OF SPIN-3/2 NUCLEI IN HETEROGENEOUS SYSTEMS.

H. MONOI. Dept. of Physiol., Tohoku Univ. School of Medicine, Sendai

In order to elucidate the origin of the nonexponential nature of the transverse magnetic relaxation of spin-3/2 nuclei in heterogeneous systems, the ^{23}Na resonance of model systems (sodium salt of higher fatty acid—related hydrophobic compound—NaCl in a sufficient amount of water) was studied. They are transparent solutions or semitransparent or milk-white emulsions (or jellylike gels), depending on the amount of the hydrophobic compound. ^{23}Na in transparent micellar solutions and microemulsions possesses a single value of the transverse relaxation time T_2. In contrast, two different values of T_2 were always observed in turbid emulsions and gels. The condition for the occurrence of two T_2 values in heterogeneous systems is formulated on the basis of a two-state model formerly presented for the ^{23}Na resonance of biological tissue (H. Monoi, *Biophys. J.* 14, 653(1974)). A theoretical consideration indicates that the *critical* diameters of colloidal particles at which two T_2 values first appear are not less than 30 to 40 nm for samples containing sodium soap. [*J. Magnetic Resonance*, in press]

11

STUDY ON PHOSPHOLIPID IN BIOMEMBRANE BY 31-PHOSPHOR NUCLEAR MAGNETIC RESONANCE

WATARI. H., *NISHIKAWA, H. and **ASATO, R. Dept. of Molecular Physiol., National Inst. for Physiol. Sciences, Okazaki, *Dept. of Physiol., Kyoto Prefect. Univ. of Medicine, **Dept. of Neurosurgery, Kyoto Univ. Med. School

The effects of calcium ion on the erythrocyte membrane were observed by 31-phosphor-nuclear magnetic resonance (NMR). The erythrocyte membrane is composed by phosphatidyl-serine, phosphatidylethanolamine, phosphatidylcholine and sphingomyelin. When 31-phosphor NMR of each phospholipid is measured, the signal of phosphatidylserine is affected more easily by the presence of calcium ion than that of other phospholipid and this is considered as the binding of calcium ion to the polar groups of phosphatidyl-serine with divalent negative charges. In order to verify the obtained NMR spectrum as to be the crystal powder pattern and to know the change of the width of the phosphor molecule by the binding of calcium ion, the simulation study is carried out. The good fittings are obtained, when the anisotropy of chemical shift is supposed with axial symmetry. The width of bound phosphor with calcium ion is about 40 Hz.

12

RESONANCE RAMAN SPECTRA OF SEMIQUINONE FORMS OF FLAVINS BOUND TO RIBOFLAVIN BINDING PROTEIN.

Y. NISHINA, K. SHIGA, H. WATARI, K. HORIIKE* AND TOJO,H*, National Institute for Physiological Sciences, Okazaki and *Dept. of Biochemistry, Osaka University Medical School, Osaka

The resonance Raman(RR) spectra of neutral semiquinones of riboflavin or 8-methoxy-riboflavin(8-OCH_3-RF) bound to riboflavin binding protein (RBP) were observed. The RR spectra of neutral semiquinone of riboflavin-RBP complex has an intense line at 1617 cm^{-1}, which is not shifted in D_2O solution, and this line probably corresponds to 1583 cm^{-1} line of oxidized riboflavin which involve the displacement of N(5) and C(4a) atoms of isoalloxazine. Some other lines were also observed at 1533, 1273, 878, 747 and 550 cm^{-1} in H_2O. The RR spectrum of semiquinone of 8-OCH_3-RF bound to RBP has doublet lines at 1623 and 1615 cm^{-1}. In D_2O solution, the 1623 cm^{-1} line is not shifted, but the 1615 cm^{-1} line is shifted to 1604 cm^{-1}. The former line is probably derived from 1578 cm^{-1} line of oxidized 8-OCH_3-RF which is related to C(4a)-N(5) stretching mode and the latter line may be mainly derived from C=O stretching.

13

THE π-ELECTRONIC STRUCTURE OF 8-AMINO-8-DEMETHYL-D-RIBOFLAVIN.

K. SHIGA, Y. NISHINA, H. Watari, K. HORIIKE*, AND H. TOJO*, National Institute for Physiological Sciences, Okazaki and *Department of Biochemistry, Osaka University Medical School, Osaka

It was known[1] that the introduction of amino group to 8-position of flavin caused the drastic changes of the π-electronic structure of flavin.

In this study, to investigate the π-electronic structure of 8-amino-8-demethyl-D-riboflavin, semi-empirical calculations of the Pariser-Parr-Pople Hamiltonian were performed and also the absorption, CD and MCD spectra were measured, which were analyzed in terms of Gaussian wave number curves(from band I to band X).

The theoretical results well depicted the novel spectral properties.

1) Zhurnal Obshchei Khimii 42, 1135 (1972)

14

EFFECTS OF VARIOUS PROTEIN INHIBITORS ON ALBUMIN ELECTROPHORETIC PATTERN

T, KAWAGUCHI, H, MATSUSHITA. Dept. of Physiol., Wakayama Medical College, Kyuban-cho, Wakayama

Serum albumin is electrophoresed as two bands in urea submerged cellulose acetate membrane at pH 8.5, it is also devided into three bands at pH 11.0. The slower migrating albumin band is considered denatured albumin in urea. Susceptibility of albumin to urea denaturation was increased by addition of 2-mercaptoethanol. In this study, effects on albumin denaturation of other protein inhibitors(each 10 mM) are tested by comparing albumin electrophoretic pattern at pH 8.5 and 11.0.

Iodoacetoamide protected the albumin denaturation at pH 11.0. Iodoacetate protected the urea-denaturation of albumin at pH 8.5 but increased at pH 11.0. P-chloromercuribenzen increased albumin urea-denaturation at pH 8.5, but protect at pH 11.0. Semicarbazide increased albumin denaturation at pH 8.5 and protect it at pH 11.0. Phenylhydrazine protected albumin denaturation at pH 8.5 but increased at pH 11.0.

15

INTRAMOLECULAR SULFHYDRYL DISULFIDE EXCHANGE REACTION OF BOVINE PLASMA ALBUMIN(BPA)—MOLECULAR AGEING.

H.INOUYE, S.ERA, S.NAGAOKA AND M.SOGAMI. Dept of Physiol., Sch. of Med. Gifu Univ., Gifu.

The effects of salt, PH and temperature on the N-A isomerization ($N \rightleftarrows A + mH$, where N and A are the N-and A(aged)-forms, respectively) were studied using moving-boundary electrophoresis in 0.03 $\Gamma/2$, PH 4.82 Na acetate buffer at 2.5°C and TRP fluorescence change, $\triangle F$ in 0.10 M KCl at isoionic PH with λ(EXC) of 300 nm. (1-A) PH-EFFECT ON AGEING AT 25°C FOR 10 HOURS IN SALT-FREE SOLUTION—PH-profile of $A/(A+N)$ obtained by electrophoresis suggested that below PH 7 the N-form is stable and above PH 8.3, $A/(N+A)$ was constant,0.55. Though mid-point of $A/(N+A)$-PH profile was PH 7.45, that of ΔF was PH 7.85. (1-B) SALT EFFECT ON AGEING AT PH 8.6 FOR 15 HOURS at 25°C—KCl exerted a stabilizing effect on the N-form. Though the A-form of BPA aged in 0.05 M KCl was 25% by electrophoretic analysis, there was almost no change in ΔF. (1-C) Kinetic studies on the ageing at PH 8.6 in salt-free solution at 25°C cleary indicated the discrepancy between results by electrophoresis and those by ΔF, especially in the initial part of the ageing. As shown in 1-A, 1-B and 1-C, no coincidence of transition curves determined by two different methods might indicate the presence of several kinds of the A-form. (2) Charge difference between the A-and N-forms, $\Delta Z = Z_A - Z_N$ in Na acetate buffer at PH 4.82 was 5~6.

16

TIME-RESOLVED FLUOROPOLARIMETRIC STUDIES ON REDUCED PROTEIN-SODIUM DODECYL SULFATE COMPLEXES

M.SOGAMI, S.NAGAOKA, H.INOUYE, S.ERA AND H.ASHIDA. Dept. of Physiol., Sch. of Med.Gifu Univ. Gifu and Dept. of Physiol., Defence Med. Col., Tokorozawa

Reynolds and Tanford (1970) and Shirahama et al (1974) have proposed a rigid rod-like model and a flexible necklace model, respectively, for the reduced protein sodium dodecyl sulfated (SDS) complexes. β-lactoglobulin (M.W. 1.84×10^4), ovalbumin (M.W. 4.3×10^4) and bovine plasma albumin (M.W. 6.6×10^4) were labeled with N-dansylaziridine (DNS-AZ) which reacts selectively with protein thiols. Number of labeled DNS-AZ per protein molecule was less than one. Rotational relaxation time (ρ) and fluorescence lifetime of reduced DNS-AZ SDS complexes were studied using the time-resolved pulse fluorometric method. Secondary structure of SDS complexes were studied using circular dichroism measurement. ρ values of SDS complexes of DNS-AZ-labeled reduced bovine plasma albumin, ovalbumin and β-lactoglobulin at binding level of 1.4g of SDS per g of protein were 45, 45 and 41 nsec, respectively. Our results might suggest the presence of domains, possessing rotationalfreedom, in reduced DNS-AZ-protein SDS complexes and might support the flexible necklace model. It might be worth to note that reduced β-lactoglobulin SDS complex might have one domain.

17

ESTABLISHMENT OF CELL LINES (MC3T3) FROM MOUSE CALVARIA. H. KODAMA, Y. AMAGAI, S. KASAI. Dept. of Physiol., Tohoku Dental Univ., Koriyama Fukushima.

Attempting to establish osteogenic cell lines, we have developed 8 cell lines from newborn C57BL/6 mouse calvaria under a rigid 3T3 subculture schedule, i.e., transfer every 3 days of an inoculum of $3X10^5$ cells / 25 cm^2 flask. Resulting cell lines had relatively low saturation densities, 0.26 to $0.76X10^5$ cells / cm^2, except one ($2.2X10^5$). Then we examined them on alkaline phosphatase activity as a screening test for osteoblast-like cell line and some activities were detected in all cell lines. The extremely high activity (100 μmoles / hr·mg protein) was detected in one of cell lines after cultures became confluent, though it was very low in growing state. Moreover, the enzyme activity released into culture medium continued to increase for at least 30 days. Unexpectedly, a myogenic cell line and 3 preadipose cell lines were included in others. The former differentiated in confluent cultures to multinucleated, spontaneously contractile muscle fibers and the latter to adipocytes.

18

NERVE GROWTH FACTOR (NGF)-INDUCED FIBER OUTGROWTH AND ELECTRICAL EXCITABILITY IN CULTURED ADRENAL MEDULLARY CELLS

OGAWA, M., ASAMI, K., IRIMAJIRI, A., ISHIKAWA* T. & SEGUCHI* H, Dept. of Physiol. and Dept. of Anat*, Kochi Medical School, Nankoku, Kochi

The effect of NGF on chromaffin cells was studied morphologically and electrophysiologically. Enzymatically dissociated cells obtained from cortex-free adrenal medullae of 10-day-old rats, were incubated at 37°C in Dulbecco's modified Eagle's medium (plus 20% fetal calf serum) containing NGF. Marked fiber outgrowth was observed in the NGF-treated cells. Both the cell body and the fiber showed strong fluorescence specific to catecholamine. Most of the fibers extended, going around fibroblasts and contaminated cortical cells, to the neighboring chromaffin cells. The fiber-extending cells showed action potential on passing current through the intracellular recording microelectrode. In the cells with relatively high resting potential the action potential was evoked either by the onset of an outward current or by the termination of an inward current. The action potential of the cells with low (-20 to -30 mV) membrane potential was elicited only by an anodal break current. The control (NGF-untreated) cells showed merely a graded response to current passing.

19

EXTERNAL CALCIUM ION AND MOUSE MACROPHAGE. M.ORI, Y.SHIBA, Y.KANNO. Dept. of Physiol., Hiroshima Univ. School of Dentistry, Hiroshima 734

Calcium ion is well known to play an important role for cell function and we have examined the effect of external calcium ion on macrophage morphology and formation of cell coupling. Macrophages were collected from peritoneal exudate of male mouse injected with thioglycollate. The cells were cultured in Eagle's MEM medium supplemented with 10 % calf serum which contained various concentrations of calcium ion ; 0.5 , 2.0 , 4.0 , 8.0 and 10 mM. After 2 days in culture macrophages exhibited the same morphological feature and contacted each other. Contacted cell pairs were coupled electrically. When external calcium concentration was increased from 0.5 mM to 4.0 mM , the number of coupled cells rapidly increased. But 10 mM calcium did not increase the number of coupled cells. The high incidence of coupled cells in 4.0 mM Ca was decreased in the presence of 0.1 mM $LaCl_3$, 2.0 mM $MnCl_2$ and 5×10^{-6} verapamil. Increase of Mg concentration from 0.1 mM to 4.0 mM did not change the incidence of coupled cells. These drugs did not affect the morphology of the cells. These results suggest that external calcium ion influences the cell coupling formation of mouse macrophages without morphological change.

20

EFFECTS OF TETRAETHYLAMMONIUM, 4-AMINOPYRIDINE AND LOCAL ANESTHETICS ON CELL COUPLING FORMATION. T. ENOMOTO, Y. SHIBA and Y. KANNO. Dept. of Physiol., Hiroshima Univ. Sch. of Dent., Hiroshima, 734

FL cells were harvested by treating with 0.02% EDTA solution. Free cells were contacted by centrifugation and cell pairs contacted were obtained by gentle pipetting of cell precipitate (about 10% in total cell population). The cells were cultured on the serum-coating cover glass in Eagle's MEM medium. All the cell pairs established electrical coupling by 3 hr after culture. Tetraethylammonium (TEA, 10mM), 4-aminopyridine (4-AP, 1mM), procaine (1mM) and tetracaine (0.1mM) added in the medium at onset of culture delayed the formation of cell coupling. The drugs added 1 hr after culture at which time the occurrence of coupled cells was about 50% did not increase the occurrence of coupled cell. These drugs added 2 hr after culture did not influence the established cell coupling. Monoiodoacetic acid-cyanide (0.5mM) inhibited the cell coupling formation and decreased the established cell coupling. TEA, 4-AP and local anesthetics suppressed the formation of cell coupling before onset of formation, but did not after onset of formation.

21

OLIGONUCLEOTIDE-LIKE CELL PROLIFERATION INHIBITORY FACTORS IN RAT LIVER SUPERNATANT. HATASE, O., KURAMITSU, M., MATSUI, H., TOKUDA, M., TAKAHASHI, F., and HORI, Y. Dept. of physiology, Okayama Univ. Med. School.

Organ-derived cell proliferation inhibitory factors have been investigated as well as stimulating factors. They are polypeptides, and show a certain tissue-specificity. On the inhibitory factors, chalone, cornin, and many other inhibitants have been reported, but purifications have not been succeeded yet. The causes are considered due to the co-existence of stimulating factors and that the biological activities of the factors might be effective only in a mutiple-complex structure. In the present communication we report the presence of low molecular weight inhibitory factors for cell proliferation in a rat liver supernatant. The factors inhibited DNA synthesis in S-phase of cultured L-cells as a cause of the inhibition of protein synthesis. The properties were investigated by gel filtration, thin-layer and DEAE-cellulose chromatography, enzymatic treatment, UV-spectrum, and so on. The molecular weight of the factors was less than 1000, and chemically they would be nucleotide derivatives.

22

INDUCTION OF RAT HEPATOCYTE DNA SYNTHESIS IN PRIMARY MONOLAYER CULTURE. K. HASEGAWA, H. OHTAKE and M. KOGA, Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi.

Isolated hepatocytes from adult male rats (170 - 200 g) were cultured for 3 days in a serum free synthetic medium. Culture period was divided into P1 (0 to 4 h), P2 (4 to 22 h) and P3 (22 to 72 h). When fibrinogen digests were supplemented in P1, and glucagon (50 ng/ml) and insulin (50 ng/ml) were added in P3, marked increase in the incorporation of [^{3}H]thymidine into hepatocyte nuclei was observed as compared with the synthetic medium alone. Incorporation of [^{3}H]thymidine began to increase at 35 hours and reached a maximum at 54 hours after the plating. At this time, cells were morphologically identifiable as hepatocytes. Glucagon in P3 could be replaced by dibutyryl-cyclic-AMP (10^{-5} to 10^{-7} M) or isobutyl-methyl-xanthine (10^{-4} M). Addition of amiloride (an inhibitor of sodium ion influx, 10 μg/ml) during the initial 22 hours completely inhibited the incorporation of [^{3}H]thymidine without impairment of hepatocyte morphology. These results suggest that influx of sodium ion during early prereplicative period and increase in intracellular cyclic-AMP levels during late prereplicative period are necessary for the induction of DNA synthesis in hepatocytes.

23

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

The aspects of cellular ATP level and macromolecular syntheses in the cell cycle were studied in populations of synchronized L cells by selective detachment of mitotic cells. These L cells were treated with the inhibitor of cellular ATP generation, such as 2-deoxy-D-glucose(2-DG), carbonylcyanide chlorophenylhydrazone(CCCP) and iodoacetate(IAA). When these inhibitors were combined, such as 2-DG plus IAA, 2-DG plus CCCP or IAA plus CCCP, cellular ATP content decreased rapidly and within two hours had fallen to 0 to 8% of the control level. In this condition, the uptake and incorporation of ^{3}H-TdR in these cells were seriously inhibited to 13 to 33% of the control cells. And also, strong effects were observed on the incorporation rather than the uptake when treated with ^{3}H-amino acid mixture. In contrast, cellular ATP content was increased significantly(140% of control) by the addition of adenine nucleotide to the medium. In this case, the addition of 1 mM adenosine markedly affected the uptake and incorporation of ^{3}H-uridine. And then, the uptake of ^{3}H-TdR or ^{3}H-amino acid mixture did not alter significantly.

24

NEW PARAMETER REFLECTING T-CELL-DIFFERENTIATION BY THYMUS HUMORAL FACTOR (THF). KINOSHITA,Y., KIMURA,S., KIMURA,E. and NAKAMORI,H.* Dept. of Physiol. and Gynecol.*, Osaka City Univ. Med. Sch., Abeno-ku, Osaka.

About 75 % of rat thymus lymphocytes attached to guinea pig erythrocytes in Eagle MEM containing 10 % native fetal calf serum and formed rosette. The rosette-forming cells (RFC) were separated from non-RFC by differential centrifugation. THF was extracted from calf thymus as reported previously. Some of non-RFC cultured in vitro changed into RFC by THF addition. Optimal incubation time and concentration of THF were 24 hours and 10 ug/ml respectively. Medullary thymocytes, which were also non-RFC and relatively mature lymphocytes, could not acquire rosette-forming activity by THF treatment. On the other hand, calf spleen extract used as control did not reveal the activity showed by thymus factor. These results suggested that some of undifferentiated lymphoid cells located in thymus cortex possibly differentiated into T-cells by an induction of THF and acquired rosette-forming capacity. An acquisition of the capacity in the experimental system would be a new indicator of T-cell-differentiation induced by THF.

25

PHYSIOLOGICAL APROACH TO SPONTANEOUS HEALING WITH CORTISONE-L-CARNOSINE-SYSTEM

K.NAGAI. Department of Physiology, Nihon University School of Dentistry
Tokyo, 101 JAPAN

L-Carnosine possesses a physiological activation to promote the spontaneous healing of wounds.
Cortisone-carnosine system has a double function of anti-edematous and granular promotion effects, thus healing various wounds in a consistent defensive manner.
The author considers this cortisone-carnosine system as working in the direction of non-specific resistance.
As a hypothesis, it is proposed that cortisone works to transfer carnosine in an inflammation rather than works on the skeletal muscles as a target organ.
Carnosine which is transferred will work in conjunction with cortisone in the consistent defensive mechanism.

Reference : Nagai, Kineshiro, Yamane Toshio, Pathophysiologische Bedeutung von L-Carnosin auf die Wund heilung, Heterocycles, 10 : 222-347, 1978

26

PANCREATIC ACINAR CELLS: THE EFFECT OF L-AMINO ACIDS ON MEMBRANE POTENTIAL AND RESISTANSE. N. IWATSUKI. and A. NISHIYAMA*. Dept. of Physiol., Univ. of Dundee, U.K. Dept. of Applied Physiol., Sch. of Med., Tohoku Univ, Sendai. * Dept. of Physiol., Sch. of Med., Yamagata Univ, Yamagata.

The mechanisms of the action of amino acids were investigated in superfused segments of mouse pancreatic acinar cells using two intracellular microelectrodes technique. All L-amino acids used evoked a stereospecific membrane depolarization accompanied by an increase in membrane conductance and this membrane effect had a much shoter latency than the secretagogue response. The equilibrium potential for L-alanine evoked potential changes corresponded to the Na equilibrium potential. Replacing all superfusion fluid Na by Tris or Li, in all cases resulted in an immediate reduction in the amplitude of L-alanine evoked depolarization. This effect was immediately reversible upon readmission of Na to the bath. The clear reduction taken together with the findings that the equilibrium potential has a value close to the caluclated Na equilibrium potential indicates that L-alanine and several other L-amino acids investigated open up conductance pathways in the plasma membrane mainly permeable to Na.

27

ELEMENTAL DISTRIBUTION IN THE PANCREATIC ACINAR CELLS DETERMINED BY ELECTRON PROBE X-RAY MICROANALYSIS. NAKAGAKI,I.,SASAKI,S.,MURAKAMI,M.,MORI,H.,IMAI,Y.*TERANISHI,S.& *SHIGUMA,M. Dept. of Physiol.and Surgery* Osaka Med. Coll.,Takatsuki, Osaka 569, Japan

The elemental distribution in the pancreatic acinar cells of dog, rat and chicken was examined by electron probe X-ray microanalysis of freshly frozen ultra thin sections of the pancreas in the resting and/or stimulating state. The cytoplasm and nucleus of pancreatic acinar cells of three species contained the large quantity of K and P and the small of Cl, while the secretory granules of the cells relatively had larger quantity of Ca, K, Cl, S and Na. The elemental concentrations in the cytoplasm and secretory granules were also measured by the peak-back ratio of X-ray spectrums of these organelle and of standard Ringer-albumin frozen thin sections. The concentration of K and Cl in the cytoplasm of dog pancreatic acinar cells was estimated to be about 140±35 mM, and 13±8 mM/Kg.wet weight (mean value±S.D. of mean), respectively. The concentration of Na, K and Cl was also estimated to be 35±13 mM, 69±18 mM and 25±17 mM/Kg.wet weight,respectively. When the pilocarpine and/or Ach was given, the concentration of Na and Cl of both cytoplasm and secretory granule of dog pancreatic acinar cell increased. It was suggested that the secretory granules of acinar cells of three animals contained relatively higher concentration of Ca which was probably in bound form. Immuno-electron microscope technique using antibody against Ca ATPase of SR was performed to localize Ca pump in acinar cells.

28

DYNAMIC CHANGES OF K NET FLUXES INDUCED BY STIMULATION OF SALIVARY GLANDS IN VITRO. K. Katoh, K. Konno and A. Nishiyama. Dept. of Physiol., Yamagata Univ. Sch. of Med., Yamagata City, Yamagata

In superfused segments of rat parotid and submaxillary glands, ACh, α-adrenergic agonists(phenylephrine, NA+propranolol) and substance P caused a significant K release which was enhanced by the addition of ouabain but suppressed by the omission of external Ca. On the other hand, β-adrenergic agonists (isoproterenol, NA+phentolamine) caused a significant K uptake which was completely blocked by the addition of propranolol or ouabain, but not affected by the omission of external Ca. β-adrenergic agonists caused membrane hyperpolarization without change of membrane resistance suggesting direct activation of the electrogenic Na-K pump in the submaxillary gland acinar cells. In the sublingual gland which does not receive adrenergic innervation, adrenergic agonists had no effects. From these results we conclude: in the salivary glands, cholinergic, α-adrenergic or substance P receptor stimulation causes K release (and perhaps Na uptake) resulting in activation of the Na-K pump. In contrast, β-adrenergic stimulation might directly activate the Na-K pump resulting in K uptake

29

INFLUENCE OF METHYLMERCURY ON THE TISSUE RESPIRATION AND THE NET MOVEMENT OF Hg^{++} AND K^{+} IONS. M, ONISHI, Y. MATSUMOTO*. Dept. of Physiol., Kagoshima Univ. Sch. Med., Kagoshima. National Institute for Minamata Disease, Minamata, Kumamoto*.

The influence of methylmercuric chloride (MMC) on the tissue respiration of the rat cerebral cortex, kidney cortex and liver slices were examined by using of the manometric method of Warburg and the electron microscopic X-ray microanalysis. The oxygen consumptions on the cerebral cortex and liver slices were decreased by the concentration of 10^{-4} mol MMC. The oxygen consumption on the kidney cortex was decreased by the all tested concentration of MMC. These results were similar that of 2,4-DNP function as the uncouplar, but the net movement of K^{+} ions did not suggest the function as the uncouplar. Mercury was observed to be bound to both the mitochondrial and nuclear membranes.

30

THE EFFECTS OF EXTERNAL Cl^{-} AND TEMPERATURE ON MEMBRANE POTENTIALS OF NEWT RED CELLS. M. FUKUSHIMA, K. KAWANO, C. IBUKI. Ist Dept. of Physiol., Nippon Medical School, Bunkyo-ku, Tokyo

Using a microelectrode the membrane potential of newt red cells was measured directly. The value was -15.2 ± 0.7 mV which was in good agreement with that estimated from the ratio of the internal and external chloride concentration ($[Cl^{-}]_{in}$ / $[Cl^{-}]_{out}$) using the Nernst equation. The change in $[Cl^{-}]_{out}$ had significant effect on the membrane potential. But, the changes in the membrane potential thus induced were related not to the logarithm of $[Cl^{-}]_{out}$, but to $[Cl^{-}]_{out}$ itself with the ratio of 1.2 mV / 10 mM. The influence of temperature upon the membrane potential was then examined. As the temperature was reduced from 18°C to 1°C, the membrane potential increased linearly with the ratio of 4.1 mV / 10°C. These results show that the membrane potential of newt red cells mainly depends on Cl, but it cannot be explained by the Nernst equation. It was further shown that the concentration of external cation (Na^{+}, K^{+}, Ca^{++}) had no effect on the membrane potential. Oxygenation and increasing pH increased the membrane potentials, and *vice versa*.

31

PROTEIN PHOSPHORYLATION IN THE STELLATE GANGLION OF THE SQUID HORIE,H.,HORI,H.,YOSHIOKA,T. and TAKENAKA,T. Dept. of Physiol.,Yokohama City Univ. Minamiku, Yokohama

Protein phosphorylation represents a major regulatory mechanism in cells. We have studied the types of phosphorylated proteins in squid giant axon, giant synapse and giant fiber lobe.
10μCi [γ-^{32}P]ATP was injected into lobe and after 60 min the lobe was dissected and analysed with SDS polyacrylamide gel electrophoresis (7.5%). Phosphorylated proteins have mol.wt. 120,000, 110,000 and 40,000. The cyclic nucleotides and Ca ion had no effect on the protein phosphorylation process in the lobe. The stellate ganglion was incubated in the 400μl test solution including 50μCi [γ-^{32}P]ATP. Each phosphorylated proteins of axon and synapse were analysed with SDS polyacrylamide slab gel electrophoresis (7.5%). Phosphorylated proteins of axon have mol.wt. 200,000 90,000, 45,000 and below 30,000. The protein phosphorylated process in the axon was enhanced by c-GMP but inhibited by Ca ion. The phosphorylated proteins in the synapse have mol.wt. 200,000, 96,000, 90,000, 55,000, 50,000 and below 20,000.The protein phosphorylated process in the synapse was enhanced by c-GMP.

32

^{31}P-NMR STUDY ON PHOSPHORUS COMPOUNDS IN NERVOUS TISSUES OF DIFFERENT SPECIES

NISHIKAWA, H., YOSHIZAKI, K., MORIMOTO, T. & *ASATO, R., Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto, * Dept. of Neurosurgery, Kyoto Univ. Med. School, Sakyo-ku, Kyoto.

^{31}P-NMR was used on spinal cords and sciatic nerves of frog, brain slices of guinea pig and ventral nerve cords of crayfish with perfusion and spinning technique, which maintains the nerve tissue in living state. ^{31}P-NMR measurements were carried out at 24 °C with pulse FT NMR spectrometer at 40.3 MHz. Intracellular pH was estimated from chemical shift of intracellular Pi. The spectrum of perfused spinal cords showed resonances of sugar phosphate, Pi, orthophosphate monoester and phosphocreatine (Pcr), and under the anaerobic conditions the signal intensities of Pi and orthophosphate monoester were increased, and that of Pcr was decreased. The spectrum of perfused sciatic nerves showed resonances of orthophosphate diester and ATP in addition to the resonances observed in spinal cords. Under the anaerobic condition, signal intensities of Pi and orthophosphate mono- and diester showed increase and Pcr and ATP were decreased. Intracellular pH of spinal cords and sciatic nerves under the aerobic conditions were 6.9 and 7.3 respectively. Resonances of phosphorus compounds in the nervous tissues of those species were almost identical. Potassium effects were observed in brain slices and spinal cords, but not in ventral nerve cords.

33

DIFFERENT ACTIVATIONS OF ADENYLATE CYCLASE BY NaF AND OF GUANYLATE CYCLASE BY NaN_3 IN NEURONAL AND GLIAL CELL FRACTIONS FROM RAT CEREBRAL CORTEX.

T.Nanba, M.Ando, Y.Nagata, K.Nakazawa*.,Dept. of Physiol., Sch. of Med., Fujita-Gakuen Univ., Toyoake, Aichi 470-11, *Dept. of Pharmacol., Facult. of Med., Kyoto Univ., Kyoto 606

Activation patterns of adenylate cyclase by NaF and of guanylate cyclase by NaN_3 were studied in neuronal and glial cell fractions separated from rat cerebral cortex.

1), Greater activation of adenylate cyclase by NaF was found in neuronal than in glial cell fractions, rather in the soluble than in the particulate fractions.

2), Stronger stimulation of guanylate cyclase by NaN_3 was observed in glial cell than in neuronal fractions, particularly in the particulate fraction.

3), Among nitro compounds tested, NaN_3, N-nitrosodiethylamine and methylnitrosourea activated remarkably guanylate cyclase in glial cell than in neuronal fractions. Hydroxylamine, on the contrary, did not stimulated glial guanylate cyclase but did activated neuronal enzyme activity.

34

CYCLIC NUCLEOTIDE PHOSPHODIESTERASE IN RAT SUBMANDIBULAR GLAND.

N. YOKOYAMA, M. ABE and S. FURUYAMA. Dept. of Physiol., Nihon Univ. Sch. Dent. at Matsudo, Matsudo, Chiba

In rat submandibular gland, phosphodiesterase (PDE) activities for c-AMP and c-GMP were separated into 4 peaks on DEAE-cellulose column chromatography. One of them was specific for c-AMP, and enzymes from other peaks hydrolyzed both cyclic nucleotides. At 5 days of age, the highest specific activity for c-GMP was observed. Activity for c-AMP was low in fetus and neonate, and increased to adult level after weaning. Cyclic GMP PDE from 5-day-old rat was suppressed by EGTA and activated by calmodulin indicating the presence of calmodulin in this gland. Neither PDE for c-GMP from adult nor c-AMP from neonate to adult rats were activated by calmodulin. Inhibitor substances for c-GMP PDE were present in adult but not in 5-day-old rats, and they were separated into several forms on DEAE-cellulose chromatography. One of them was sensitive to calmodulin-insensitive activity, and others were effective on calmodulin-dependent activity. These substances were not effective on c-AMP PDE, and supposed to be protein in nature since they were susceptible to trypsin, but not to RNase, DNase and dialysis. They were also heat labile.

35

BIOSYNTHESIS OF THE RAT HEPATOCYTE RECEPTOR SPECIFIC FOR SERUM ASIALOGLYCORPOTEINS.

NAKADA, H., SAWAMURA, T. and TASHIRO, Y.
Dept.of Physiol., Kansai Medical University, Moriguchi 570.

Localization of nascent receptor protein and its subsequent incorporation into rough microsomes in rat hepatocytes was studied using immunochemical techniques. Specific antibody to the purified receptor protein was found to bind preferentially with membrane bound ribosomes. ^{3}Nascent receptor protein labeled and released out of ribosomes with ^{3}H-puromycin was detected exclusively on "tightly bound" ribosomes, which can be detached from the membrane by the puromycin treatment in the presence of 750 mM KCl. ^{14}Rough microsomes labeled in vitro with ^{3}H-puromycin or in vivo with ^{14}C-amino acid mixture were digested with protease. In the former case, about 50% of the nascent receptor protein was digested, while in the latter it was almost perfectly protected from the digestion as in the case of nascent serum albumin. These results suggest that the receptor protein exclusively synthesized on the membrane bound ribosomes is incorporated into the rough ER membrane probably exposing the amino-terminal segment charged with carbohydrate moieties on the luminal side of the membrane.

36

PROTEIN-LIPID INTERACTION IN MITOCHONDRIAL MEMBRANE.

H. FUJIMURA, Y. NAKASE, Y. TAMAI and T. TSUJIMOTO. Dept. of Physiol., Wakayama Med. Coll., Wakayama.

Influence of glutaric dialdehyde (abbr. as GA), a bifunctional cross-linking agent, on the molecular environment of mitochondrial membrane was studied by spin-labeled ESR to elucidate the mechanism of energy conservation. Parallel tests of the extent of chemical, structural and functional modifications were also made. Mitochondria were treated with GA during centrifugation through the layer of "sucrose density gradient". Spin probes, maleimide or stearate N-oxyl of varied chain length, were labelled after the treatment. The treatment with increasing concentrations of GA resulted in the progressive loss of primary amino groups (26% at 125mM, 12% at 15mM), and the parallel loss of sensitivity to hypotonicity (at greater than 30mM) and uncoupler (stimulation of ATPase was absent at 125mM). The decrease of weakly immobilized signals and the increase of τ_o (empirical motion parameter) with maleimide probes were observed with increasing concentrations of GA. The changes in τ_o were small but significant in the case of stearate probes, and the immobilization was higher with the probes having radicals situated closer to the hydrophilic polar head. Temperature of the phase transition (in Arrhenius plot) became higher with GA treatment.

The effect of the protein fixation on the lipid domain of mitochondria suggested the presence of protein-lipid interaction in the membrane.

37

FLUORESCENCE QUENCHING BY SH REAGENTS ON BRAIN TUBULIN.

S. SAKAI, K. AIZAWA, S. O'HATA, M. YAMAO*. Dept. of Physiol., Tokyo Medical College, Shinjuku-ku, Tokyo 160, *Dept. of Biol., O'tsuma Women's Univ. Chiyoda-ku, Tokyo 102

Various factors affect the fluorescence output of tryptophanyl and tyrosyl residues in protein molecules. By the addition of colchicine(10^{-4} M) to tubulin, tryptophanyl emission at 334 nm(ex. 292 nm) almost totally drops, whereas tyrosyl emission is left. In contrast to colchicine, 10^{-4} M vinblastine completely quenches the tyrosyl emission, although tryptophanyl emission remains. To examine the effect of SH reagents on the fluorescence of tubulin, we used the following compounds; methyl mercury, mercuric bichloride, PCMPS(mercaptide forming), NEM(alkylating), DTNB(oxidizing). These SH blocking reagents quench both tryptophanyl and tyrosyl emission. We have also observed the same effect of above reagents on authentic tryptophan and tyrosine. The ratio of tyrosyl emission to tryptophanyl emission is increased in proportion to concentration of colchicine, while vinblastine conversely decreased the ratio. Methyl mercury and PCMPS in the range of 10^{-6}M to 10^{-4}M give the 0.9:1 ratio which is the same as control. The difference among the fluorescence quenchings by the addition of colchicine, vinblastine and SH reagents might be suggested that conformational changes in three dimentional structure are caused by binding of these compounds to tubulin at a different site or sites.

38

ON THE ANALYSIS OF THE RELATION BETWEEN ORDERING ARRANGEMENT OF AMINO ACIDS AND THEIR FUNCTIONS. S.O'HATA, K.AIZAWA, S.SAKAI, M.KITAHARA, M.SAEKI, and M.YAMAO.
Dep. of Physiol., Tokyo Medical College Shinjuku-ku Tokyo

In order to approach to this problem, we started first with the research of glutathione, because this material is well known since F.Hopkins (1929). Glutathione is composed of amino acids of Glu, Cys and Gly. And, paticular function of glutathione is attributable to oxydation and reduction. In composition of glutathione, the first mass of amino acid is estimated 130 (Glu), the second mass of amino acid represents 103(Cys) and the third one shows 74 (Gly). Therefore, in order to show the character of glutathione, ordinal number representing the ordering arrangement of amino acids in glutathione, and the cardinal number indicating the mass of amino acids are necessarily. The most suitable matemathical representation which contains both ordinal numbur and cardinal one should be matrix. Then, we get: $S=\begin{pmatrix} 130^{(1)} & * \\ 103^{(2)} & 74^{(3)} \end{pmatrix}$. Further, from this trigonal matrix, we get the most simplest diagonal one, that is: $S=\begin{pmatrix} 130 & * \\ * & 74 \end{pmatrix}=\begin{pmatrix} Glu & * \\ * & Gly \end{pmatrix}$. From the stated above, it is clearly that Cys is excluded from the matrix. Thefore, Cys should be considered as the special material. In fact, Cys explains the characteristic function of glutathione of oxydation-reduction as following: $2SH \rightleftarrows (-S-S-)$.

39

MEASUREMENT OF CAROTENOID ON MEMBRANE BY THE HIGH SPEED MICRO RAMAN SPECTROMETER.
K.AIZAWA, S.O'HATA. Dept. of Physiol., Tokyo Medical College Shinjuku-ku Tokyo

Abdominal nerve cord between 2nd and 5th ganglion of a crayfish was mounted on a cell. Modified Harreveld solution (prepared with 205 mM NaCl, 5.4 mM KCl, 2 mM $CaCl_2$, 2.6 mM $MgCl_2$, 1 mM EGTA, and $NaHCO_3$ to pH 7.4) flowed into the cell at 20 ml/min. K depolarization was caused to occur by flowing into the cell modified H. solution replaced with 105 mM NaCl and 105.4 mM KCl. Resonance Raman spectra of carotenoids on abdominal nerve cord were measured by the high speed micro Raman spectrometer for a excitation at 5145 Å, 300 mW. Those spectra have been tree typical lines at ν_1 1523 cm^{-1} (C=C stretch.), ν_2 1160 cm^{-1} (C-C stretching mode with a inplane C-C-H bending contribution) and ν_3 1005 cm^{-1} (C-C-H bending deformation). In the presence of 5.4 mM KCl, intensity ν_1/intensity ν_2 ratio remain at 1.00 ± 0.05 for 30min. But the ν_1/ν_2 ratio decreased from 1.00 ± 0.05 to 0.75 ± 0.05 by K depolarization, and then 1305 cm^{-1} (CH_2 twist + CH_2 rock. ν_7 δ-π) and 1200 cm^{-1} (CH_2 twist + CH_2 rock. ν_7 δ-O) lines on the phospholipid side chain groups decreased those intensity, and 895 cm^{-1} (CH_3 rock. + C-C stretch.) line increased. Thus the change of carotenoid on membrane by the K depolarization have effct upon the C-H mode on the phospholipid side chain.

40

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

The aim of the present work was two-fold:(i) To obtain information on the passive electrical properties of small cells and organelles to which the conventional microelectrode technique is not applicable, and (ii) to develop a new, fast, automated method of dielectric analysis which is expected to disclose the limiting membrane characteristics and is applicable to a wide range of biomaterials. The latter has been realized by a computer-controlled impedance analyzer system which can process a complete set of dielectric data within 1 min over a frequency range of 1-1000 MHz. As an example we applied the new method to a suspension of chromaffin granules isolated from bovine adrenal medulla. The result of measurenents and subsequent analyses revealed that the membrane capacity of granules was apparently higher (2-3$\mu F/cm^2$) than that of the ordinary cell membranes and that the conductivity of the intragranular phase was~1/3 of the conductivity of the external ionic solutions(80-160 mM NaCl). Such a finding suggests a necessary involvement of the presence of membrane-fixed charges.

41

STUDIES ON PENETRATION PHENOMENA THROUGH INTESTINAL MEMBRANE, NAKANO,S.,YOSHIOKA,T., NARUSAWA,M.,NAGAMI,K. Dep. of Physiol., The Tokai Univ. Sch. of Med., Isehara.

In previous studies by use of our divised circulation apparatus, we have investigated series of experiments on penetration of insulin as activepolypeptides, L-tryptophane and its related activetransport 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 conditions. The obtained experimental results were as follows: 1) In germ-free rat, intestinal penetration of above substances were inhibitory in comparison with conventional rat. 2) In 30sec's pretreatment of surfase mucosal membrane with 0.1N HCl and 0.1N NaOH, insulin and L-tryptophane penetration were enhanced, but glucose transport was slight inhibited. 3) In 5min's pretreatment with 5% Sodium Lauryl Sulfate, insulin penetration were increased. 4) In pretreatment with 5% BRIJ-35, insulin penetration was slight increased. 5) In pretreatment with 5% Sarcosin, insulin penetration had no defined change. 6) On the contrary, in pretreatment with above agents, transport of L-tryptophane and glucose was inhibitory. 7) Isotachophoretical results were obserbed unchanging tendency in mucosal and serosal fluid of above conditions. 8) As the results it will be considered that selective structural change of such the components of intestinal cell membrane as proteins, lipids, mucopolysaccharid layer, could produce their own different penetrations features of intestinal wall.

42

PURIFICATION OF RENAL AND INTESTINAL BRUSH BORDER MEMBRANES AND RECONSTITUTION OF SUGAR/Na^+ AND AMINO ACID/Na^+ COTRANSPORT SYSTEMS

KANO, A. OHSAWA, K. and HOSHI, T. Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

In an attempt to prepare highly purified homogeneous brush border membrane vesicles from the kidney and the small intestine, repeated elution of membrane fractions through a CPG-column was examined. After the second run of the CPG-column chromatography, renal brush border membranes could be purified to a extent that the enrichment factors for alkaline phosphatase and maltase activities increased up to 45-50 times as high as those of the initial renal cortex homogenate. Repeated elution technique did not seem to be adequate for intestinal preparations because of a relatively high purity after the first run and a relative small additional increase after the second run. From the purified intestinal brush border membrane vesicles, membrane proteins were extracted with Triton X-100. After elimination of Triton X-100 by passing through Bio-Beads SM2, the proteins were embedded into liposomes made of soybean phospholipids by the aid of sonication. Marked Na^+-dependent overshooting uptake of D-glucose and L-alanine was observed in proteolipid vesicles, indicating that sugar/Na^+ and amino acid/Na^+ cotransport systems were successfully reconstituted.

43

α-KETOGLUTALATE-INDUCED STIMULATION OF p-AMINOHIPPURATE UPTAKE BY RAT KIDNEY CORTEX SLICES. H. HAYASHI, Tohoku Univ. College of Medical Sciences, Sendai.

The augmenting effect of α-ketoglutalate (α-KG, 0.1-0.5 mM) on p-aminohippurate (PAH) uptake was studied in rat kidney cortex slices. At a fixed Na concentration, α-KG increased both the initial rate and the equilibrium tissue concentration of PAH uptake. α-KG induced stimulation on the initial rate of PAH uptake was dependent on the medium Na concentration, i.e., the lower the Na concentration, the smaller the stimulation by added α-KG and α-KG had no effect when Na was absent . Kinetically, α-KG decreased the Kt for PAH without changing the Vmax value. The stimulation on the initial rate of PAH uptake was seen even in the absence of K, in the presence of ouabain (5.0 mM) in the medium and under anoxic (N_2 gas) and hypothermic (14°C) condition, but the augmenting effect was smaller compared with that seen under aerobic control condition. In the Na-free-high-K medium, PAH uptake by binary complex (PAH-carrier) increased proportionally to the increase in log [K]o/[K]i. α-KG had no effect on this PAH uptake. These findings indicate that α-KG stimulates only the uptake mediated by ternary complex (PAH-carrier-Na), a part of the stimulatory effect is independent of the cellular metabolism or Na transport, and α-KG directly increases the apparent association constant for Na to the binary complex at the peritubular membrane.

44

UNIQUE PROPERTIES OF ELECTRICAL PHENOMENA ASSOCIATED WITH GLYCYLGLYCINE TRANSPORT BY GUINEA PIG SMALL INTESTINE

HIMUKAI, M., KAWAHARA, K. and HOSHI, T. Dept. of Physiol. Faculty of Med., Univ. of Tokyo, Bunkyoku, Tokyo

Glycylglycine (Gly-Gly) is known to be transported as such across the mucosal border of the small intestine by a poorly Na^+-dependent carrier system distinct from glycine transport system. In order to characterize the interaction between Gly-Gly and Na^+, the increments in the transmural PD(ΔPD) and short circuit current (ΔI_{sc}) were studied at various concentrations of Na^+ or Gly-Gly. In contrast to glycine which induces no increment in both PD and I_{sc} in Na^+-free media, Gly-Gly induced a transient increase in PD and I_{sc} even in the absence of Na^+. An increase in medium Na^+ concentration resulted in a saturable increase in glycine-induced ΔPD and ΔI_{sc} which conformed to Michaelis-Menten kinetics. On the other hand, the increase in Na^+ concentration caused an increase in Gly-Gly-induced ΔPD and ΔI_{sc} in a sigmoidal fashion. Hill plot of data represented a Hill constant of 1 for glycine-induced ΔI_{sc} and that of 1.8 for Gly-Gly, indicating the existence of cooperativity (allosteric interaction) in Gly-Gly related Na^+ transport pathways.

45

CADMIUM-INDUCED INCREASE IN THE ACTIVE TRANSPORT OF SODIUM: COUNTERACTION OF CALCIUM AND AMILORIDE WITH CADMIUM.

M. TAKADA and H. HAYASHI Dept. of Physiol., Saitama Medical School, Iruma-gun, Saitama

Short circuited current(SCC) was increased with an increase in [Na] in accordance with the rate law of Michaelis-Menten. We analyzed the binding of sites which related with an active sodium transport, Na, Ca, Cd, and amiloride by using an analogy of enzyme kinetics. Uncompetitively, SCC was inhibited by Ca, and activated by Cd. The relation between Cd and SCC was sigmoid. As the Hill coefficient was less than 1 (about 0.7), binding of Cd to sites became more difficult after first one. Amiloride inhibited SCC by the mechanism of a mixed type. Calcium is considered to inhibit the dissociation of the Na-site complex. Cadmium may facilitate the dissociation of Na from the site. In other words , the rate constant of Na and the sites was never changed by either Ca or Cd. On the other hand, amiloride altered the rate constant of Na and sites. Cadmium may not inhibit calcium in a competitive manner.

46

EFFECTS OF Ca ION ON THE PROXIMAL TUBULAR CELL MEMBRANE.

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

Micropuncture experiments were performed on the proximal tubular cells of perfused bullfrog kidneys. Time courses of changes in the membrane potential (E_M) and the intracellular activities of K^+ (a_{Ki}) or Na^+ (a_{Nai}) were recorded with K^+- or Na^+-microelectrodes. Removing Ca^{++} from the normal perfusate, a depolarization of E_M, increase of a_{Nai} and decrease of a_{Ki} were produced. With restoration of Ca^{++}, a hyperpolarization of E_M, decrease of a_{Nai}, and increase of a_{Ki} were elicited. The depolarization would be resulted from an increased Na^+ influx due to the increased membrane permeability to Na^+, but the hyperpolarization would be due to an activation of Na^+-K^+ pump on the peritubular membrane. When Na^+ was decreased to 25 mM in the perfusate, E_M was depolarized slowly with the decrease of a_{Ki}. Similar changes are observed in the addition of Ca^{++} or ionophore, A23187, to the control perfusate. When the tubule cell had been pre-perfused with Ca^{++}-free solution for a few hrs, the E_M was hyperpolarized rather than depolarized in response to low Na^+ perfusate. Both the increase of a_{Ki} and the decrease of a_{Nai} were also observed in this case. Under such conditions of Ca^{++} depletion, the Na^+-K^+ pump must be activated. It is concluded, therefore, that the increased intracellular free Ca^{++} not only increase the membrane permeability to K^+ and/or Na^+, but also depress the activity of Na^+-K^+ pump, thus regulating the net transport of Na^+ and K^+ across the peritubular membrane.

47

ROLE OF CELLULAR c-AMP AND Ca IN THE ACTION OF PROSTAGLANDIN E_1 ON ACTIVE Cl TRANSPORT ACROSS TOAD CILIARY EPITHELIUM. Y. SAITO and *T. WATANABE, Depts. of Physiol. and *Ophthalmol., Tohoku Univ. Sch. Med., Sendai

Effects of prostaglandin E_1 (PGE_1), A23187 and EGTA on the electrical parameters and unidirectional Cl fluxes across the isolated toad ciliary epithelium and the cyclic-AMP content of the tissue have been investigated. Addition of PGE_1 or dibutyryl cyclic-AMP to the epithelial side of the tissue caused a sustained decrease in the short-circuit current (SCC) without an appreciable change in the electrical resistance. Tissue content of cyclic-AMP increased immediately and significantly after the addition of PGE_1. Unidirectional Cl flux from the stromal to epithelial side was decreased by PGE_1, while the flux in the opposite direction increased very slightly. Consequently, the net Cl flux toward the epithelial side decreased considerably. Addition of Ca ionophore A23187 (>4 μg/ml) decreased the SCC and the effect of PGE_1 was additive. In the Ca-free medium with 0.1 mM EGTA, SCC decreased slightly and the inhibitory effect of PGE_1 was reduced significantly. These results suggest that PGE_1 exert the inhibitory action on the active Cl transport across the toad ciliary epithelium through the binding with a receptor site at the aqueous-facing membrane, stimulation of the adenylate cyclase activity and elevation of the cellular levels of cyclic-AMP and free Ca.

48

TRANSPORT ATPase IN GASTRIC VESICLE. T. KASHIWAGURA, M. MORII, N. TAKEGUCHI
Fac. Pharmaceutical Sci., Toyama Medical & Pharmaceutical Univ., Sugitani, Toyama

A study has been made of the effect of calcium on the H^+-K^+ exchange mechanism on hog gastric membranes. For the purpose, results from the without-ATP experiments (osmotic gradient signal) were combined with that from with ATP experiments (acridine orange signal, pH change signal and ATPase activity).

1) The fresh vesicle membrane had some KCl permeability and was not affected by Ca^{++}. But, of the old rised with increasing Ca^{++} conc. A23187 or valinomycin with Ca^{++} increased the K^+ permeability in the fresh preparation.

2) The rate of H^+ uptake was decreased by Ca^{++}, but the peak level was not affected. Both the rate and the peak value were suppressed by A23187. The K^+-ATPase activity was also suppressed by Ca^{++}.

It was suggested that the extravesicular Ca^{++} at high Ca^{++} conc. has an inhibitory effect to the ATPase and that in the presence and absence of ATP the intravesicular Ca^{++} increased the K^+ and H^+ permeabilities of the vesicular membrane probably due to the reduced tightness of the K^+-ATPase channel.

49

EFFECTS OF PHENAZINE METHOSULFATE ON THE MEMBRANE Rb^+ TRANSPORT IN HELA CELLS. MIYAMOTO, H., SAKAI, T., AND IKEHARA, T. Dept. Physiol., Kinki Univ. Sch. Med., Osaka.

We reported previously that HeLa S3 cells did not distinguish between Rb^+ and K^+ in the membrane transport, except for the furosemide-sensitive efflux. We have developed simple techniques to use Rb^+ as an analog for K^+ in studying the ouabain-sensitive Rb^+ uptake. As phenazine methosulfate (PMS) was found to stimulate the ouabain-sensitive Rb^+ uptake, we attempted to analyze a mechanism by which the phenomenon occurred. The optimal concentration of PMS was 20-25 μM, and there was no significant change in the extent of stimulation as preincubation time with PMS was varied from 0 to 2 h. The stimulation was mainly caused by an increase in the maximal influx and any change in Km for Rb^+ was noticed. Also, this was not due to either a decrease in K^+ or an increase in Na^+ level in the cells. We found that cellular NADH/NAD ratio and lactic acid production markedly diminished by PMS both in the presence and absence of the respiratory inhibitors, NaCN and rotenone, while the ouabain-sensitive Rb^+ uptake increased significantly especially in the presence of the inhibitors. Furthermore, the Rb^+ uptake increased abruptly as pH of the medium, which influences intracellular pH, was elevated from 7.0 to 8.0. The rate of non-enzymatic oxidation of NADH mediated by PMS became higher as pH was elevated from 6.0 to 9.0. These results suggest that an increase in the flux of the reducing equivalents from NADH to a membrane component mediated by PMS may have a close relationship to the stimulated ouabain-sensitive Rb^+ uptake.

50

EFFECT OF PMS+NADH ON NA^+,K^+-ATPASE AND HCO_3^--ATPASE FROM KIDNEY OF GUINEA PIG.

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

We had reported the inhibition of PMS+VC and PMS+NADH on Na^+, K^+-ATPase system. Then effects of PMS+VC on the bindings of ligands to Na^+, K^+-ATPase were studied. Ouabain bindings to Na^+,K^+-ATPase from kidney microsomes were reduced by PMS+VC. The association rate of ouabain binding were decreased rather than Bmax. The inhibition of ouabain binding was more prominent in the presence of Na^+, Mg^{++}, K^+ and ATP than the presence of Na^+, Mg^{++}, and ATP. ADP binding to the enzyme was decreased exceedingly by PMS+VC. The calcium binding to the enzyme preparation which occurred on phospholipid moiety was not reduced by PMS+VC. These data agree with the previous conclusion and suggest that the inhibition occurrs on the protein moiety relevant to K^+ site. The inhibiton of the enzyme by PMS+VC was reduced by catecholamines. The reductions by catecholamines were not protected by α-blocker or β-blocker of adrenergic receptors. The role of catecholamines was not replaced by c-AMP or c-AMP + protein kinase. It may be concluded that the reversal by catecholamines is not related to the adrenergic receptor system. The HCO_3^--ATPase activity in kidney microsomes was also inhibited by PMS+VC.

51

EFFECTS OF OUABAIN ON NACL AND WATER TRANSPORT ACROSS THE SEAWATER EEL INTESTINE

ANDO, MASAAKI, Lab. of Physiol., Fac. of Integrated Arts & Sci., Hiroshima Univ., Higashisenda-machi, Hiroshima

Ouabain decreased both the transepithelial potential difference (PD) of serosa negativity and the net water flux across the seawater eel intestine in normal Ringer solution. A good correlation was observed between the decreases of these 2 parameters, and the linear regression was the same as that obtained from inhibiting Cl^- transport by replacing Cl^- in the bathing media with $CH_3SO_4^-$ successively. When both mucosa and serosa were bathed with K^+ free Ringer solution, both the PD and the net water flux decreased gradually to attain zero. On the other hand, ouabain also increased Cl^- diffusion potential and induced water secretion from serosa to mucosa under 118.5 mM gradient of Cl^- concentration in which mucosa and serosa were bathed with $NaCH_3SO_4$ and normal Ringer solution respectively. These 2 effects of ouabain, decrease in the spontaneous PD and increase in Cl^- permeability, occured at the same time. The 118.5 mM gradient of Cl^- concentration also induced high Cl^- diffusion potential and water secretion in K^+ free Ringer solution just like ouabain treatment. These results indicate that ouabain blocks Na^+-K^+ATPase primarily, and inhibition of this enzyme inhibits secondarily Na^+, Cl^- and water trasport as well as increase in Cl^- permeability.

52

THE INHIBITION OF INSULIN-STIMULATED Na EFFLUX BY OUABAIN.

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

The increase in Na efflux induced by insulin is always accompanied by an elevation of the apparent affinity to internal Na of Na-transport system. On the other hand, it has been reported that insulin increases the binding of [^{3}H]ouabain to muscle. In order to elucidate the relation between ouabain-binding and the change in the apparent affinity caused by insulin, present experiments were designed, and following results were obtained. 1. Ouabain inhibited the Na efflux, which had been stimulated by insulin, to that level which the Na efflux from the control muscle attained after the addition of ouabain. 2. Before adding ouabain the rate coefficient of ^{22}Na efflux from the high-Na muscle was larger than that of ^{22}Na efflux from the low-Na muscle. However, after the addition of ouabain the rate coefficient of high-Na muscle became even lower than that of low-Na muscle. The similarity between effects of insulin and of internal Na suggest that the Na-transport units whose ion-binding sites are occupied by internal Na are susceptible to ouabain. It may be concluded that the elevation of the apparent affinity to internal Na of Na-transport system caused by insulin is not due to an elevation of the affinity of individual ion-binding site, but is due to an increase in the number of Na-transport units having high affinity to internal Na.

53

EFFECT OF OUABAIN ON PANCREATIC ENZYME RELEASE IN THE ISOLATED RABBIT PANCREAS. SAITO, T. Dept. of Vet. Pharmacol., Fac. of Agr., Univ. of Tottori, Koyama-cho, Tottori, 680

In order to determine whether the Na-pump may play a role in pancreatic enzyme release, the enzyme protein output in the absence or presence of ouabain was investigated with the isolated rabbit pancreas perfused with Krebs-Henseleit solution. The isolated pancreas secreted a slight amount of enzyme protein spontanuously,and continuous stimulation with 1 mU/ml pancreozymin (PZ) or 5 x 10^{-9}M acetylcholine (ACh) on the pancreas caused a sustained output of pancreatic enzyme at high level. The presence of 5 x 10^{-6}M ouabain, which caused a marked decrease in the spontaneous juice flow, little affected the spontaneous output of enzyme, although replacement of ouabain perfusate by ouabain-free caused a transient increase in enzyme output. The presence of ouabain (5 x 10^{-6}M) also did not influenced significantly the sustained output of enzyme induced by PZ (1 mU/ml) or ACh (5 x 10^{-9}M). These results indicate that in the rabbit pancreas the Na-pump play a primary role in the pancreatic juice production, and a indirect role in the enzyme release through maintaining intracellular Na ion concentration.

54

THE MECHANISM OF ADRENALINE HYPERPOLARIZATION IN THE RAT DIAPHRAGM. M. NOHMI & K. KUBA. Dept. Physiol., Saga Med. Sch., Saga 840-01.

Either addition of adrenaline (10-40 μM) to a perfusing solution or iontophoretic application of adrenaline to the muscle fiber hyperpolarized the fiber membrane. This hyperpolarization was 3-5 mV in Krebs solution, but increased to 6-10 mV in a K^+-free solution. The membrane resistance increased during the adrenaline hyperpolarization by 37 %, while only a small increase in the resistance (4 %) was observed by a conditioning membrane hyperpolarization. Lowering temperature (8°C) and application of ouabaine (0.1 mM), both of which reduced resting potential by 10 mV in a K^+-free solution, blocked the adrenaline hyperpolarization as well as an increase in the membrane resistance. The membrane hyperpolarization induced by replacement of all Na^+ with Tris ion in a K^+-free solution was only slightly decreased (from 8.3 mV to 6.2 mV) in the presence of adrenaline (30 μM). These results suggest that adrenaline hyperpolarizes the membrane of rat diaphragm muscle fiber, not only by the activation of the electrogenic Na-pump, but also by the enhancement of its effect as a result of the increased membrane resistance.

55

Regulatory mechanism of cell pH in the renal proximal tubule. Y. MATSUMURA, S. AOKI, K. KAJINO, M. FUJIMOTO. Dept. of Physiol., Osaka Medical College, Takatsuki City, Osaka.

1) To clarify cellular mechanism of urinary acidification, micropuncture studies were performed on the bullfrog proximal tubule with Nigericin-based pH microelectrodes. 2) Luminal perfusion of 10^{-3} M Cyanide caused a biphasic change in cell pH (pH_i): early acidification by 0.04 pH unit in 2 min and later alkalinization by 0.04. A profound depolarization by 30-35 mV was observed in the peritubular membrane potential (E_M), but the tubular fluid pH (pH_{TF}) was elevated by 0.11 unit. 3) Luminal substitution for 100 mM Na^+ by Li^+ acidified the cell by 0.06 pH unit with a depolarization of E_M by 8 mV and an alkalinization of pH_{TF} by 0.10 unit. Thus, blockades of luminal H^+ secretory mechanism caused a cellular acidification and a luminal alkalinization. 4) Perfusion of 10^{-4} M SITS from the peritubular side caused a rise in pH_i by 0.04 without appreciable changes in E_M. 5) Peritubular perfusion of 10^{-4} M Ouabain lowered the pH_i by 0.07 with a depolarization of E_M by 15.4 mV, while the pH_{TF} was also lowered by 0.07 unit initially, but elevated by 0.12 later in 4 min. 6) Thus, inhibitions of the peritubular ion transport mechanism caused some pH changes in the same direction in both the cell interior and the tubular fluid. Further, from the Ouabain-experiment, it is inferred that some feed-back mechanism, which is probably mediated by Na^+, would exist between the peritubular and luminal membranes.

56

EXOCYTOTIC RELEASE OF CATECHOLAMINES FROM THE PERFUSED CAT ADRENAL BY Na+ FREE MEDIA M.SORIMACHI, S.NISHIMURA, K.YAMAGAMI AND M.ONISHI. Dept. of Physiol.,Kagoshima Univ.Sch.Med., Kagoshima

Çat adrenals were retrogradely perfused with Ca++ deficient medium and secretion was induced by perfusion with Na free medium containing Ca++ (NaCl was replaced by sucrose). Release of CA and dopamine-b-hydroxylase was concomitantly found in the effluents indicating the exocytotic secretion. The addition of EGTA to sucrose medium completely abolished the response, and the response was dependent on the concentrations of Ca++ (adjusted by Ca-EGTA buffer). Secretion was also induced by other Na+ substitutes including Li, choline, Tris and K unless Ca++ was removed, but the efficacy of the response depended on Na+ substitutes. Secretion was markedly inhibited by various Ca channel blockers including D 600. The inhibition of the response by the addition of Na+ was overcome by the increase of Ca++. Experiments using the isolated bovine chromaffin cells revealed the marked increase of Ca uptake in the absence of Na+. The results suggest that the increased entry of Ca++ by the removal of Na+ is responsible for secretion.

57

IMPEDANCE CHANGES OF SALIVARY GLAND DURING SECRETION

INAI,Y., NAKAHARI,T., MURAKAMI,M. & MORI,H.

Dept. of Physiol. Osaka Med. College Takatsuki, Osaka

Tissue conductance measured at low frequency (1000Hz) depends on volume of extracellular fluid, because of low conductiviy on the cellular components. We measured the conductance changes of whole tissue of dog submandibular gland at resting state and also during secreting state. A little decrement of tissue conductance was observed with massive salivary secretion in normal condition of blood circulation. Same experiments were done under a condition of arterial clamp. A marked decrement of tissue conductance was observed with a little salivary secretion. When the arterial clamp was taken off, the tissue conducance rose up to normal level. It was concluded that the extracellular fluid supplied from blood was transported across the acinar cell into the lumen according as secretory process.

58

SEXUAL DIFFERENCE OF SECRETORY PATTERN OF ESTERASE IN THE MOUSE SUBMANDIBULAR GLAND.
H. IZUMI and T. AOKI, Dept. of Physiol., Tohoku Univ. Sch. Den., Sendai

The secretory pattern of esterase (benzoyl-arginine-ethyl-ester esterase), one of the typical sex-related enzymes in the mouse submandibular gland, was compared between the male and female by using the dispersed cell preparation.

In the male, the gland produced definite release of esterase in response to norepinephrine (α-adrenergic agonist), but almost negligible response to mecholyl (cholinergic agonist). In contrast, the female gland responded not only to norepinephrine, but also to mecholyl. Isoproterenol was almost without effect in the esterase release in both sexes. Castration of the male markedly reduced esterase content of the gland to the female level, and moreover the pattern of secretory response was found to be converted to the female type. That is, the gland became to respond to both norepinephrine and mecholyl. On the other hand, administration of testosterone to the female not only elevated the enzyme content to the male level, but switched the secretory pattern to the male type. Thus, the sexual difference of secretory pattern of esterase in the mouse submandibular gland descibed above might be explained by assuming that in the male esterase is localized mainly in the convoluted tubules, and in the female in the striated duct.

59

THE EFFECT OF ACETYLCHOLINE CONCENTRATION ON SECRETORY RESPONSES, REDOX STATE AND MEMBRANE POTENTIAL OF THE PANCREATIC ACINAR CELL.

KANNO, T., HABARA, Y., SAITO, A. & YONEZAWA, H. Dept. of Physiol., Hokkaido Univ. Fac. Vet. Med. Kita-ku, Sapporo, 060

Continuous stimulation of the isolated perfused rat pancreas with acetylcholine (ACh) at a low concentration (5×10^{-8} M) induced flat increase in secretory responses, which were decreased to values of about 30 per cent of control obtained in the standard solution when Ca was omitted from the perfusing and bathing solution. The responses in the standard solution were associated with little or no change in the membrane potential and the redox state of the acinar cells.

Continuous stimulation with ACh at a moderate concentration (3×10^{-7} M) induced the highest secretory responses. When Ca was removed from the external environment, the latter phase of responses was more strongly inhibited than the initial phase. Continuous stimulation with 3×10^{-7} M ACh caused only a transient small depolarization of the acinar cell, and a gradual reduction in the redox state.

The secretory responses induced by stimulation with 10^{-6} M ACh were rather potentiated in the Ca-deficient environment . The responses associated with a transient depolarization , and a transient oxidation followed by a gradual reduction in the redox state.

60

ASYMMETRICAL CAPACITANCE CURRENTS AND THE INACTIVATION OF SODIUM CHANNELS.
K. MURAYAMA, H. KITASATO, K. NISHIO, and Y. MARUNAKA. Dept. of Physiol., Shiga Univ. of Med. Sci., Ohtsu

The asymmetrical capacitance current has been considered to be a current relating to the replacement of charged groups controlling the gating of ionic channels in the excitable membranes. In these experiments, we isolated the asymmetrical capacitance currents from tail currents produced in voltage-clamped crayfish giant axons, and investigated how these asymmetrical capacitance currents were related to the sodium inactivation process observed from sodium conductance changes.

In terms of sodium currents, crayfish giant axons showed two phases of inactivation process: a short term inactivation attaining to a steady level within some 10 ms and a long term inactivation lasting more than 300 ms. Release from the long term inactivation was particularly remarkable when a conditioning prepulse to -100 mV and then a depolarizing test pulse were given to axons held at a level of resting membrane potentials (mean: -74 mV). Next, relating to the inactivation, the responses of asymmetrical capacitance currents to test pulses with various duration were tested in the membranes whose sodium inactivation was completely eliminated by a fully-long (400 ms) prepulse to -100 mV, but no change was observed at least within a period of short term inactivation (0-20 ms).

61

DIFFERENTIATION OF EXCITABLE CELLS IN CLEAVAGE-ARRESTED EMBRYOS OF AN ASCIDIA.
KUNITARO TAKAHASHI, NAOHIDE YAMASHITA & MITSUNOBU YOSHII Dept. of Neurophysiol., Inst. of Brain Res., Sch. of Med., Univ. of Tokyo and Dept. of Physiol., Nippon Med. Sch., Bunkyo-ku, Tokyo.

It has been considered that in mosaic eggs the segregation of cytoplasmic factors of the unfertilized egg during early developmental stages determines the fate of each blastomere. The cell-cleavage of embryos of an Ascidia, Halocynthia roretzi, was arrested by cytochalasin B at various developmental stages from 1 to 64 cell. These embryos were further cultured in cytochalasin B-containing sea water until the time when the control intact larva hatched. Electrical excitability of respective blastomeres in these embryos was analysed by current-and voltage-clamp techniques. In 8, 16, 32 and 64 cell embryos, a long-lasting Ca action potential was always evoked in presumptive ectodermal region of the animal hemisphere. In addition, short-lasting Ca and Na-Ca spikes developed in the presumptive neural blastomere of the animal hemisphere and in the presumptive muscular blastomere of the vegetal hemisphere, respectively. In 1, 2 and 4 cell embryos in which there was no separation of animal and vegetal halves, only the long-lasting Ca action potential of ectodermal type was found in all blastomeres. All blastomeres in 1, 2 and 4 cell embryos were usually electrically coupled together.

62

A Ca-ACTIVATED TRANSIENT K CURRENT IN SNAIL NEURONS.
N. AKAIKE AND K. NISHI. Dept. of Pharm., Kumamoto University Medical School, Kumamoto 860, Japan

A fast transient K current in molluscan neuron, similar to the fast outward current described by Connor & Stevens (1971) and Neher (1971), is blocked by externally applied 4-AP but was much less sensitive to TEA or Co (Thompson, 1977). In the present experiments, isolated single nerve cell bodies of land snail were studied by using suction electrode for voltage clamp and internal perfusion. I_{Na} was suppressed by Tris substitution so that both I_{Ca} and I_K were recorded together. We found a fast transient K current (TI_K) which is sensitive to external Ca ions. Prepulses that inactivated I_{Ca} abolished the TI_K. TI_K was inhibited by organic and inorganic Ca antagonists such as Co, Ni, Mg and Diltiazem regardless of the external or internal application. However, TI_K was unaffected by 4-AP. The effects of TEA and quinidine on TI_K were also studied. It was concluded that the physiological and pharmacological characteristics of TI_K are very similar to the transient outward current of calf cardiac Purkinje fibres depends on internal Ca ions (Siegelbaum & Tsien, 1980). The functional significance of TI_K was discussed.

63

HYPERPOLARIZING RESPONSE IN THE SOMA OF CRAYFISH MEDIAN GIANT FIBER.
A. ARITA, H. HAYASHI. Dept. of Physiol., Saitama Med. Sch., Moroyama, Iruma-gun, Saitama.

The soma of median giant fiber of the crayfish, Procambarus clarkii, develops hyperpolarizing response in the normal saline. During the application of a constant current, the membrane undergoes hyperpolarization to a large peak that is followed by a plateau. Under voltage clamp conditions, the current-voltage relationship in the early phase showed N-shape, and that in the late steady phase did inward rectification mainly due to the increase in membrane conductance. Under current clamp conditions, the resting conductance of the high value transited to the low conductance corresponding to the N-shape region under voltage clamp. The current-voltage relationship in the plateau phase under current clamp shifted toward the lower voltage axis than that under voltage clamp. Changes in external K had effects on both the resting conductance and the threshold current. However, it had no effects on the current-voltage relationship in either peak or plateau. The threshold charge for the transition from a peak to a plateau phase also was not affected by changing the external K.

64

EFFECTS OF Na AND Ca IONS ON THE MEMBRANE POTENTIAL OF A ONCHIDIUM BEATING PACEMAKER NEURONE
GOTOW, T., ANRAKU, M., HASHIMURA, S. Dept. of Physiol., Sch. of Med., Kagoshima Univ., Kagoshima, 890

The membrane potential of the identified beating neurone (Be-1) in the Onchidium ganglion was examined by internal microelectrodes under various ionic medium. In the external Na concentration ((Na)o) greater than 30 mM (1/15 of the normal), the membrane potential of the Be-1 in the solution with Ca became lower when Ca was depleted. However, when the (Na)o was below 20 - 30 mM, the membrane potential of the neurone in the solution with Ca became depolarized by the depletion of Ca. Application of the constant field theory to explain the behavior of the Be-1 membrane was partly unsatisfied. The membrane potential of the neurone in the Ca-free solution was hardly explicable by the constant field theory when (Na)o was above 30 mM unless the K concentration ((K)o) exceeded 50 mM. When the (K)o exceeded 50 mM, the membrane potential could be explained by the estimation that P_{Na}/P_K increased by 20 % in comparison with that in the presence of Ca. Below 50 mM (K)o, the caliculated curve of the membrane potential could not explain the experimental results. As a possible explanation of the anomalous behavior of the neuronal membrane, an idea that the exchange mechanism between the external Na and the internal Ca might hyperpolarize the membrane was presented.

65

BURSTING ACTIVITY AND INTRACELLULAR PROTEINS IN SNAIL NEURONS.
M.ONOZUKA, H.FURUICHI, T.IWATA, E.SUGAYA, *T.TSUDA, *A.SUGAYA, **H.ASO AND **S.HIRANO. Dept. of Physiology, Kanagawa Dental College, Yokosuka, *Faculty of Pharmaceutical Sciences, Josai University Sakado, Saitama and **Dept. of Physiology, School of Medicine, Toho University, Tokyo.

To clarify the interaction between the intracellular proteins and calcium during bursting activity(BA) in snail neurons, the behavior of the intracellular protein during pentylenetetrazole(PTZ) induced BA was studied by microdisc electrophoresis using ^{45}Ca.

Identifiable D-neurons in the suboesophageal ganglion of the snail, Euhadra peliomphala, were used. Microdisc electrophoresis was performed with three to five neurons.

During BA, the peak of 15K protein which is characteristic of the lysosomal and microsomal fractions was changed into three peaks and the 5K peak which is characteristic of the plasma membrane was increased by PTZ treatment. After incubation with ^{45}Ca, the PTZ treated samples showed a prominent peak of radioactivity at the 5K protein level. A experiment using Ca free and 4xCa snail Ringer revealed that the change in radioactivity originated from intracellular Ca and not from any extracellular source. The freeze replica specimens of cell membrane showed a apparent difference between the normal and BA states.

The above findings, together with the previous experiments, suggest that when a neuron manifests BA, intracellular Ca is released from the cell organella and binds to the protein of the plasma membrane.

66

BURSTING ACTIVITY AND CALCIUM IN SNAIL NEURONS. H.FURUICHI, M.ONOZUKA, T.KOBORI, K.YAMADA, E.SUGAYA, *T.TSUDA AND *A.SUGAYA. Dept. of Physiology, Kanagawa Dental College, Yokosuka and *Faculty of Pharmaceutical Sciences, Josai University, Sakado, Saitama.

To elucidate the role of intracellular calcium in bursting activity(BA) induced by pentylenetetrazole(PTZ) in snail neurons, a combined study consisting of voltage clamping, neurochemical experiments with ^{45}Ca, computer controlled electron probe X-ray microanalysis(CCEPXMA), flameless atomic analysis(FAA) and ion shower milling was performed.

Freeze-dried identified specimens of a single neuron of the snail, Euhadra peliomphala were used for the CCEPXMA study. The distribution change of intracellular Ca during BA was examined using ^{45}Ca and fractionation. The calcium inward current was measured by the voltage clamp technique with Na free snail Ringer containning TTX and TEA.

During BA, PTZ induced decreased Ca influx but the efflux showed no change. The lysosomal fraction showed remarkably decreased incorporation of Ca due to PTZ. Mitochondrial and microsomal fractions did not show any change. The calcium inward current was inhibited by PTZ. The binding state of membrane calcium was found to be changed by examination of the chemical shift using CCEPXMA and double peak formation by FAA.

The above findings suggest that intracellular calcium plays an important role in manifesting BA.

67

NERVE EXCITATION INDUCED BY INTRACELLULAR PERFUSION OF Ca, Mg AND Mn IONS IN SQUID GIANT AXONS.

YAMAGISHI, S., FURUYA, K. AND KUKITA, F. Dept. of Cell Physiol., Nat. Inst. Physiol. Sci., Myodaiji, Okazaki

By the intracellular perfusion of Ca, Mg, Mn or other divalent cations at the concentrations between 0.1 and 30mM, the resting membrane of the squid giant axons suddenly produced a large electrical spike. An amplitude and a rate of rize of the spike were nearly equal to those of electrically stimulated action potentials. But, the duration of divalent cation induced spikes prolonged largely up to 1 min.

During internal perfusion of divalent cations, the electrical stimulation also produced the action potential by the application of smaller electrical current. The divalent cation induced spike is considered to be essentially similar to the action potential, which is produced by the fall of the threshold level below the resting potential.

68

EFFECTS OF AROMATIC AMINO ACID DERIVATIVES ON THE EXCITABILITY OF A GIANT NEURONE. H. TAKEUCHI and H. TAMURA. Dept. of Neurochem. Inst. for Neurobiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama

The effects of derivatives of aromatic amino acids on the excitability of an identifiable giant neurone (TAN, tonically autoactive neurone) of the African giant snail (Achatina fulica Férussac) were examined.

The following substances had marked inhibitory effects on TAN using bath application : N-β-phenylpropionyl-(p.p.-)L-Tyr and N-β-p.p.-L-Trp (critical concentration : 3×10^{-7}M), N-β-p.p.-L-Phe, N-cinnamoyl-DL-Trp and N-phenoxyacetyl-L-Trp (critical concentration : 10^{-5} to 3×10^{-5}M). However, N-β-p.p.-D-Tyr and N-β-p.p.-tyramine had no effect.

Microdrop (150μm in diameter) application of a solution of N-β-p.p.-L-Tyr or N-β-p.p.-L-Trp containing about 100pg resulted in marked inhibitory effects on TAN. The effect was observed in Ca^{2+}-free and Mg^{2+}-rich (24mM) solution. Substitution of Cl^- by acetate$^-$ did not alter the response. This indicates that the two substances act directly on the TAN membrane and not via synaptic influences, and that the inhibition produced by the two substances is not due to the permeability increase of the TAN membrane to Cl^-.

69

SYNTHESIS OF PHOTOAFFINITY LABELLING REAGENT OF TTX DERIVERTIVES AND ITS EFFECT ON THE SQUID GIANT AXON

HORI,H. HORIE,H.TAKENAKA,T. and YOSHIOKA,T.
Dept. of Physiol. Yokohama City Univ. Minami-ku Yokohama

^{3}H-Arylazido-β-alanine was prepared as described by Guillory et al and it was coupled to tetrodotoxin(TTX) by the method which was established for its binding to ATP. The reagent was composed from three components which have Rf values of 0.78 (F-1),0.75(F-2), and 0.70(F-3),respectively. The toxicity of each component was tested by the use of 20g weight mouses and the values of LD_{50} was determined as 480μg/Kg for F-3 and 23μg/Kg for F-2.

The reagent was applied to squid giant axon extracellularly, and the preparation was photoirradiated by 500 W tungsten lamp for 10min. Na channel blocking effect was monitored by the values of dV/dt against the time. In the case of photoirradiation, Na channel blocking effect was more irreversible than it was treated in the dark.When UV lamp was used in stead of tungsten lamp, the effect was more drastic.

About 20 axons were minced and homogenated to submit to the membrane fraction differentiation and subsequently analysed by gel filtration technique. Membrane protein bound to this reagent showed a broad and small peak of radioactivity and its molecular weight was estimated as 230,000 daltons.

70

PHOTOAFFINITY LABELING OF THE TETRODOTOXIN BINDING PROTEINS IN *ELECTROPHORUS electricus* ELECTROPLAX MEMBRANES.

Seiji UEHARA and Keiichi UYEMURA. Dept. of Physiol., Saitama Med. Sch., Moroyama-cho, Saitama

^{3}H-NAP-TTX (2-nitro-4-azidephenyl-β alanine-tetrodotoxin) was synthesized and its binding to *Electrophorus electricus* electroplax membranes was examined. The synthesized ligand showed a specific activity of 260 mCi/mmol and one-thirtieth toxicity of that of tetrodotoxin by measuring lethal dose for crayfish. In the dark, the ligand bound reversibly to the binding component of the membranes with apparent dissociation constant of 280 nM and maximum binding capacity of 1 pmol/mg protein. The membranes photolabeled with the ligand were repetitively washed, solubilized with SDS, and dialyzed to a buffer solution with SDS. It was clearly demonstrated that the solubilized-dialyzed membranes bound irreversibly 1.3 pmoles of NAP-TTX/mg protein. SDS-polyacrylamide gel electrophoresis of the dialyzed membranes showed that proteins of apparent molecular weight 200,000 and 60,000 were photolabeled. Further characterization of the two tetrodotoxin binding proteins are in progress.

71

CHANGES IN MORPHOLOGICAL AND PHYSIOLOGICAL PROPERTIES OF TISSUE-CULTURED NERVE CELLS ASSOCIATED WITH BREAKDOWN OF CYTOSKELETONS BY CYTOCHALASIN B OR COLCHICINE.

JUN FUKUDA and MASAKI KAMEYAMA, Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo.

Nerve cells, dissociated from dorsal root ganglia of adult guinea-pigs, were grown in vitro on collagen-coated plastic dishes for 14 to 20 days. Intracellular recording was made with a KCl-filled microelectrode. Action potentials were elicited in the nerve cells by passage of pulse currents through the microelectrode; Na spike component and Ca spike component were differentiated in the action potential (FUKUDA & KAMEYAMA, Nature 279, 546, 1979, Brain Res. 181, 191, 1980). $\dot{V}_{max}$ of each spike component, which represents amplitude of an inward Na or Ca current, was obtained with an electronic device, and was compared among nerve cells grown under different tissue-culture conditions.

Breakdown of microfilaments of the tissue-cultured nerve cells with cytochalasin B induced formation of fine branches in the neurites. The nerve cell body changed into a spherical form. Cytochalasin B induced reduction in the $\dot{V}_{max}$ of the Na spikes but not in that of the Ca spikes. Breakdown of microtubules with colchicine caused retardation of the neurites; the nerve cells became spherical. The $\dot{V}_{max}$ of the Ca spikes became small during the colchicine treatment. By contrast, no change was induced in the Na spikes. Changes in the resting membrane potential and in the input impedance remained small during the incubation of the nerve cells with cytochalasin B or colchicine.

72

TWO KINDS OF POTENTIAL FLUCTUATIONS IN THE SENSORY NERVE TERMINAL OF THE FROG MUSCLE SPINDLE.

F. ITO, N. FUJITSUKA, N. KANEKO. Dept. of Physiol., Nagoya Univ. Sch. of Med., Nagoya

In muscle spindles isolated from the frog sartorius muscles, the potential of the sensory nerve terminal was recorded across an air-gap on which the myelinated segment just outside the capsule was bridged. During application of depolarizing currents between 1 and 9 nA, rectangular fluctuations were observed of 1 to 10 mV in amplitude and 0.5 to 2 Hz in frequency. As 100 μM quinine blocks reversibly the fluctuation, the potential changes may be due to $[Ca^{2+}]_i$-activated G_K.

After spikes were blocked by TTX, $CoCl_2$ or $MnCl_2$, noise-like fluctuations (around 0.2 mV and 10 Hz) were observed during hyperpolarization with 7 - 10 nA or more. As the noise is blocked by intracellular application of $CoCl_2$ or $MnCl_2$, it may be due to potential dependent calcium outflows at the terminal.

These fluctuations were discussed in correlation with slowly adapting discharges from the muscle spindle.

73

THE CHARACTERISTICS OF APLYSIA NERVE ON ITS STRETCHING

HIROYUKI KOIKE, Dept. of Neurophysiol., Tokyo Metropolitan Institute for Neurosciences, Fuchu City, Tokyo 183

Aplysia nerve can be stretched up to several times of its resting length, without injuring its impulse conduction. Upon stretch from resting to about 1.5 times length the conduction velocity increases linearly, then it becomes almost constant in the nerve length from 1.5 times to about 5 times. From the intra-axonal diffusion distances of radioactive ACh or GABA injected into a cholinergic neuron soma, it is revealed that the 'real' axoplasmic length in the nerve is longer about 1.2 to 1.5 times than the resting nerve length. This indicates that axon is zigzagging in the resting nerve sheath, and that the straightening of the axon causes the apparent conduction velocity increase. The axonal membrane of Aplysia wrinkles and has numerous infoldings. Therefore, in the range of 1.5 to 5 times nerve stretch, axon elongates with smoothing out the axonal membrane accompanied with increase of effective membrane resistance and decrease of axon radius. As a result, the axonal conduction velocity is constant (Martin, 1954; Hodgkin, 1954). In contrast, the conduction velocity of the frog sciatic nerve or lobster peripheral nerve decreases by stretching from their original lengths.

74

INCREASE IN LENGTH OF INTERNODE OF THE SENSORY NERVE FIBER DEPENDING ON THE DISTANCE FROM THE NERVE ENDING.

YAMAMOTO, T. & SAKADA, S. Dept. of Physiol., Tokyo Dent. Coll., Chiyoda-ku, Tokyo.

Internodal length(L) of the myelinated nerve fibers from bush-like nerve endings(BE) and small encapsulated corpuscles(EC) in the labial mucosa of the mouse were measured under a light microscope. For measurement, labial mucosa and nerves innervating the mucosa were fixed with osmium tetroxide. At the first internodal segment adjacent to the nerve ending the L of the fibers from BE was 52.1±22.7μm and that from EC 82.4±35.3μm. The farther away the internode of the fiber was from the nerve ending, the greater became the increase of L and at the fourth segment their values were 155.7±45.5μm(BE) and 177.7±55.8μm(EC), respectively. After these fibers entered the nerve trunk a slight increase of L was still observed in proportion to the distance from the nerve ending. At the point of foramen mandibulae L reached the definite value, 431.5±93.1μm. Result of this experiment suggested that conduction velocity of the impulses evoked at the nerve endings increase gradually when the conduction is made toward the ganglion.

75

^{31}P-NMR STUDY ON ORDERED STRUCTURE OF PHOSPHOLIPIDS IN EXCITABLE MEMBRANES

NISHIKAWA, H. YOSHIZAKI, K. MORIMOTO, T. & *ASATO, R., Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto, *Dept. of Neurosurgery, Kyoto Univ. Med. School, Sakyo-ku, Kyoto.

NMR technique is particularly well suited for studying the dynamic structure of membranes, which composed of lipid bilayer. In this study, ^{31}P-NMR measurements of intact spinal cords of frog, Rana catesbiana, were successfully carried out for the first time, and the dynamic structure of phospholipids in myelin was observed under the various conditions. Soluble phosphorus compounds were removed from spinal cords cut 5 mm length with incubation in Krebs-Ringer's solution, and the spinalcords were placed in parallel or perpendicular with magnetic field in NMR tube. ^{31}P-NMR measurements were carried out at 24 °C with a pulsed FT NMR spectrometer at 40.3 MHz. The spectrum of the spinal cords showed the narrow resonances of phospholipids at -1.9 and -0.5 ppm with a broad one at +13.4 ppm. The resonance at higher field showed the dependence on the angle between orientations of the axis of rotation of the phosphate group in phospholipid and the magnetic field. ^{31}P-NMR spectrum of sonicated spinal cords showed no resonances in the higher field, and spinal cord extract (liposome) showed the broad resonances in lower and higher field. The resonance peak in higher field became to be a shoulder at 60 °C. No effects of Ca^{++} and procaine were observed on the resonances.

76

STRACTURE-ACTIVITY RELATIONSHIP OF GRAYANOTOXINS.

ISSEI SEYAMA. Dept. Physiol., Hiroshima Univ., Hiroshima 734,.

Biologically active grayanotoxins produced a sudden generation of action potential which was followed by a sustained depolarization. This depolarization was due to the specific increase of the membrane permiability to Na ion, because the withdrawal of Na ion from the external medium and the application of 1 x 10^{-6}M TTX abolished this depolarization. By measuring the critical concentration, the potency of biological activity of 34 grayanotoxin analogues was estimated. The critical concentration was defined as the concentration at which the generation of action potential followed by a sustained depolarization occurred. It was found that the biological action of grayanotoxins was largely dependent on both the stereospecificity and the hydrophobicity of grayanotoxin molecules. Essential groups for the biological action were determined to be either 3β-OH or 2β, 3β-epoxy group, 5β and 6β-OH group and 10β-methyl group. Their hydrophobicity was roughly estimated by counting the number of OH group on grayanotoxin molecules. Either increase or decrease in number of OH group from the optimal number of 5 reduced the biological activity.

77

This reserch reports the analizing method by the transient value and inclination at any time of the transient.The applying potential e is $E_m \sin(\omega t + \phi_0)$.($E_m$; applying potential , ω ;angle velocity , ϕ_0 ;initial angle) The circuit of living body is assumed by series resistance r and capacitance c The transient potential and inclination are shown as v and c.

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

$$\varepsilon^{-\omega t}x = \frac{x\{K\omega\sin(\omega t+\phi_0)+\cos(\omega t+\phi_0)\}+\sin(\omega t+\phi_0)-K\omega\cos(\omega t+\phi_0)}{x(1+K\omega x)(\cos\phi_0-\sin\phi_0)}$$

$$v = \frac{RE_m}{R+r}\cdot\frac{\sin(\omega t+\phi_0)+x\cos(\omega t+\phi_0)-x(\cos\phi_0-x\sin\phi_0)\varepsilon^{-\omega t}x}{1+x^2}$$

Through these formulas resistance and capacitance of the frog muscle fiber could be determined.

78

The electric model of the frog muscle fiber consistes of two series condensers c_1, c_2 with parallel resistanes r_1, r_2 respectively. The transient potential is as follws and v_0 and v_∞ show voltages when time is 0 and ∞.

$$v = A_0 + A_1\varepsilon^{-\alpha_1 t} + A_2\varepsilon^{-\alpha_2 t}$$

$$v_0 = \frac{c_1 c_2 E}{c_0 c_1 + c_1 c_2 + c_2 c_0} \qquad v_\infty = \frac{r_0 E}{r_0 + r_1 + r_2}$$

The resistances and capacitances can be determined by the next formulas. (E; applying potential, r_0, c_0; input resistance and condenser of the mesuringapparatus)

$$\alpha_1\alpha_2 = k_1, \quad \alpha_1 + \alpha_2 = k_2$$

$$k_1 = \frac{r_0 + r_1 + r_2}{r_0 r_1 r_2 (c_0 c_1 + c_1 c_2 + c_2 c_0)} \qquad k_2 = \frac{r_0(r_1 c_1 + r_2 c_2) + r_1(r_2 c_2 + r_0 c_0) + r_2(r_0 c_0 + r_1 c_1)}{r_0 r_1 r_2 (c_0 c_1 + c_1 c_2 + c_2 c_0)}$$

$$r_1 c_1 \cdot r_2 c_2 = \frac{v_0}{v_\infty} \cdot \frac{1}{k_1} \qquad r_1 c_1 + r_2 c_2 = \left(k_2 \frac{E}{v_\infty} - \frac{V_0}{r_0 c_0}\right) \cdot \frac{v_0}{v_\infty} \frac{1}{k_1} - r_0 c_0 V_\infty$$

79

A FACTOR FROM NERVOUS TISSUE PROMOTES THE DEVELOPMENT OF TETRODOTOXIN-SENSITIVE SODIUM CHANNELS ON CHICK SKELETAL MUSCLE CELLS IN CULTURE. M. Kano, S. Yamazaki, T. Sato, M. Yamamoto. Dept. of Physiol., Sch. of Med., Kitasato Univ., Sagamihara, Kanagawa.

A soluble extract of embryonic chick brain contains a factor which is capable of promoting the development of tetrodotoxin(TTX)-sensitive sodium channels in chick skeletal muscle cells in cell culture. The effect of the presence of chemical substances in the brain extract on the development of this channels was examined by measuring the maximum rate of rise of TTX-sensitive spike potential. To estimate the molecular size of the factor in brain extract, the extract was ultrafiltrated through Diaflo membranes. The filtrates passing through XM-300, XM-100, PM-30, YM-10 and UM-2 promoted the development of the channels, but the UM-05 filtrate was ineffective. The activity in the brain extract was also retained after dialysis. When this brain extract was subjected to ammonium sulfate fractionation and gel filtration (Sephacryl S-300), activity was detected in most of the fractions. The activity of the brain extract was destroyed by trypsin or protease treatment. The fractionation study described here, although far from providing definitive information on the chemical properties of the factor molecule, indicates that an active material could be diffusible chemical substance related to a protein.

80

ROLE OF Ca CHANNEL IN OSCILLATING HYPERPOLARIZING RESPONSES IN L-STRAIN FIBROBLASTS. Y. OKADA, W. TSUCHIYA, H. YAWO, T. YADA, *S. SASAKI, *I. NAKAGAKI & *Y. IMAI. Dept. of Physiol., Fac. of Med., Kyoto Univ., Sakyo-ku, Kyoto and *Osaka Med. Coll., Takatsuki.

Cultured fibroblastic L cells show spontaneous oscillation of membrane potential composed of repetitive hyperpolarizations, and respond with a hyperpolarizing response (HR) to a mechanical, electrical or chemical stimulus. These HRs are known to be caused by a K^+ conductance increase due to an increase in the intracellular Ca^{2+} concentration.

Electron probe microanalysis was performed with freshly frozen ultrathin sections of L cells. It was found that the distribution of K^+, Na^+ and Cl^- was almost homogeneous within the cell and these concentrations were much the same as those previously determined by flamephotometry. Ca ions were not detectable by this method (i.e. below 0.1 mM) in any regions within the cell. Therefore, it seems that the activity of intracellular Ca stores is, if present, not powerful. Oxalate, caffeine and dantrolene sodium did not affect the potential profiles in L cells. In contrast, Ca channel blockers (verapamil, D-600 and nifedipine) inhibited HR. Based on these observations, it is concluded that Ca ions responsible for HR generation are mainly derived from outside the cell through Ca^{2+} channel (not from the internal stores).

81

DEVELOPMENT OF ELECTRICAL MEMBRANE PROPERTIES IN CULTURED CHICK CORTICAL NEURONS. MORI,J., ASHIDA,H., MARU,E., TATSUNO,J. Dept. of Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama

Development of action potentials was studied during culturing of explanted cortical neurons from chick embryo. The maximum rates of rise of action potentials were measured after the membrane potential had been adjusted to -80mV by steady hyperpolarization. At 6-10days the maximum rates of rise were low (below 10V/sec) in many neurons and they increased as maturing of neurons. The mean value was 24V/sec at about 1 month. At early stages (6-15days) action potentials were still elicited in tetrodotoxin (TTX, 5×10^{-7}g/ml)-containing tyrode's solution, and the maximum rates of rise further increased in solution elevated Ca^{2+} concentration. TTX-sensitive potentials were frequently seen in older neurons and even then, the elevation of Ca^{2+} concentration increased the maximum rates of rise. The effect of Ca^{2+} was more prominent at 18-19days than at later stages. These results suggest that action potentials at early stages are probably contributed by Ca^{2+} current and the effect of Ca^{2+} can not be ignored even at later stages when potentials due to Na^{+} current appear.

82

RELATIONSHIP BETWEEN THE VARIATION OF VISCOELASLICITY AND THE EXCITATION ON THE GIANT AXON OF THE CRAYFISH NERVE.
O. ICHIKAWA, M. MIYOSHI, T. KASAGI* AND Y. HIJI Dept. of Physiol., Tottori Univ. Sch. of Med. Yonago and *Dept. of Nursing, Tottori Univ. Col. of Med. Care Technol. Yonago

We already reported that values of viscoelastic constants such as Young's modulus and viscosity coefficients as well as relaxation time were estimated by rheological analysis of the stress relaxation curve obtained from the stretch of the crayfish nerve bundle. The blockade of the nerve conduction was occurred at the low temperature and the treatment of local anesthetics, accompanying the increase of stiffness of the nerve. Further experiment was done using a single giant axon. The stiffness was found to be increased with the treatment of the blocking agents such as phenol, quinine-HCl, benzyl alcohol and Lidocaine by the range of 1.5$\sim$2.2 times to the control value, while with that of urethane, procain-HCl, sodium acetate etc, it was not increased by the range of 0.5$\sim$1.0 times. Latter ones did not block the nerve conduction. TTX and α-Naphthoquinon, considered as the protein modifiers, blocked, whereas these hardly stiffened the nerve fiber.

83

EFFECT OF TETRODOTOXIN AND TETRAETHYLAMMONIUM ON THE SLOW EXCITATION PROCESS IN PERFUSED SQUID GIANT AXONS. A. WATANABE, T. SAKAI, Dept. Physiol., Fac. Med., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo.

Squid axons were externally and internally perfused continuously with solutions containing Na and K; the external medium always contained Ca in addition to the alkali cations. On application of a depolarizing voltage pulse with the voltage clamp technique, an inward membrane current with a slow time course was produced in most ionic environments. Effects of tetrodotoxin (TTX) and tetraethylammonium (TEA) were examined on the slow inward current. Results: (1) TTX suppressed the inward current when the external medium contained Na, but did not suppress it when the external medium contained K. (2) With K as the external cation, the inward current increased when the internal cation was replaced from K to Na. Externally or internally applied TTX did not suppress this increase. (3) With Na as the internal cation, the inward current increased when the external cation was replaced from Na to K. Internally applied TEA reduced the amount of current either with Na or with K as the external cation, but the current was still larger with K. Conclusion: Externally applied TTX suppresses specifically the Na conductance in the external layer of the membrane but has no effect on the Na or K conductance in the internal layer of the membrane; internally applied TTA suppresses the slow increase in membrane conductance either of Na or of K.

84

RELATION BETWEEN THE VALUE OF MEMBRANE POTENTIAL AND VARIABILITY OF MEMBRANE RESISTANCE DUE TO STIMULATING CURRENT IN NERVE FIBER.

MATUMOTO M. AND M.SANO. Depart.of Physiol., Sch.of Dentistory, Showa Univ., Tokyo

In matumoto's theory action potential is elicited by temporal change of membrane potential due that of membrane resistance. Semiexcitation is excitation like phenomenon which occurrs, when the membrane potential is smaller than the value in which self-regenerative action anable to occurr. By analysis of the courses of potential change in semiexcitations occurred in different value of membrane potential, it was shown that the potential changes by secrease of membrane resistane differed it's time courses from that of the polarization potentials caused by the stimulating current, and the variability of quite small, and that potential change in local response consisted of potential change due to decrease of membrane resistance and that of polazation by the stimulating current.

85

SOME PROPERTIES OF SPINAL NEURONS UNDERLYING THE SPINO-BULBO-SPINAL REFLEX OF THE CAT. M. SHIMAMURA, and I. KOGURE Dept. of Neurophysiol., Tokyo Metro. Inst. for Neurosci. Fuchu city, Tokyo.

In an attempt to analyze a transmission from the reticulospinal tracts to the spinal motoneurons underlying the spino-bulbo-spinal (SBS) reflex, spinal neuron activities were recorded in chloralozed cats.

1) Latency difference between unit discharges of reticulospinal tract fibers and responses of spinal ventral root (VRL_7) was 3.5 msec in shortest one following sural nerve stimulation. Stimulation to the reticulospinal tract elicited response of VRL_7 with 3.5-4 msec in latency. When unit discharge of the reticulospinal tract fibers was used for triggering signal, averaged response of VRL_7 with 5 msec in latency was observed. These observations suggested that a spinal interneuron may exist between the reticulospinal tracts and spinal motoneurons. 2) Two kinds of EPSP were obtained in response of spinal interneurons following sural nerve stimulation, corresponding with spinal and SBS reflexes. When train pulses applied to the sural nerve, EPSPs both of SR and SBS reflexes were increased in amplitude, but EPSP of SBS reflex showed markedly increaseing and appeared spike potentials, whereas EPSP of SR reflex exhibited less augmented. These characteristics may be due to the different synaptic organizations of spinal afferents and reticulospinal tracts on the spinal neurons.

86

LINGUALLY-INDUCED IPSPs IN HYPOGLOSSAL MOTONEURONS AFTER AXOTOMY. M.TAKATA,
Dept.of Oral Physiology, School of Dentistry, Tokushima Univ., Kuramoto-cho, Tokushima

Inhibitory postsynaptic potentials (IPSPs) produced in axotomized hypoglossal motoneurons by stimulation of the lingual nerve were explored in the cat. It has been reported that lingually-induced IPSPs in tongue protruder motoneurons (P-Mns) were the composite of the short-lasting and the long-lasting IPSP (S- and L-IPSP). By the application of double shocks separated by 100 msec intervals to the lingual nerve, the percent magnitude of a S- and a L-IPSP (S% and L%) in lingually-induced IPSPs was measured. In the present experiments it was found that IPSPs produced in the P-Mns 24 days after axotomy were mainly composed of a L-IPSP. This finding suggests that in axotomized P-Mns the effectiveness of inhibitory synapses for the S-IPSP are diminished in the late stage of chromatolysis.

87

ON THE EFFECT OF Ca ON THE AMINOPYRIDINE RAPID COOLING CONTRACTION. M. ANRAKU and S. HASHIMURA Dep. of Physiol., Fac. of Med., Kagoshima Univ., Kagoshima

The effect of Ca on the rapid cooling contraction in the 4-aminopyridine (AP-RCC) was studied in the bullfrog muscle. When the Ca concentration was varied from 0.05 to 6 mM, the AP-RCC was not proportional to Ca. However, the muscular contraction induced by the stimulation of the nerve or the muscle in 6 mM Ca Ringer was nearly equal to that in 1.5 mM Ca. By the addition of Mg or the reduction of K, the maximum AP-RCC in the various concentration of Ca shifted to 0.25 mM. The spontaneous muscle contraction on excess K (7.5 mM) Ringer was suppressed by the addition of 4 mM Ca. From these results, it was concluded that the effect of Ca on the AP-RCC was dual. Besides the action as the releasing factor of the transmitter substance, Ca has been considered to act as the membrane stabilizing factor on both of the nerve terminal and the muscle membrane.

88

DESENSITIZATION OF THE MUSCARINIC RECEPTOR IN BULLFROG'S ATRIUM. HASUO, H., TOKIMASA, T. & KOKETSU, K. Dept. of Physiol., Kurume Univ. Sch. Med., Kurume

The amplitude and duration of action potentials of bullfrog atrium are depressed by the muscarinic action of acetylcholine (ACh), and this is known to be due to a depression of the slow inward current (voltage-dependent Ca^{2+} current). One of the most interestig nature of the agonist-receptor reaction at cell membrane level is the desensitization, which has been studied in detail in the case of the receptor-ionic channel complex (RICC) of frog skeletal muscle end-plate. The present experiment was initiated for the purpose to clarify if the muscarinic receptor responsible for the depression of action potentials shows a desensitization to ACh. According to the present results, the depression of atrium action potentials exhibited a gradual restoration during a prolonged application of ACh. When ACh was removed from external solution, the configulation of action potentials was rapidly restored to normal within a few minutes whereas the sensitivity to ACh was depressed for much longer periods. These results were obtained also in the presence of d-tubocurarine and by use of carbachol or bethanechol instead of ACh. The present results suggested that the muscarinic receptor controling the voltage-dependent Ca^{2+} current is composed with a receptor-ionic channel (voltage-sensitive) complex of which nature is essentially similar to that of the RICC of the end-plate.

89

EFFECT OF DIISOPROPYLFLUOROPHOSPHATE (DFP) ON THE FROG NEUROMUSCULAR JUNCTION

T.KITA. Dept. of Physiol., Fukuoka Univ., Sch. of Med., Nishi-ku, Fukuoka.

Two different kinds of effects on the evoked EPC were observed by the serine residues modification with DFP. The first effect was an increase of EPC amplitude and duration by the inhibition of the AChE, since it was blocked by neostigmine and not observed on the carbamylcholine response. The second was that DFP reduced the EPC amplitude according to the first order reaction under the influence of neostigmine. The dose-response curves obtained with the iontophoretic application of either carbamylcholine or ACh were shifted competitively depending on the DFP exposure time, which were returned by pyridine-2-aldoxime application. The d-TC effect decreased after 40 min-exposure to DFP. These results suggest that the serine residues play an important part both in the ACh binding site and active site of AChE.

90

EFFECTS OF BENZALKONIUM CHLORIDE ON THE NEUROMUSCULAR TRANSMISSION.

N. TAKEUCHI, Y. TAKIKAWA. Dept. of Physiol., Sch. of Med., Juntendo Univ., Bunkyo-ku Tokyo. N. SHIBUYA. Dept. of Neurol., National Kawatana Hospital, Kawatanamachi, Nagasaki.

Benzalkonium chloride (B.Cl)— one of the cationic surface-active agents— has been widely used as a sterilizer or preservatives. Since B.Cl is a quaternary ammonium compound, it is expected to have some effects on cholinergic synapse. In the present study, the effect of B.Cl (10^{-4} — 10^{-5}M) on the neuromuscular transmission was investigated, using the m.sartorius of the frog, rat, mouse and guinea-pig, and the diaphragm of the mouse. Solutions were kept flowing in all cases. When the flowing was stopped during the application of B.Cl, the effect of B.Cl was decreased. End-plate potentials recorded intracellulary or extracellulary, voltage-clamped end-plate currents, spontaneous m.e.p.p.s and iontophoretically applied acetylcholine potentials were reduced in the size by the application of B.Cl to the solutions. The rate of the reduction was dependent on the concentration of B.Cl applied. The present observations indicate that B.Cl is a notable depressant on the neuromuscular transmission and its main site of action is post-synaptic.

91

DESENSITIZATION OF THE CHANGES IN THE ACTION POTENTIALS OF NERVE CELLS BY A MUSCARINIC ACTION OF ACh. T. AKASU & K. KOKETSU. Dept. of Physiol., Kurume Univ. Sch. Med., Kurume

Muscarinic action of acetylcholine (ACh) caused not only the depolarization (slow EPSP) but also depressions of active ionic currents (voltage-dependent Na^+, K^+ and Ca^{2+} currents) during action potentials of bullfrog sympathetic ganglion cells. One of the most interesting nature of the receptor-agonist reaction at membrane level is the desensitization, which has been studied in detail in the case of receptor-ionic channel complex (RICC) of the end-plate. The present experiment was carried out in order to clarify if the muscarinic receptor which controls voltage-dependent currents of these cells exhibited the desensitization to ACh. Amplitudes of both after-hyperpolarizations (K^+ currents) and spike heights (Na^+ current, mainly) of action potentials as well as amplitude of TEA spikes (Ca^{2+} currents) were decreased by the muscarinic action of ACh, and these depressions were gradually restored to a certain extent during a sustained application of ACh. After removal of ACh, the receptor sensitivity to ACh was still depressed for an extent period whereas the configulation of these spikes was restored to normal.

These results suggested that the muscarinic receptor, which is responsible for the depression of voltage-dependent K^+, Na^+ and Ca^{2+} currents during action potentials, is composed with a receptor-ionic channel (voltage-sensitive) complex of which nature is essentially similar to that of the RICC of the end-plate.

92

ACTIONS OF CATECHOLAMINES ON THE SYMPATHETIC GANGLION CELLS OF BULLFROGS. SUMIKO MOCHIDA & TSUNEO TOSAKA. Dept. Physiol., Tokyo Medical College, Tokyo 160.

112 cells in the lumber sympathetic ganglia of bullfrogs were examined for responsiveness to adrenaline which was reported to be contained in the SIF cells of this animal species. The preparation was pretreated by 0.1% collagenase to improve the accessibility of micropipettes for iontophoretic application of chemicals to the surface membrane of the cells as close as possible. The purely depolarizing response associated with a decrease in membrane resistance was elicited in 39 cells (35% of the cells tested). The reversal potential of the depolarization was estimated as -30 mV. This response was resistant to both α- and β-adrenergic blockers. The hyperpolarizing response or the diphasic one, hyperpolarizing followed by depolarizing, was obtained in 10 cells (9%). By treating the ganglion with phentolamine at 50 μg/ml, the hyperpolarization turned to depolarization. The hyperpolarization was usually associated with an increase in membrane resistance. Phenylephrine elicited neither depolarizing nor hyperpolarizing response in 25 cells tested, although it always produced depolarizing response in 4 cases in the sucrose-gap recordings. We may conclude that adrenaline elicits two kinds of response in the frog sympathetic ganglion cells: one is to depolarize the cell membrane through an adrenergic receptor whose nature is not known yet; another is to hyperpolarize the cell via α-adrenergic receptors.

93

NATURE OF DEPOLARIZING MEMBRANE POTENTIAL CHANGES INDUCED BY CYCLIC GMP IN THE SYMPATHETIC GANGLION CELLS OF RABBITS. TOSHIO HASHIGUCHI, SUMIKO MOCHIDA, HARUO KOBAYASHI & JUNKO ITO. Dept. Physiol., Tokyo Medical College, Shinjuku-ku, Tokyo 160.

Externally administered dibutyryl cyclic GMP (db-cGMP) effectively produced marked depolarization (DP) in the rabbit superior cervical ganglion cells. Other related compounds, including 8-Br-cGMP, non-butyryl cGMP, non-cyclic 5'-GMP, Na-butyrate, etc., were almost without effect (as examined by the sucrose-gap recordings). As reported already (Nature: 271, 267, 1978), db-cGMP caused two different kinds of DP: one was with an increase in membrane conductance (type 1) and another was with no change in conductance (type 2). The reversal potential (E_r) for the DP type 1 was found to be -36.1 ± 7.1 mV (7 cells). This type of DP was unaffected when external Na was replaced by tris, whereas it was eliminated by replacing Na with choline, leaving the DP type 2 behind. By reducing external Cl down to 1/3 together with Na (i.e. 2/3 NaCl was substituted by sucrose), the DP type 1 was augmented and E_r moved significantly toward zero (-25.5 ± 8.0 mV, 6 cells). We may suggest that an increase in Cl conductance would largely contribute to the production of the DP type 1. Electrogenic mechanism for the DP type 2 is not known yet.

94

EFFECTS OF Ca^{2+} AND CAFFEINE ON THE SUBSYNAPTIC MEMBRANE OF THE NICOTINIC SYNAPSE IN THE SYMPATHETIC GANGLION CELL. K. KUBA, S. MINOTA, E. KATO*' & K. MORITA*. Dept. Physiol., Saga Med. Sch., Saga 840-01, and Dept. Physiol.*, Kurume Univ. Sch. Med., Kurume 830.

The amplitude of acetylcholine (ACh) potential induced by iontophoretic application of ACh was converted to the conductance change (G_{ACh}), with known values for the membrane resistance, resting potential and the equilibrium potential (E_{ACh}). The G_{ACh} was reduced by either increasing or decreasing the extracellular Ca^{2+} ([Ca]o). The analysis of the dose-response curves revealed that the high and low [Ca]o increased the dissociation constant (Km) and decreased the maximum conductance (Gmax), but did not alter the Hill number (N). Caffeine (2 mM), known to raise the intracellular free Ca^{2+} ([Ca]i), reduced the G_{ACh}. This depression was partially reversed by intracellular EGTA injection, and dependent on the [Ca]o; higher the [Ca]o, greater was the depression. These results indicate the action of an increased [Ca]i. The G_{ACh} increased during the generation of caffeine hyperpolarizations which would further raise [Ca]i. The amount of this increase in G_{ACh}, however, never exceeded the G_{ACh} in Ringer. Caffeine increased Km and decreased Gmax without altering N. The E_{ACh} and the half decay time of the fast excitatory post-synaptic current were unaffected by caffeine. We suggest that Ca^{2+} has multiple modes of actions on the G_{ACh} of the bullfrog sympathetic ganglion cell membrane and that it acts from both the extracellular and intracellular sides of the membrane.

95

HIGH-GAIN SYNAPSE IN THE SENSORY TRANSDUCTION OF THE AMPULLARY ELECTRORECEPTORS. S. OBARA, T. HIGUCHI*. Dept. of Physiol., Teikyo Univ., Sch. of Med., Itabashi-ku, Tokyo, *Dept. of Biol., Higashinihon-gakuen Univ., Onbetsu.

The afferent synapse in the secondary sensory receptors differs from the neuronal synapses in its continual transmission of gradedly variable presynaptic informations. Quantitative evaluation of the synaptic transfer properties was attempted in in situ electroreceptors of Plotosus. The synaptic transfer curve in terms of external PSP's is a steep sigmoid, extending within ± 500 μV in (presynaptic) ampullary potentials. Intraaxonal PSP's are linearly related to the external PSP's, and may reach a peak of 50 mV from the fully repolarized level of - 20 mV. Voltage gain across the synapse then can be estimated as more than 50 times, with a 10 fold output increase on every increment of less than 200 μV in the ampulla. Conversion efficacy in encoding PSP's into afferent impulse frequency is estimated as c. 7 impulses/s/mV, or as an increase of c. 1.8 times in incremental slope when normalized to their respective maxima. The initial process of transduction, modulation of the spontaneous receptor cell activity, has been estimated to give only 2-3 times amplification (modulation efficacy). The high-gain synaptic transfer presumably results from its integrative properties which have been inferred by experiments of selective pre- or postsynaptic stimulation.

96

BIOASSAY AND CHEMICAL ANALYSIS OF THE AFFERENT NEUROTRANSMITTER IN THE AMPULLARY ELECTRORECEPTOR. S. UMEKITA, Y. MATSUMOTO, S. OBARA. Dept. of Physiol., Teikyo Univ., Sch. of Med., Itabashi-ku, Tokyo.

The afferent discharge of Plotosus electroreceptors is facilitated specifically and postsynaptically by L-glutamate (Glu). The present series of experiments was designed to determine whether Glu be released by orthodromic stimulation in isolated ampullae (receptor units). A single ampulla (releaser) in a small saline pool was stimulated repetitively by anodal pulses to lead to a maximal afferent facilitation. After several minutes another ampulla (detector) placed in the same pool started to give rise to unsuppressible afferent discharges. The induced discharges increased progressively, indicating a stimulus-dependent release of an active substance. This substance could also be removed into another saline pool for bioassay. The detector ampullae proved to be sensitive to Glu in the order of 10^{-4} M. For chemical analysis of the active substance, a larger quantity of sample was collected from more than ten releaser ampullae, with its activity confirmed by bioassay. Glu, however, was not detected ($<10^{-7}$ M) by ninhydrin or fluorescamine reaction on TLC, or by fluorometric amino acids analysis. Therefore, Glu appears to remain only as a powerful agonist to the natural neurotransmitter in the present sensory receptor system.

97

KINETIC ANALYSIS OF DRUGS SHOWING A LARGE FACILITATORY ACTION ON THE MOTOR NERVE TERMINAL OF THE NEUROMUSCULAR JUNCTION

MAENO, T., ENOMOTO, K. and ICHINOSE, M. Dept. of Physiol., Shimane Med. Univ., Izumo, Shimane

Assuming that a proportion of the available store of the ACh quanta is discharged with a single nerve spike, the quantal content of the first EPP (M) is given by M=PN, where N is the total number of available store of the ACh quanta in the resting nerve terminal, and P is the probability of evoked release (kinetic p). The number of available store of ACh quanta remained immediately after the first response is N-M=(1-P)N. Thus, the second EPP should be depressed with a factor of (1-P). The present investigations were designed to analyze, by calculating P from the data obtained with train stimulations, the effect of drugs on ACh release. As reported already, 4-aminopyridine (4AP) increased tremendously both the amplitude of EPP and the release parameter, P. An existence of a linear double reciprocal dose-release relation between 4AP and P, and facilitatory and inhibitory actions of structurally related substances suggested that the effect of 4AP could be described by Michaelis-Menten kinetics; i.e. 4AP combines with a specific site in the motor nerve terminal thereby modifies the release process of the available ACh quanta. Antibiotic aminoglycosides such as streptomycin suppress the neuromuscular transmission by competing with 4AP for this presumptive receptor.

98

EFFECTS OF TONICITY AND NA^+ ON TETANIC RISE IN FREQUENCY OF MINIATURE END-PLATE POTENTIALS IN LOW-CA^{2+} SOLUTIONS.

H. KITA & K. NARITA Dept. of Physiol., Kawasaki Med. Sch., Kurashiki, Okayama

Evidence is accumulating that the frequency of MEPPs is largely determined by $[Ca^{2+}]_i$ in the nerve terminals. Factors affecting $[Ca^{2+}]_i$ include Ca^{2+} influx through the presynaptic membrane, Ca^{2+} uptake and release by the mitochondria and active Ca^{2+} efflux across the terminal membrane. At the frog neuromuscular junction bathed in solutions made with no added Ca but containing MgEGTA, tetanic stimulation (50 Hz, 3 min) of the motor nerve caused an increase in MEPP frequency. The increase, expressed as maximum MEPP frequency during tetanus/average MEPP frequency before tetanus, was always larger in hypertonic low-Ca^{2+} solutions than in isotonic ones, irrespective of whether sucrose or NaCl was added. This can be interpreted by the finding that hypertonic solutions decrease Ca^{2+} uptake by the mitochondria. Conversely, in hypotonic low-Ca^{2+} solutions made by reducing NaCl, the ratio was lower than in isotonic solutions. However, when the decrease in tonicity was compensated by adding sucrose or glycine, higher ratios were obtained compared to normal NaCl solutions regardless of the kind of the solutes added. This might be due to the decreased activity of a Na^+-Ca^{2+} exchange pump at reduced $[Na^+]_o$.

99

EFFECT OF 5-HT ON TRANSMITTER RELEASE FROM AMPHIBIAN CHOLINERGIC NERVE TERMINALS.

HIRAI, K. & KOKETSU, K.* Tokyo Res. Lab., Kowa Co. Ltd., Tokyo & Dept. of Physiol., Kurume Univ. Sch. Med., Kurume*

The effects of serotonine(5-HT) and adrenaline (Ad) on the release of acetylcholine (ACh) from bullfrog sympathetic preganglionic nerve terminals and frog motor nerve terminals were studied with intracellular microelectrode. The change in transmitter release was measured from the mean number of quantal contents calculated by the variance method from evoked fast EPSPs or EPPs in a low Ca^{2+}-high Mg^{2+} Ringer's solution. 5-HT facilitated the release of ACh by its low concentrations and depressed it by its relatively high concentrations in both preganglionic and motor nerve terminals. Ad showes similar concentration dependent dual effects at the motor nerve terminals, that is, the facilitation of the ACh release by relatively low concentration of Ad and inhibition of it by its high concentration. At the preganglionic nerve terminals, the release of ACh was facilitated after the removal of Ad in high concentrations inhibiting the ACh release during its presence and also in low concentrations having no effects on ACh release during its presence. The mechanism underlying these concentration dependent dual effects of Ad and 5-HT on the transmitter release from cholinergic nerve terminals was discussed.

100

RELEASE OF GLUTAMATE FROM THE NEUROMUSCULAR JUNCTION OF THE CRAYFISH.

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

L-Glutamic acid is the prime candidate for the excitatory transmitter in the crayfish neuromuscular junction. However, a crucial test for this hypothesis: the detection of the release of glutamate in the response to nerve stimulation, has not been conclusive. The abdominal slow flexor muscle was isolated from the crayfish (Cambarus clarkii) and placed in a small bath. After washing for 30-60 min with Harreveld solution, 100 µl of the solution was put into the bath. After 10 min the solution was sampled and the glutamate concentration was measured with mass fragmentography using gas chromatograph-mass spectrometer. The background release of glutamate was 20.4 $\pm$ 0.75 pmole/10 min (n = 200) and the nerve stimulation significantly increased the glutamate concentration ($P < 0.01$). Net release of glutamate was 11.9 $\pm$ 3.0 pmole (n = 6) with stimulation at 10 Hz and 20.3 $\pm$ 2.4 pmole (n = 11) at 20 Hz. When the Ca concentration was decreased by partially replacing it with Mg, the net release upon nerve stimulation was significantly reduced ($P < 0.025$). It is concluded that L-glutamate is released from the nerve terminal.

101

THE EFFECT OF TETANUS TOXIN ON THE GROUP Ia SYNAPSE ON THE CAT MOTONEURON.

K. KANDA, A. TOYODA. Dept. of Physiol., Sch. of Med., Chiba Univ., Chiba

Tetanus toxin (100 mMLD/kg) was injected into the left medial gastrocnemius (MG) muscle of the cat. Just before the toxin injection, the lateral gastrocnemius-soleus (LGS) nerve was ligated and sectioned peripherally at the entry to those muscles so that the toxin could not be transported by this nerve. After five days, intracellular recording from triceps surae motoneurons was performed in the usual manner. Homonymous group Ia EPSPs evoked in MG motoneurons decreased in amplitude significantly in comparison with the normal data (2.3±1.6mV vs. 6.0±3.1mV; $P<0.001$). Those evoked by the LGS nerve, however, showed no change (3.1± 1.4mV vs. 2.9±2.1mV). These results suggest that the toxin impairs the excitatory synapses, such as group Ia synapses on the motoneuron, as well as the inhibitory synapses. Moreover the toxin seems to be transported by the anterograde transport along the group Ia afferents themselves. Post-tetanic potentiation (PTP) could be produced at poisoned Ia synapses.Therewas no indication that either the amount and duration of PTP was significantly altered by the tetanus toxin.

102

VOLTAGE-DEPENDENT EFFECT OF CURARE AT THE INSECT NEUROMUSCULAR JUNCTION.

YAMAMOTO, D. and WASHIO, H. Lab. of Neurophysiol., Mitsubishi-Kasei Institute of Life Sciences, Machida, Tokyo

We have analysed the action of curare on the neuromuscular junction of *Tenebrio* larvae. Extracellular focal recordings have revealed that the postsynaptic current was substantially depressed but that the presynaptic impulse and the synaptic delay remained unchanged after the treatment of 5×10^{-4}M curare. The quantum content estimated by the failure method was unaffected by curare. Curare produced a reduction in the apparent maximum of the dose-response curve for glutamate-induced depolarisation. The amplitude of the glutamate current as well as e.p.s.c. under voltage-clamp does not increase with hyperpolarisation, but may actually be reduced in the presence of curare. These results suggest that curare might combine with the receptor-transmitter complex at the postsynaptic site, thereby 'plugging' the open channel itself.

103

ON THE DIRECTION OF THE PROPAGATION OF TTX-RESISTANT SPIKE IN THE NERVE TERMINAL OF LOBSTER. A. NIWA, and N. KAWAI. Dept. of Neurobiol., Tokyo Metropolitan Institute for Neurosciences, 2-6, Musashidai, Fuchu-City, Tokyo 183.

We made intra-axonal recording and stimulation near the nerve terminal of the neuromuscular junctions of lobster and studied characteristics of TTX-resistant regenerative responses. After applying TTX (3 μM), depolarizing currents near the nerve terminal set up action potentials which induced postsynaptic potentials, whereas no antidromic action potential could be recorded in the axon apart from the current electrode (more than 6 mm). By impaling three microelectrodes near the nerve terminal we found that the TTX-resistant action potenital could propagate orthodromically towards the nerve terminal but it failed to propagate antidromically and decreased in size as the recording electrode became further from the current electrode. When 30 mM $CoCl_2$ was added to TTX solution, the propagating spike potential was abolished and only graded responses were generated in both orthodromic and antidromic direction. The results indicate that Ca-spike in the nerve terminal has a property of uni-directional conduction to the nerve terminal.

104

Post-synaptic effects of iontophoretically applied LHRH and anti-LHRH antiserum in medial preoptic nucleus neurones in rats. Ban, M. and Yagi, K. (Dept. of Physiol., Jichi Med. Sch., Tochigi)

Median eminence (ME) stimulation produces excitatory and inhibitory synaptic effects in medial preoptic nucleus (MPO) neurones (Yagi & Sawaki, Brain Res. 120, 342, 1977). Tuberoinfundibular (TI) neurones are activated antidromically after MPO stimulation (Harris & Sanghera, Brain Res. 81, 401, 1974). Since the ME includes luteinizing hormone-releasing hormone (LHRH)-containing axon terminals, the present experiments aimed to test the possibility that LHRH mediates these synaptic inputs to MPO neurones. In urethane-anaesthetized female rats, iontophoretically applied LHRH produced excitation and inhibition of spontaneous discharge in some of the MPO units which showed excitation and inhibition after ME stimulation, respectively. During iontophoretic application of anti-LHRH antiserum, ME stimulation failed to produce these synaptic effects which were observed in the same MPO neurones during iontophoretic application of rabbit IgG. These data suggest that LHRH functions as a synaptic transmitter. They also suggest the possibility that LHRH may mediate either excitatory or inhibitory synaptic effect depending on the MPO cell under recording. In addition, these data support the view that TI neurones directly project to the MPO.

105

BARBITURATES AND GABA-INDUCED CURRENTS OF PRIMARY AFFERENT NEURONS
HIGASHI, H., INOKUCHI, H. & NISHI, S. Dept. of Physiol., Kurume Univ. Sch. Med., Kurume

The effect of barbiturates (thiopentone and pentobarbitone) on the GABA-induced current of cat primary afferent neurones was studied. Barbiturates (0.1-10 μM) augmented the GABA-current without affecting the dissociation constant of GABA-GABA receptor interaction and without altering the membrane properties. This would indicate that barbiturates at low concentrations act on the allosteric site of GABA receptors or Cl channel directly and facilitate the GABA-current.

At higher concentrations (0.1-1 mM) barbiturates caused a marked prolongation of the GABA-current, which was followed by a strong depression of the current. This action was associated with a few mM reduction in the resting membrane potential. The membrane resistance initially decreased and gradually increased during the barbiturate-induced depolarization. Analysis showed that the initial conductance increase was also due to Cl conductance which was increased by barbiturate action on the allosteric site of GABA receptors and that subsequent conductance decrease was associated with a reduction of K conductance of the ordianry membrane. At the later stage of barbiturate action, the Cl-channels would gradually close and tend to being in a state of refractory.

This study was supported by grants from the Ministry of Education Science and Culture.

106

FINE LOCALIZATION OF GABA(γ-aminobutyric acid),GAD(Glutamate decarboxylase) AND GLUTAMATE IN A SINGLE DEITERS' NEURON. Y.OKADA Dept.Neurochemistry Tokyo Metropolitan Inst. Neuroscinces,Musashidai, Fuchushi, Tokyo.

In order to know the reason for an uneven regional distribution of GABA, fine distribution of GABA, GAD and glutamate was determined in the single dorsal Deiters' neuron which receives monosynaptic GABAergic nerve terminals from Purkinje neuron in the cerebellum using microbiochemical methods. A single Deiters' cell was dissected out from freeze-dried sections of rabbit brain stem and separated further into small pieces with or without membrane fragments. High concentration of GABA(32.2mmol/kg dry) with high GAD activity(43.3mmol/kg/hr) was found in the region containing membrane fragments whereas intracellular GAD activity was extremely low (2.9mmol/kg/hr). The glutamate distribution in each region of dissected cell showed even distribution(15-25mmol/kg). These results showing that GAD and GABA are localized in the membrane region which receives GABAergic imput, may shed light on the interpretation of the uneven regional distribution of GABA in the brain. Regions with high concentration of GABA and high GAD activity may contain more GABAergic nerve terminals or boutons per unit area than regions with low GABA concentrations.

107

SYNAPSE FORMATION BY NEUROBLASTOMA X GLIOMA HYBRID CELLS. H. HIGASHIDA, A. MIYAKE*, K. KANO-TANAKA**, AND T. TANAKA**. RES. INST. ENVIRON. MED., NAGOYA UNIV., NAGOYA 464, *INST. EQUIL. RES., GIFU UNIV. GIFU 500, **LAB. CELL BIOL., AICHI CANCER CENT. RES. INST., NAGOYA 464.

The NG108-15 hybrid cell derived by fusion of mouse neuroblastoma and rat glioma cells is one of the 6 cell lines that form synapses with rat striated muscle cells (Syn +) (Higashida, et al. Abst. Soc. Neurosci. 4,591 [1978]). The hybrid cells could be regulated in both directions, activation and inhibition, with respect to the rate of synapse formation. Synapses were found with high frequency (80-100 % of myotubes tested were innervated) with treatment of 1 mM dibutyryl cAMP or 10 μM PGE_1, an activator of adenylate cyclase, plus 1 mM theophylline, an inhibitor of phosphodiesterase, in 3 days (Higashida, Kenimer, Wilson, and Nirenberg, unpublished data). The low rate of synapse formation was obtained in the presence of about 100 μg/ml glia maturation factor (GMF) (gifted from Dr. T. Kato). The involvement of cAMP on regulation in synapse formation of NG108-15 cells is discussed. A part of these experiments were carried out in the Laboratory of Biochemical Genetics, NHLBI, NIH, U.S.A. with M. Nirenberg and S. P. Wilson.

108

ISOELECTRIC FOCUSING ANALYSIS OF ACETYLCHOLINE RECEPTORS ON THE SURFACE OF MOUSE AND CHICK MUSCLE CELLS IN CULTURE.

HIROYUKI SUGIYAMA. Laboratory of Membrane Biology, National Institute for Physiological Sciences, Okazaki, 444

Acetylcholine receptros (AChR) on the surface of mouse clonal muscle cells and chick primary muscle cells in culture were analysed by isoelectric focusing after labeling them with ^{125}I-labeled α-bungarotoxin (αBT) or [^{3}H]propionyl-αBT. Two forms of AChR-αBT complexes were detected from mouse muscle cells, the major one with a pI of ≃5.4 and the minor one of ≃5.1. It was suggested that these two forms corresponded to AChR of extrajunctional and junctional types, respectively. These pI values are readily modified by various treatments, resulting in an increase to around 6.0. From chick muscle cells, the acidic form of AChR-αBT complex with a pI ≃5.1 was not detected. These results raised a possibility that the junctional AChR of chick skeletal muscles could be indistinguishable from extrajuncitonal AChR.

109

EFFECTS OF VARIOUS ONIUMS ON THE DIFFERENT TYPE OF ACh-RECEPTOR ACTIVITIES OBSERVED IN APLYSIA GANGLION CELLS.

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

The ganglion cells of Aplysia include three types of ACh-receptors. The activation of one type(D_{Na}-type) produces Na^+-dependent depolarization. The other receptors are H_K- and H_{Cl}-types, the activation of which produces either K^+- or Cl^--dependent hyperpolarization. Some oniums activated certain types but inhibited other types of ACh-receptors. The potencies of activation(PA) or inhibition(PI) were estimated from the dose-response curves, and expressed in a fraction relative to either PA of ACh or PI of Hexa. The mode of inhibition was analyzed on the dose-inhibition curves.

The D_{Na}-type of receptors were activated by trimethylammonium(TMA) and choline(Ch). Their PA ratios are ACh : TMA : Ch = 1 : 1/60 : 1/1000. The D_{Na}-type of response was inhibited competitively by both hexamethonium(Hexa) and decamethonium(Deca), but non-competitively by tetraethylammonium(TEA). Their PI ratios are Hexa : Deca : TEA = 1 : 1/38 : 1/23. The H_{Cl}-type of receptors were activated by TMA, Deca, Ch. Their PA ratios are ACh : TMA : Deca : Ch = 1 : 1/100 : 1/350 : 1/500. The H_{Cl}-type of response was inhibited by neither Hexa nor TEA. The H_K-type of receptors were activated by neither TMA, Ch, nor Deca. The H_K-type of response was inhibited only by TEA, and the mode of inhibition was competitive.

110

SINGLE MUSCLE FIBRE POTENTIALS IN RESPONSE TO PERIPHERAL NERVE STIMULATION

HOMMA, ISAKO., ISHIYAMA, YOJI., and EBE, MITSURU.; Departments of Physiology, Toranomon Hospital, Minato-ku, Tokyo.

Single muscle fibre potentials evoked by electrical stimulation of the innervating peripheral nerve were recorded by microelectrode. Simultaneously, M- and H-waves were induced by surface electrode. The configuration and latency of the single fibre potentials were analyzed in relation to the intensity of stimulation and the type of muscle. Results; (1) Single fibre potentials did not always appear simultaneously with M- and H-waves induced by surface electrode. (2) The latency of single fibre potentials fluctuated with repetitive stimulation. (3) The latency fluctuation ranges of single fibre potentials corresponding to H-waves were about two times larger than those corresponding to M-waves. (4) Blocking phenomena were observed in single fibre potentials of H-waves. The results suggest that a physiological excitation state occurred in the synapses of the spinal cord and the motor neurons.

111

NEURAL FUNCTION AND MORPHOLOGY OF SUBSTANTIA GELATINOSA NEURONS IN THE SPINAL CORD.

HAYASHI,H., DUBNER,R, BENNETT,G.J., and ABDELMOUMENE,M. Dept. Physiol., Fac. Dent., Tokyo Med. Dent. University, Tokyo and National Institute of Dental Research, National Institute of Health, Bethesda, Maryland.

Neurons in the substantia gelatinosa (SG; Rexed's layer II) of cat lumber cord were Physiologically characterized with natural and percutanous electrical stimuli applied to their receptive fields. The neurons were then intracellularly stained with HRP. Three general physiological types of neurons were found. Nociceptive specific (NS) neurons responded to modelately heavy pressure and to noxious stimuli, but did not responded to light touch. Wide dynamic range (WDR) neurons responded to both gentle mechanical stimulation and to tissue damaging stimulation. Low threshold mechanoreceptive (LTM) neurons responded only to gentle mechanical stimulation. Morphologically two types of neurons were identified. Stalked cells had their perikarya situated at the dorsal border of the SG. Their dendrites streamed ventrally and their axons arborized extensively in lamina I. Stalked cells were either NS or WDR neurons. Islet cell perikarya were located within the SG. Their dendritic and axonal arbors were confined within the SG. NS and WDR islet cells were found in the dorsal part of the SG. LTM islet cells were in the ventral part of the SG.

112

PERIPHERAL ORIGINS OF HUMAN EVOKED ELECTROSPINOGRAMS.

H. SHIMIZU, Y. MARUYAMA, H. ENDO & K. SHIMOJI. Dept. Anesthesiol., Niigata Univ. Sch. Med., Asahi-machi 1, Niigata 951

Human evoked electrospinograms recorded from the posterior epidural space elicited by segmental nerve stimulations have previously been shown to consist of initial spike potentials (P_1) followed by sharp negative (N_1) and slow positive (P_2) waves. Sequential changes in N_1 and P_2 were investigated by producing ischemia on upper limb with a sphygmomanometer cuff. With weak stimulations (below the intensity of 3 x N_1 threshold) amplitudes of N_1 and P_2 waves enhanced during the first 20 minutes of ischemia, while with supramaximal stimulations the enhancement of both components was not observed. Twenty five minutes after the start of ischemia, N_1 was markedly decreased in amplitude and prolonged in latency and duration. These changes in N_1 were closely related to those of the A-β fiber nerve action potentials recorded from ulnar sulcus simultaneously. By contrast, P_2 and the A-α fiber nerve action potentials were more resistant to ischemia than N_1 and the A-β fiber action potentials. These results may indicate that A-β fiber is more sensitive to ischemia than A-α fiber and most parts of peripheral origins of N_1 and P_2 waves of human evoked electrospinograms are A-β and A-α fibers, respectively.

113

RHYTHMIC BURST DISCHARGES OF THE SPINAL CORD MEDIATING THE SPONTANEOUS TREMOR IN MONKEYS WITH MESENCEPHALIC LESION. C. OHYE, S. IMAI, M. MIYAZAKI, H. NAKAJIMA, T. HIRAI, K. TASAKI, Y. TSUKAHARA, T. MATSUSHIMA. Dep. of Neurosurg., Gunma Univ. Sch.of Med., Maebashi, Gunma.

Extracellular recordings were made in the spinal cord (C_1-C_2) of the awake monkey with spontaneous sustained tremor induced by a mesencephalic ventromedial tegmental lesion. The head of the monkey in sitting posture was mounted on a stereotactic apparatus with the aid of a metal plate fixed on the skull. After laminectomy under local anesthesia, a recording electrode (Elgiloy) was introduced in micron steps into the spinal cord through a small dural incision. In 9 tremor monkeys, 85 trackings were made and 30 unitary rhythmic burst discharges preceded the ipsilateral tremor EMG were found. They were always positive spikes indicating the fiber activity and located within 1-2 mm from the midline and deep in the ventral quadrant, corresponding to Rexed's VII and IX layer. In 2 cases, after temporal immobilization using curare under artificial respiration, 3 tremor synchronous units kept almost the same rhythm. In one particular monkey having the spontaneous tremor only in the lower limb, similar rhythmic bursts were found also in the same cervical area.

These fingings support the idea that the tremor rhythm originates somewhere in the higher center and descends the spinal cord probably not via the corticospinal tract.

114

MUSCLE SPINDLE SENSITIVITY OF HUMAN EXTENSOR DIGITORUM COMMUNIS MUSCLE AND SERVO HYPOTHESIS K.AKAZAWA, K.FUJII, *K.KANOSUE Dept. of Electrical Engng.,Faculty of Engineering, *Dept. of Physiol.,Sch. Med.,Osaka Univ., Osaka

The shortest latency response to quick stretch of the human extensor digitorum communis(EDC) muscle was examined under two types of voluntary contractions by recording surface EMG and force. One type of contraction was "force control": the subject was asked to maintain constant isometric force, while watching both the force and the desired value displayed on CRT. The other was "position control": the subject was asked to maintain the movable middle finger at a constant position against load force generated by an electric motor. In both experiments, the EDC muscle was quickly stretched by a small amount with an electromagnet or a stepping motor. The tendon jerk(latency about 40 msec) was greated during "position control" than during "force control". It follows that the gain of the motor servo increases during "position control", because the initial conditions were approximately the same.

Simulating observed force-extension relations in terms of the mathematical stretch reflex model, we estimated the muscle spindle sensitivities of the EDC muscle. The position sensitivity during "position control" was greater than during "force control". According as the load force applied to the finger became large, the position sensitivity and the stiffness of the muscle increased in both types of contractions.

115

A MODEL OF PHYSIOLOGICAL TREMOR INCLUDING TWO REFLEX LOOPS
WATANABE, A. and SAITO, M., Inst. of Med. Electron., Univ. of Tokyo, Bunkyo-ku, Tokyo

A feedback model is constructed to describe physiological tremor of human extremities. The Laplace transform of the equation of motion including a physiological feedback term provides the condition for sustained oscillation. The physiological feedback is assumed to be a parallel connection of a short loop (monosynaptic reflex loop) and a long loop (polysynaptic reflex loop). The oscillating frequency is determined from the point of intersection of the physiological and physical terms in the graph of the phase angle. The natural frequency and a time constant $T_r = I/R$ (I: moment of inertia, R: rotational damping coefficient) are determined from damped oscillation after a tap. When T_r is much larger than predicted by the theory, the data of the damped oscillation are excluded as affected by the physiological feedback and actual physical parameters are estimated by theoretical extrapolation. The physiological parameters such as delay times and the gain ratio are determined so that the curve of the physiological term passes through the points representing the sustained oscillation plotted on the curve of the physical term. Double line frequency spectra or frequency spectra with two peaks are necessary for parameter determination. This procedure is successfully applied to the sustained oscillation of the hand during stroke movement.

116

MUSCLE SPINDLE DISCHARGES ELICITED BY RANDOM TRIANGULAR WAVEFORM MUSCLE STRETCHES.
S. HOMMA, K. HAYASHI, Y. NAKAJIMA. Dept. Physiol., Sch. Med., Chiba Univ., Chiba 280.

The triceps surae muscle of cats was stretched by triangular waveform(rising- and falling-time of 4 ms) pulses with random inter-stretch intervals, while single primary spindle discharges were recorded from the dorsal root by usual manner. Cross-correlation of the primary spindle discharges and the onset of the stretches revealed the so-called primary correlation kernel. Since a primary correlation kernel obtained from a cross-correlogram of input and output in monosynaptic connection is suggested to correspond with derivatives of excitatory postsynaptic potentials elicited by the input, the primary correlation kernel calculated from the primary spindle spikes and the triangular waveform stretches was supposed to correspond with derivatives of generator potentials transduced in the primary endings by the stretches. Integration of the kernel showed slow slope at the onset and near the summit and steep slope on the way. Some primary spindle discharges showed bending on the rising slope of the integrated kernel. This bending was attributed to the difference in time-course of generator potentials elicited in multiple branches of primary endings on the intrafusal muscle fibers.

117

A SHIFT OF VOLUNTARY CONTROL OF MUSCULAR ACTIVITIES OBSERVED DURING VARIED SPEED OF PEDALLING MOVEMENT.
S. SUZUKI, S. WATANABE, S. HOMMA*, Dept. of Physiol., Kyorin Univ. Sch. of Med.Mitaka,Tokyo,181 and Dept.Physiol.,Chiba Univ. Sch. Med.,Chiba,280*

Present study was performed to investigate the dynamic relations between varied bicycle pedalling and voluntary muscular control of lower extremities in the well trained healthy male subjects. Dynamic characteristics of voluntary control could be observed as some shifts of phase of EMGs recorded from the rectus and biceps femoris muscles against knee and hip joint movements. When the rotary pedalling movement was performed in slow range(0.1Hz-0.5Hz), activity of rectus femoris muscle appeared slightly before the maximum flexion of the knee joint and continued towards the maximum knee extension. It was invariably observed that faster pedalling movement was effected by the gradual forward shift of femoris driving towards peceding maximum knee extension.

Activity of biceps femoris appeared quite reciprocal to the phase of the rectus femoris in slower range of pedalling speed. In faster range, forward shift of the biceps control was so remarkable that control of both rectus and biceps muscles was under state of so-called co-contraction in most of their activated phase.

It is suggested that the central neural command to the lower extremities during pedalling was strongly concentrated to hip flexor than to knee flexor muscles especially during quick rotary movement as judged by above phase shift of EMGs.

118

EVIDENCE FOR A TRANSCORTICAL REFLEX: RESPONSES OF PRIMATE MOTOR CORTEX NEURON TO RAMP STRETCH OF MUSCLES.
TSUNEO SAKAI, JAMES B. PRESTON, KENICHI UEMURA Dept. of Neurosurg., Hamamatsu Univ. Sch. of Med., Hamamatsu and Dept. of Physiol., SUNY Upstate Med. Ctr., Syracuse, N.Y., U.S.A.

One hundred forty-three units responding to muscle stretch of ankle extensor muscles were isolated from chloralose anesthetized baboons'(Papio papio) area 3a and motor cortex, and their response characteristics were examined by using ramp stretches of these muscles. Their response to antidromic stimulation of the corticospinal tract was also examined. None of area 3a neurons were CST(corticospinal tract) neurons. Among 83 motor cortex neurons, 37% were CST neurons. The discharge of some CST and non-CST neurons in the motor cortex reflected changes in both the rate and amplitude of muscle stretch. Other units responded only to changes in stretch amplitude. Such properties fulfil one requirement of a transcortical reflex;i.e., motor cortex output varies with changes in muscle spindle afferent input. These results emphasize the coupling of afferent input to motor cortex output.

119

A STUDY ON THE DURATION TIME IN CHEWING MOVEMENT, BEING CHANGED THE VERTICAL DIMENTION.

SAKAI, T., KONO, M. and KAMOGAWA, H. Dept. of Physiol., Chiyoda-ku, Tokyo

There are many recent studies of EMG to analyze the function of jaw movement. The authors recorded and analyzed the duration of the surface EMG waves and Tooth contact waves, using the method which was already demonstrated in their department. They also experimented to know the chewing movement, by fixing blocks of form different height(0, 5, 10, 15, 20mm) to the one side and the pre-molars and molars of the examinees.

The authors chose the left hand side of the Temporal muscle and Masseter muscle from elevators muscles; the left hand side of the Digastric muscle(ante.) from depressors muscles.

Three kinds of rhythm were observed in Vacant movement(60times/min., 90times/min., 120times/min.).

120

Tooth pulp neurons in marginal layer of trigeminal subnucleus caudalis.
NISHIKAWA, Y., OHNO, S. & KAKUDO, Y. Dept of Physiol., Osaka Dental Univ. Kyobashi, Higashi-ku, Osaka. YOKOTA, T. Dept of Physiol., Med. Coll. of Shiga, Seta, Otsu

Units responding to electrical stimulation of canine tooth pulp afferents were studied in urethan-chloralose anesthetized cats.

Tooth pulp units were obtained from the marginal layer of the ipsilateral trigeminal subnucleus caudalis. In the rostral part of the trigeminal subnucleus caudalis, more than 20% of marginal layer neurons were excited by tooth pulp stimulation. The same stimulation excited only few marginal layer neurons in the caudal part of this subnucleus.

These tooth pulp units responded to either mandibular or maxillary canine tooth pulp afferents. None of them were additionally excited by noxious mechanical stimulation of the trigeminal integument.

Tooth pulp units were incorporated in the general somatotopic pattern of the nociceptive representation within the marginal layer; The mandibular tooth pulp units were obtained from the dorsomedial part, while maxillary tooth pulp units were located next to it.

About 10% of them were antidromically invaded by impulses from the contralateral posterior thalamus.

121

MIDBRAIN NEURONS RELAYING OPTIC SIGNALS WHICH INDUCE MOSSY FIBER RESPONSE IN THE CEREBELLAR FLOCCULUS.
K. MAEKAWA, M. KIMURA. Dept. of Physiol., Jichi Med. Sch., Minamikawachi-machi, Tochigi-ken.

In the previous studies, the origin of mossy fiber (mf) afferents which convey optic signals to the flocculus has been identified as the nucleus reticularis tegmenti pontis (Nrt, Bechterew). HRP iontophoretically injected into the Nrt labelled cells mainly ipsilaterally in nucl. of optic tract (NOT), nucl. pretectalis anterior (PA) and the central portion of the mesencephalic reticular formation.

Stimulation threshold mapping in the pretectal area to induce mf responses in the contralateral flocculus showed the lowest threshold area in and around NOT and dorsal part of PA.

Single neuronal activities were extracellularly recorded in the pretectal area and cells in NOT were orthodromically activated from the ipsilateral optic tract (latency, 1.5-2.3 msec) and were antidromically invaded from the ipsilateral Nrt (latency, 0.8 -1.0 msec). The sum of these latencies well corresponded with the latency of Nrt neurons activated from the optic tract, if allowance was made for one more synaptic delay spent in the Nrt.

These findings suggested that the optic activities are transferred through NOT to Nrt and eventually activate the flocculus through mossy fiber afferents.

122

CENTRAL PATHWAYS OF THE GLOSSOPHARYNGEAL(IXth) NERVE FIBERS IN FROGS STUDIED BY HRP METHOD.
T. HANAMORI, N. ISHIKO. Dept. of Physiol., Miyazaki Med. Coll. Miyazaki

Retrograde transport of horseradish peroxidase(HRP) along the bullfrog IXth nerve was studied 6-16 days after application of HRP to cut end of either the IXth nerve trunk or its distal 2 branches. The ganglion and/or the lower brain tissue was removed after fixation and serial sections of 50um in thickness were stained by Graham and Karnovsky method. It was found that 62% of the cell bodies of the whole IXth nerve fibers were found to distribute within the IXth nerve ganglion, the remaining 38%, within the jugular ganglion. Similar distribution was found with the cells of each branch fibers. After entering the medulla oblongata, a part of the IXth nerve fibers ascended to the cerebellar peduncle while most of them descended into the fasciculus solitarius and ended in the dorsal field at the 3rd spinal nerve. Some other fibers run within descending tract of the Vth nerve. The majority of fibers descending in the fasciculus solitarius seemed to terminate on the 2nd order neurons at the area 1-1.5mm rostral to the obex.

123

PARASYMPATHETIC OCULOMOTOR NEURONS CONTROLLING LENS ACCOMMODATION IN THE CAT. T. BANDO, K. TSUKUDA, N. TSUKAHARA. Dept. of Biophysical Eng., Fac. Engineering Science, Osaka University, Toyonaka, Osaka.

We obtained a new evidence against the classical notion that parasympathetic oculomotor (POM) neurons are in the Edinger-Westphal (EW) nucleus. Microstimulation of the restricted region of the medial midbrain in the anesthetized cat evoked increased lens accommodation. Unit recording from this region by the same tungsten electrode used above was performed. Eighteen out of 81 units were identified as POM neurons controlling lens accommodation based on the following two criteria; 1) units were driven by stimulation of the posterior commissure and the interpositus nucleus of the cerebellum, both of which were the characteristics of the units and evoked potentials recorded in the ciliary ganglion and the accommodation responses measured by infrared optometer, 2) their discharges precede lens accommodation responses by about 200 msec. Twelve out of 18 identified units were found in the medial midbrain tegmentum and other six of them, in the central grey lateral to the EW nucleus. None of them was found in the EW nucleus.

124

MESENCEPHALIC INPUTS TO THE FACIAL NUCLEUS IN THE CAT. T. TANAKA, T. ASAHARA, Y. TAKEUCHI*, Dept. of Physiol., Sch. of Med., Mie Univ., Tsu, *Dept. of Oral Anat., Sch. of Dent., Hiroshima Univ., Hiroshima

Anatomical and electrophysiological techniques were employed to investigate the mesencephalic inputs to the facial nucleus in the cat. After injections of horseradish peroxidase (HRP) into the medial part of the facial nucleus, HRP-labeled neurons were abundant contralaterally around the dorsomedial border of the medial lemniscus (paralemniscal zone). Neurons are reactive also in the perioculomotor region bilaterally. Intracellular recordings were obtained from the facial motoneurons of origin of the posterior auricular branch of the facial nerve (PA neurons). Stimulation of the paralemniscal zone induced monosynaptic EPSPs (latency range 1.0-1.3 msec, mean 1.2 msec, N=20) in the PA neurons. Stimulation of the contralateral superior colliculus evoked polysynaptic EPSPs in the PA neurons. Stimulation of the perioculomotor region was also capable of inducing monosynaptic EPSPs (latency range 0.7-1.3 msec, mean 1.0 msec, N=21) in the PA neurons. Since the paralemniscal and perioculomotor regions receive tectal input, it is possible that the links described in this report may be utilized to elicit pinna orientation to sound.

125

Responses of interstitiospinal neurons to tectal, cortical and peripheral stimuli. Fukushima, K., Murakami, S., Ohno, M.& Kato, M. Dept. Physiol. Hokkaido Univ. Sch. Med. Sapporo, 060

Interstitiospinal fibers have direct synaptic connections with neck motoneurons, but not with motoneurons below the neck. Recently we showed that interstitiospinal neurons that project only to the neck region (N cells) and those projecting below the neck (D cells) differ in conduction velocities, in semicircular canal inputs and in vestibular branching. We have now studied responses to tectal, cortical and peripheral stimuli. Stimulation of the deep layers of the contralateral superior colliculus produced firing of less than 10 % of neurons studied (n=57). Ipsilateral stimulation evoked firing of about 23 % of neurons (n=42). Thresholds of activation for contralateral and ipsilateral stimulation were high in intermediate tectal layers and declined as the electrodes entered in the deep fiber layer and underlying tegmentum, suggesting that the origin of evoked activity was in the tegmentum. Stimulation of the pericruciate cortex excited 37 % of cells ipsilaterally and 19 % contralaterally (n=74). Stimulation of the muscle nerves innervating biventer of the C2 segment excited about 14 % of cells bilaterally (n=61). There was no difference in responses of N and D cells to stimulation of the pericruciate cortex, tegmentum and C2 biventer nerves.

126

NEURONS IN THE TRIGEMINAL SENSORY NUCLEI SENDING AXONS TO NECK MOTONEURONS IN CATS.
SUMINO, R., KATO, M., Sec. Physiol., Inst. Stomatognathic Sci., Sch. Dent., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo.

Previous studies have shown that the trigemino-neck reflex (TNR), induced by mechanical stimulation of the face was abolished by transection of the lateral one third of the brainstem at the level of the obex, indicating that neurons in the trigeminal sensory nuclei are involved in induction of TNR. Some mechanically induced neurons in the caudal and rostral parts of the trigeminal spinal tract nucleus, which were activated orthodromically with latencies of 3.3 and 2.8 msec by electrical stimulation of the face, were also activated antidromically with 0.8 and 1.2 msec, respectively, by selective electrical stimulation of the C_2 motoneuron pool. Sum of ortho- and anti-dromical latencies of the caudal and rostral neurons were 0.4 and 0.5 msec shorter than mean latency of EPSP in the C_2 motoneurons following electrical facial stimulation (4.5 msec). By FCF fast green, these neurons were found to be localized in laminae IV and V of the subnucleus caudalis, the rostral part of the subnucleus oralis and the main sensory nucleus. Neurons of 25-40 μm in diameter in the same areas were marked by HRP injected into the C_2 motoneuron pool. It was, therefore, assumed that mechanically activated neurons in the subnucleus caudalis, the rostral part of the subnucleus oralis and the main sensory nucleus projected mono-synaptically to neck motoneurons.

127

NECK MUSCLE AFFERENT PROJECTION ONTO TRIGEMINAL SUBNUCLEUS CAUDALIS.
YOKOTA, T. Dept. of Physiol., Med. Coll. of Shiga, Seta, Otsu 520-21

Projection of neck muscle afferents onto the medulla oblongata caudal to the obex were studied in urethan-chloralose anesthetized cats.

Units responding to electrical stimulation of low threshold neck muscle afferents were obtained from the lateral part of the cuneate nucleus and the junction between this nucleus and the trigeminal subnucleus caudalis.

Electrical stimulation of high threshold neck muscle afferents excited wide dynamic range neurons in the neck area of the trigeminal subnucleus caudalis, and neurons in subnucleus reticularis ventralis.

Neurons in subnucleus reticularis ventralis were additionally excited by mechanical stimulation of the ipsi- or bilateral cornea. Many of them were also excited by electrical stimulation of bilateral canine tooth pulp afferents and by pinching the bilateral pinnae. Some of them were antidromically invaded by impulses from the contralateral posterior thalamus.

128

VESTIBULAR INPUTS TO SPINOCEREBELLAR TRACT CELLS OF THE CENTRAL CERVICAL NUCLEUS IN THE CAT.
N. HIRAI*, T. HONGO, S. SASAKI, K. YOSHIDA.
Dept. of Physiol., Institute of Basic Med. Sci., Univ. of Tsukuba and *Dept. of Physiol., Kyorin Univ. Sch. Med.

The pathway and the pattern of labyrinthine effects on spinocerebellar tract neurones in the central cervical nucleus (CCN) were investigated in cats anesthetized with Nembutal. CCN neurones were excited from the contralateral VIIIth nerve and often inhibited from the ipsilateral VIIIth nerve. Stimulation of individual canal nerves showed that these effects derived from the vertical but not from the horizontal canal. Each cell received the contralateral excitation from either the anterior or posterior canal, and the ipsilateral inhibition, when present, from a canal that was plane-specific to the canal of excitatory input. Both lesion and stimulation experiments of the brain stem agreed in that the labyrinthine effects were mediated by fibres descending in the medial longitudinal fasciculus. It was further indicated that vestibulospinal tract fibres could evoke direct effects on CCN cells but predominant excitatory effects were mediated by additional neurones which probably were in the spinal cord.

129

INTERACTION OF VESTIBULAR AND NECK AFFERENTS IN VESTIBULOSPINAL TRACT NEURONS. N.HIRAI*, E.BRINK, V.J.WILSON. The Rockefeller University and *Department of Physiology, School of Medicine.

To study a possible site of interaction of vestibular and neck afferents, we have recorded extracellularly from vestibulospinal tract(VST) neurons in the descending and Deiters' nucleus of decerebrate and decerebellate cats, while stimulating the C2 ganglion and dorsal rami bilaterally. Many VST neurons were excited by stimulation of the contralateral C2 ganglion with latency of less than 6ms(early excitation). Early excitation could be followed by late excitation, which was sometimes the only effect seen. In some neurons, inhibition was initial effect. Early excitation was due to proximal, perhaps joint area, afferent because stimulation of the dorsal rami usually caused lated exciation, but some contribution of muscle afferent was seen. Both early and late excitation were seen in lateral and medial VST neurons. In many cases the same neurons were excited from both contralateral C2 ganglion and vestibular nerve. The results show that interaction of reflexes evoked by neck and vestibular afferents and acting on, probably, neck and limbs may take place in the vestibular nuclei.

130

CAT MEDIAL PONTINE RETICULAR NEURONS RELATED TO VESTIBULAR NYSTAGMUS: FIRING PATTERN, LOCATION AND PROJECTION. S. NAKAO. Dept. of Physiol., Tottori Univ. Sch. of Med., Yonago. C. H. Markham. Dept. of Neurol., UCLA Sch. of Med., Los Angeles.

Extracellular spikes of neurons in the medial pontine tegmentum were recorded during rotationally-elicited horizontal vestibular nystagmus in alert cats under local anesthesia. Nystagmus-related neurons were classified by their firing patterns into five main categories: long-lead burst neurons, medium-lead unidirectional burst neurons, medium-lead bidirectional burst neurons, burst-tonic neurons and pause neurons (PNs). Burst neurons tended to be distributed in and around the gigantocellular tegmental field, nucleus raphe pontis and nucleus reticularis tegmenti pontis. Most burst-tonic neurons were found on the ventrolateral border of the MLF. PNs typically clustered in the nucleus raphe pontis. The causal relationship was studied between PNs and inhibitory reticular burst neurons (IBNs) known to directly inhibit abducens motoneurons (Hikosaka & Kawakami, 1977). PNs were antidromically activated from the IBN area, while monosynaptic IPSPs were induced in IBNs by PN area stimulation. This suggests IBNs are under a direct inhibitory control of PNs.

131

AN ANALYSIS OF NEURONAL CONNECTIONS IN THE MOTOR CORTEX OF THE CAT BY THE CROSS-CORRELATION METHOD. K. ENDO AND T. ARAKI Dept. of Physiol., Fac. of Med., Kyoto Univ., Sakyo-ku, Kyoto 606

Cross-correlation analyses of spontaneous impulse discharges were performed with simultaneous recording from two cortical neurons including pyramidal tract (PT) cells and interneurons in the motor cortex of the cat, and excitatory and inhibitory neurons were identified. PT cells were found to be excitatory to cortical neurons which received monosynaptic inputs from axon collaterals of PT cells. Polysynaptic recurrent facilitatory pathways were also found. Interneurons, monosynaptically excitatory and inhibitory to PT cells or interneurons, were identified and the input to excitatory and inhibitory interneurons were examined. The existence of more than 10 kinds of interneurons was suggested on the basis of their inputs, outputs and locations in the cortical layer. Some interneurons, which were located in the superficial cortical layer and monosynaptically excitatory to PT cells, were found to receive monosynaptic excitatory inputs from thalamic nonspecific nuclei and association fibers. Interneurons which were suggested to be Martinotti cells were also found. They were located in the deep layer and had monosynaptically excitatory action on interneurons in the superficial layer. The horizontal extent of influences of PT cells and that of interneurons were found to be restricted within diameters of 4000 μm and 400 μm respectively.

132

DUAL PATHWAYS MEDIATING MAMMILLARY BODY RESPONSES TO FORNICAL AND SEPTAL STIMULATION.

KOBAYASHI,N. Dept. of Radiological Technol., Kanazawa Univ., Sch. of Paramed., Kanazawa.

A single shock to the body of the fornix or septum elicited three positive waves (wave 1, 2, and 3) in the mammillary body (MB) of the cat anesthetized with Nembutal. Stimulation of column of the fornix (postcommissural fornix) evoked only waves 1 and 2 in the MB. Electrolytic lesion of the column and adjacent tissue resulted in a marked decrease in the amplitude of wave 2, while that of wave 3 remained unaffected. Stimulation of the stria medullaris (SM) induced a wave similar to wave 3. A knife cut through dorsal thalamus including the SM abolished wave 3, while it was without effects on wave 2. From these observations, it was concluded that wave 2 was induced mainly via column of the fornix and wave 3, via the SM.

133

NEURONAL MECHANISMS IN RELEASING THE UROPOD STEERING MOVEMENT IN CRAYFISH.

M. Takahata, M. Hisada. Zool. Instit., Fac. of Science, Hokkaido Univ., Sapporo

Synaptic connections between statocyst-driven interneurons and uropod motoneurons were investigated. Each spike in the interneuron evoked a subthreshold e.p.s.p. in the motoneuron. The short synaptic delay (< 3ms) indicated that the interneuron activates the motoneuron monosynaptically. An electrical shock applied to one statocyst activated two ipsilateral interneurons which responded with several spikes, and thus caused a subthreshold compound e.p.s.p. in the motoneuron. Spike intervals in the interneuron activity in this stimulation experiment were 2-5ms, and were much shorter than those in rolling experiment. This indicates that interneuron activities to body roll can not evoke by themselves any spike in motoneurons. This conclusion is compatible with our previous finding that the interneurons can initiate the uropod movement only while the abdomen is actively extended or bent. It seems that this collaboration of interneurons with abdominal posture system is based on a heterosynaptic facilitatory process, rather than a disinhibitory one, between the p.s.p.s evoked by the interneurons and the abdominal posture system.

134

RESPONSES OF AFFERENTS FROM THE STRETCH RECEPTORS IN CAT MASSETER MUSCLE.

H. INOUYE, I. SAKAN and T. MORIMOTO. Dep. of Oral Physiol., Osaka Univ. Dental Sch., Osaka.

The responses of 130 neurons in the trigeminal mesencephalic nucleus which responded to stretch a masseter muscle were recorded in a decerebrated and decerebellated cat under artificial respiration. The conduction velocity of the afferents ranged from 15 m/sec to 70 m/sec, showing bimodal distribution. However, the afferents with velocity of 40-70 m/sec were more frequently recognized than those with velocity of 15-40 m/sec. The afferents conducting at above 55 m/sec showed larger dynamic response and greater velocity sensitivity to ramp stretch of the muscle and also higher ability to follow vibratory stimulus up to 430 Hz than those conducting at below 55 m/sec. The dynamic and/or static response of these afferents were increased by Sch administration (200 μg/kg,i.v.). On the other hand, the afferents conducting at below 40 m/sec showed small dynamic response and velocity sensitivity to ramp stretch and also were relatively insensitive to vibratory stimulus and Sch injection. The former and the latter responses were similar to those of classical primary and secondary endings of cat's hindlimb muscles, respectively. The afferents with velocity of 40-55 m/sec showed intermediate pattern of response to ramp stretch between above two types of response.

135

SUPPRESSION OF JAW OPENING REFLEX INDUCED BY RAT RAPHE STIMULATION.

H.TANAKA, K.TODA*, A.IRIKI*, M.ICHIOKA*. Dept. of Anes., Fac. Med., *Dept. of Physiol. Fac. Dent., Tokyo Med. & Dent. Univ., Tokyo, 113 Japan.

Effects of raphe stimulation on the rat jaw opening reflex evoked by electrical stimuli applied to the tooth pulp were investigated using Wistar albino rats. Conditioning stimulus of single pulse (0.1 ms-duration, 20-60 μA) applied to the ipsilateral raphe (median nuclei) suppressed the jaw opening reflex in amplitude to about 30% of the control, and that applied to contralateral one to 50% of the control at its maximum , respectively, which appeared at conditioning-test interval of 25 to 50 ms. This suppression was not antagonized by naloxone 1.0 mg/kg i.p. On the other hand, raphe stimulation by repeated rectanglar pulses (0.1 ms-duration, 50 Hz) for 1 min suppressed the reflex to about 30% of the control ipsilaterally and about 40% contralaterally 1 or 2 min after the cessation of the stimulation. And depressant jaw opening reflex returned to the control at about 30 min after. This suppression was partially antagonized by naloxone (1.0 mg/kg). It is concluded that the suppressive effect of the raphe stimulation is produced by short-term neural mechanism and by long-term neurohumoral one which may partially relate to endorphinergic system.

136

COEFFICIENT OF TREND ON SPONTANEOUS SINGLE UNITS DISCHARGE IN THE VENTROBASAL COMPLEX.

AIKAWA, S., AKITA, H., OHTA, K., AOKI,K., SATO, A., KOBAYASHI, S.* Dept.of Physiol. Sch.of Hygenic Sciences Kitasato Univ., Sagamihara-city, Kanagawa. Dept. of Neurophysiol. Seishin-Igaku Inst., Itabashi-ku, Tokyo.*

Recording of spontaneous single units discharge within the ventrobasal complex (VBC) of thalamus was done through extracellular microelectrode for 30 minutes or more.
Numbers of impulses counted for one minute showed stability coefficient in 54.4% of the all. The other showed exponential coefficient of trend such as increase and decrease, the former was 7.4%, the latter was 38.2%.
This distribution was similar to simultaneous recording of single units discharges using of multi-microelectrode technique.
It has no relationship between the coefficient trends and location of receptive field or modality. Extracellular recording showed positive-negative and negative spike, that trend was not bringing on a change.
These coefficient trends may suggest; 1) the relationship of distance between microelectrodes' tip and neurons; 2) the influence of distruction of neurons; 3) the physiological phenomena.
It is necessary to consider the quantitative analysing of spontaneous discharge.

137

RHYTHMICAL BURST ACTIVITY IN BULBAR RETICULAR NEURONS RELATED TO ORBITAL CORTICALLY INDUCED MASTICATORY RHYTHM IN IMMOBILIZED CATS.

S. ENOMOTO, M. KATO, Y. NAKAMURA. Sec. Physiol., Inst. Stomatognathic Sci., Tokyo Med. Dent. Univ., Bunkyo-ku, Tokyo

Repetitive stimulation of the orbital gyrus of immobilized cats induced a rhythmical efferent burst discharge in the nerves innervating masticatory muscles, a rhythmical positive-negative field potential in the jaw closer motoneuron pool and a rhythmical IPSP-EPSP sequence in jaw closer motoneurons, corresponding to rhythmical alternation of jaw opening and closing resembling the masticatory movement evoked before immobilization. The medial bulbar reticular neurons were found which responded with short-latency spike potentials to single or a short train of pulses applied to the orbital gyrus and showed a rhythmical burst activity with the same rhythm as the field potential evoked in the jaw closer motoneuron pool during repetitive orbital cortical stimulation. By the spike-triggered averaging technique, a decrease was revealed in the spontaneous efferent discharge in the nerves innervating jaw closer muscles with a latency of monosynaptic range after spontaneous spike potentials of some of these bulbar reticular neurons, suggesting that they were inhibitory neurons directly projecting to jaw closer motoneurons. It was concluded that these bulbar reticular neurons were involved in the generation of the rhythmical IPSP in jaw closer motoneurons during orbital cortically induced masticatory rhythm in cats.

138

SPECIFIC UNIT ACTIVITY IN THE DIAFFERENTED HIPOTHALAMIC ISLAND

H. SAITO, M. FUJITA, A. USHIKOSHI, K. SETO, M. KAWAKAMI. Dept. of Physiol., Kochi Medical School, Nankoku

Unit activity in the deafferented hypothalamus(Hyp) was recorded long termly, being compred with that in the intact one. Nerual activity of the Hyp showed palsatile peaks of frequency that revieled periodically with 20 to 40 min. Diafferentation of the nerve projection to the Hyp cause the activity of most neurones in the island to be arhythomic and fluctuateless in rate of successive 30 sec. Inter-spike interval distributions from Hyp units over 1 min period dureing low or high frequency stage showed Γ(-like)-distribution either in the Hyp diafferented rat or in the intact one. However, three neurones out of twenty in the island demonstrated defferent patterns; one neurone having a mean duration of firing train of 10 min with a mean frequency of 30 to 60 spikes per 30 sec., an intermittent of 10 to 15 min, an inter-spike-interval of Γ-like distribution .; Another two neurones having a palsatile peaks of firing rate ofevery 40 min without a long period ofinterruption. More over, three monthes after diafferentation of Hyp, the number of neurones above mentioned were augumented. These results suggest that Hyp neurone has not only autonomic firing potenciality but also has a rhythomic activity of fluctuation in rate of firing activity existing within the neurone itself or the connecting system between the neurones in the Hyp.

139

THE REFLEX RESPONSE OF SALIVARY SINGLE NEURON IN CAT.

MURAKAMI,T.,YOSHIHARA,M.,NAKASHIZU,Y. and ISHIZUKA,K., Dept. of Oral Physiol., Nippon Dental Univ.,Niigata, Niigata

This study was undertaken to determine accurate portion of salivary nucleus by using electrophysiological technique and to clarify sensory input from oral region to these salivary neurons. The experiments were carried out on urethane-chloralose anesthetized cats. A total of 77 salivatory single neurons were identified by antidoromic stimulation of corda tympani. These neurons were recorded in the ipsilateral portion of lateral reticular formation of ventral portion of vestibular nucleus and dorsal portion of facial nucleus. The latency of neuronal responses were ranged 2.5-8 msec. The 79% of the identified neurons responded by stimulation of ipsilateral lingual nerve. The shortest latency of these responses was about 4.2 msec. The all neurons responded by stimulation of lingual nerve responded by stimulation of ipsilateral trigeminal ganglion. We could record only 3 neurons responded by contralateral trigeminal ganglion. The identified neurons did not show the spontaneous activity.

140

RELATIONS BETWEEN LATERAL HYPOTHALAMIC NEURON ACTIVITY AND FEEDING BEHAVIOR IN CHRONIC RATS.

K. SASAKI, M. FUKUDA, K. MURAMOTO, H. NISHINO and T. ONO, Department of Physiology, Faculty of Medicine, Toyama Medical and Pharmaceutical University, Toyama 930-01.

Relations between long-term single neuron activity recorded from lateral hypothalamic area (LHA) and feeding behavior were investigated. Single neuron activity was recorded for more than 1 day from 7 teflon insulated platinum-iridium wires which were chronically implanted in the LHA. The neuron activity was divided into 4 types according to its relation to feeding. Type I-A activity was tonic and increased during the dark period. Type I-B activity stopped transiently, for a few minutes, when light was turned off at 18:00, and increased when light was turned on at 6:00. Type II activity increased prior to and during feeding behavior in the dark period. Type III activity was completely inhibited for a few seconds when the animal took the food in its mouth. Type IV activity was suppressed following the transient excitation after taking the food. It also increased during spontaneous neck or mouth movement. The above data suggest that feeding behavior could depend on interaction of these 4 neuron types. Light-dark condition is first indicated by Type I-B which synchronizes Type I-A to the circadian rhythm. Circadian activity (Type I-A) modulates Type II in the dark period. When Type II activity increases, feeding occurs. Feeding is monitored by Type III which affects actual feeding behavior through Type IV.

141

MONKEY ORBITOFRONTAL CORTEX ACTIVITY IN HIGH FIXED RATIO (FR) SCHEDULES FOR FOOD INTAKE

OOMURA,Y., SHIMIZU, N., KITA, H., ISHIZUKA, S., AOU,S., YOSHIMATSU, H.,& YAMABE, K.,
Dept. of Physiol. Fac. Med. Kyushu Univ. 60, Fukuoka,812

In a continuous reinforcement bar press schedule for food, single neuron activity in the orbitofrontal cortex (OBF) correlated closely with activity in the lateral hypothalamus (LHA). OBF neuron activity pattern was similar in timing but inverse to LHA response. In high FR schedules, LHA activity increased during a series of bar presses but decreased just before reinforcement. If FR was increased from 10 to 40 activity still showed depressions at intervals of 10, perhaps indicating anticipation of reward. OBF activity had two types of neuron response patterns: A type (orthodromically driven by amygdala stimulation): B type (anti-and orthodromically driven by LHA stimulation) A type had a middle peak in a series of bar presses then declined to post reinforcement. B type was high just before and at beginning of trial and high at reinforcement period. After changing the schedule from FR 30 to 50 B type exhibited substantial activity increase near the completion of first 30 bar presses. The evidence indicates OBF anticipation of reward and a close functional link between OBF and LHA in food intake task.

142

NEUROCHEMICAL STUDIES ON THE DEVELOPMENT OF THE CEREBELLUM FROM REELER MUTANT MICE. K. MIKOSHIBA, K. NAGAIKE, S. KOHSAKA, K. TAKAMATSU and Y. TSUKADA. Dept. of Physiol., Keio Univ. School of Med. Shinjuku-ku, Tokyo

Reeler mutation is characterized by the abnormal position of Purkinje cells below the granular cells in the cerebellum. The time schedule for the proliferation and the migration of granule cells to the inner granule layer in the reeler shows no significant difference from the control. SDS-polyacrylamide gel electrophoresis revealed that all cerebellar proteins which increase during development are found in the same amounts in reeler and the control. Immunohistochemical methods using antisera against S-100 and GFA proteins reveal that most of the Bergmann cells are scattered around the molecular and granular layers. High CNPase activity in the reeler cerebellum was suggested to be due to a decrease in granule cells. In the reeler, incorporation of 2-deoxyglucose was found not only in the granular layer but also in the white matter, while little was incorporated in the white matter in the control. The primary cultures from the reeler cerebellum were generally comparable to those of the control, except for the lack of laminar structure.

143

AFFERENT PROJECTION FROM THE NUCLEUS RETICULARIS TEGMENTI PONTIS TO THE CEREBELLAR FLOCCULUS RELEVANT TO OPTOKINETIC RESPONSE IN CATS.
KAWASAKI, T., SATO, Y. AND *KATO, I., Dept. of Physiol., Fac. of Med., Toyama Med. & Pharm. Univ., Sugitani, Toyama and *Dept. of Otolaryngol., Sch. of Med., Yamgata Univ., Zao-iida, Yamagata.

Horseradish peroxidase was injected iontophoretically into the cerebellar flocculus, in order to identify the origin of the mossy fiber projections to the flocculus. Labeled neurons were surveyed through the contralateral inferior olive to the injection site, the bilateral vestibular nuclei, the bilateral raphe nuclei, the ipsilateral lateral reticular nuçleus, the bilateral perihypoglossal nuclei and the bilateral nucleus reticularis tegmenti pontis (NRT).

Electrical stimulation of NRT evoked the mossy fiber responses in the contralateral flocculus to the stimulating site. The threshold current necessary to evoke the responses was lower than 100 uA in the area of NRT. Destruction of NRT revealed an abnormal optokinetic preponderance to the ipsilateral direction to the lesion site and loss of visual suppression of caloric nystagmus to the contralateral direction to the lesion site, suggesting the existence of the projection to the flocculus cinveying neuronal information relevant to visually induced eye movements.

144

DERIVATIVE ACTION OF THE DENTATE NEURON IN CATS
YAMAMOTO, KEN-ICHI and ODAGIRI, MEGUMI. Div. of Neurophysiol., Psychiatric Research Institute of Tokyo, 2-1-8, Kamikitazawa, Setagaya-ku, Tokyo

Three cats were trained to perform an isometric stepwise muscle contraction with a lever, and the neuronal activities of cerebellar nuclei were recorded. Histological identification revealed that firing rate of the interpositus neuron changed in proportion to the exerted force, whereas that of the dentate neuron increased or decreased with relation to the rate of force change.

145

THE EFFECTS OF CEREBELLAR SURFACE STIMULATION UPON FASTIGIAL NEURONS.
Hamamatsu Medical Univ; Tetsuo Yokoyama, Kenichi Uemura.
University of Michigan; George W.Dauth, Sid Gilman.

Chronic stimulation of the cerebellar surface has been used in humans with movement disorder or with intractable seizure. In this study we stimulated the posterior cerebellar surface and recorded extracellularly the unitary activity of fastigial neurons in lightly anesthetized cats. Three stimulus frequencies were used:0.3Hz,I0Hz and 40mSec trains of 200 Hz presented every 3 sec for 64 trains. Monophasic I.5mA,0.5mSec squre wave pulses were delivered through bipolar platinum disk electrodes. The predominat response of 68 units was an initial suppression and subsequent activation. Median duration of suppression and activation were: 200Hz(I06.2mSec,204.5mSec);0.3Hz(69.5mSec,I04.5mSec);I0Hz(44.5mSec,36.5 mSec). These results suggest that continuous high frequency stimulation (200Hz) reduces the excitatory output from fastigial neurons but low frequncy stimulation(I0Hz) first decrease then increase the output.

146

SPINDLE-LIKE POSITIVE WAVES IN THE CEREBELLAR CORTEX OF THE CAT. T. SHIMONO, K. HATADA*, A. OZAKI & Y. MIMORI**. Dept. of Physiol. and Dept. of Physiol., Inst. for Brain Res.*, Dept. of Geriat.**, Fac. of Med., Kyoto Univ., Kyoto

Electrical activities of the cerebellar cortex were examined in relation to electrocorticogram in lightly nembutalized cats. They revealed sporadically spindle-like positive waves with slow rhythm (6-10/sec) and with high voltage potentials. The waves were recorded mainly from the intermediate part of the cerebellum and appeared to be coincident with the spindle waves of the electrocorticogram. The waves disappeared when the contralateral motor cortex was ablated. The superficial positivity of the waves reversed to be negative at around the depth of 200 μm from the cerebellar surface. Neuronal units of the cerebellar cortex fired in synchronization with the positive waves. These facts indicated that the waves are truly generated in the cerebellar cortex and are induced due to the spindle waves of the contralateral motor cortex. The pathway responsible for the waves was studied by ablation of the contralateral inferior olive or the ipsilateral inferior cerebellar peduncle to the recording side of the cerebellum. Disappearance of the waves after such ablation might indicate that the waves are mediated in a part by the climbing fibre pathway.

147

INPUT DUALITY OF CEREBELLAR CORTEX AND UNGRADABILITY OF PURKINJE CELL RESPONSE. H. TAKAHIRA. Dept. of Physiol., Tokai Univ. School of Med, Bohseidai, Isehara, 259-11

The duality of extrinsic input to cerebellar cortex, MF and CF, are well known. Further, the duality of responses of cerebellar cortex in evoked potentials; SL and LL of Jansen, Jr. (1957) and in single P-cells; 'simple' and 'complex' spikes of Thach, (1967), has been well documented. The electrophysiological dualities were attributed to the structural input duality (Oscarsson, 1973 and Crill, 1979), as if the CF input were responsible for ungradable 'complex spike response' and the MF input were for gradable 'simple spike response'. I reported last year (J. Physiol. Soc. Japan 41: 319) that all of the responses of P-cells was ungradable by white matter stimulation. In the present experiments, the peripheral nerves in forelimb of cats were stimulated and the responses of single P-cells and MF were recorded with microelectrodes. The MF response was graded by grading the peripheral nerve stimulation. The P-cell responses were not directly graded by peripheral stimulation, however, it was multiplied at the time of arrival of repetitive MF volley, depending upon the on-going activity of those P-cells.

148

MORPHOLOGY OF PHYSIOLOGICALLY IDENTIFIED MONKEY PYRAMIDAL TRACT NEURONS.
HAMADA,I. and SAKAI,M. Dept. Neurophysiol., Primate Res. Inst., Kyoto Univ., Inuyama City, Aichi, 484.

Fast and Slow pyramidal tract neurons (PTNs) of the monkey motor cortex were stained intracellularly with HRP. PTNs were identified by their antidromic spike potentials to the medullary pyramid stimulation, and injected with 4% HRP from a recording glass microelectrode(20-50MΩ) by pressure. Three fast PTNs and 3 slow PTNs(antidromic latency, more than 2.0 ms) were successfully stained. They were all located in layer V. Fast PTNs had large soma(1000μm^2) and two to three long(1000μm) and thick(5μm) spine-rare dendrites. On the other hand, slow PTNs had small soma(200-800μm^2) and spine-rich thinner dendrites. Axons of both fast and slow PTNs showed a similar branching pattern within layers V and VI, spreading about 300μm. Some secondary collaterals extended tangentially more than 2000μm. Averaged diameter of main axon within 500μm from soma was 2.1-5.2μm for fast PTNs and 1.4-2.6μm for slow PTNs. These features are not different from those reported on cat pyramidal tract neurons.

149

PREFRONTAL NEURON ACTIVITIES DURING SPATIAL DELAYED RESPONSE AND COLOR DISCRIMINATION WITH DELAY.
S. FUNAHASHI and K. KUBOTA, Dept. of Neurophysiol., Primate Res. Inst., Kyoto Univ., Inuyama City, Aichi, 484.

Neuron activities of the prefrontal cortex were compared between two-choice delayed response with spatial cues (right or left) and two-choice discrimination with color cues (green or red). In these tasks, after cue (0.5sec) and delay (2.5sec), GO signal appeared. Monkey flexed or extended the wrist according to the cue location or color. A total of 21 neurons was examined in 2 rhesus monkeys. All neurons were activated after GO signal uni- or bi-directionally in association with the movement. Their activities were not different each other in two tasks. Five were activated by spatial and color cues. Activations of 4 neurons were not differential to any of cue stimuli, but only in one the activation was differential to spatial cues. Nineteen showed gradually increasing activities during later phases of two tasks. As far as the movement-coupled activity was concerned, no difference was found. Visual activation showed a minor difference which would agree with a notion that the PF neurons were more concerned with the delayed response than with the color discrimination.

150

NEURONAL ACTIVITY IN THE HINDLIMB AREA OF THE SUPPLEMENTARY MOTOR CORTEX.
TANJI, J. Dept. of Physiol., Hokkaido Univ. Sch. Med. Sapporo, 060.

In order to delineate the hindlimb representation areas and to ascertain the relative responsiveness of the supplementary motor cortex (MII) and the precentral motor cortex (MI) to a controlled peripheral stimulus, single unit recording and intracortical microstimulation techniques have been employed in awake monkeys.

The hindlimb representation of MII and the tail representation of MI appear to be considerably further rostral than depicted in the classical maps. This finding serves to resolve a discrepancy between the classical physiological and cytoarchitectonic maps for this region of cortex.

Only 10 % of neurons in MII as against 82 % in MI responded to the peripheral sensory stimulus. Quantitative analysis revealed that the response magnitude of MII neurons was much less than that of MI neurons.

151

COMPARISON OF THE CORTICAL POTENTIALS PRECEDING SELF-PACED AND VISUALLY TRIGGERED HAND MOVEMENTS IN MONKEYS. HISAE GEMBA, SHUJI HASHIMOTO and KAZUO SASAKI Dept. of Physiol., Inst. Brain Res., Fac. Med., Kyoto Univ., Kyoto

Recording electrodes were chronically implanted on the surface and in the depth of the premotor cortex and the forelimb areas of motor and somatosensory cortices of monkeys, and potential changes prior to self-paced (s-p) and visually triggered (v-t) hand movements elevating a lever were led and analysed with electronic averaging method. Monkeys performing the s-p movement revealed slowly increasing, surface negative - depth positive potentials in these cortices on the contralateral side to the moving hand, which were interpreted to be composed mainly of EPSP currents in the cortical pyramidal neurones through superficial thalamo-cortical (T-C) projections (1). Monkeys of v-t movements showed early surface positive - depth negative responses about 40 ms after a light stimulus in the premotor and motor cortices on bilateral sides and following surface negative - depth positive responses in the motor cortex on the contralateral side to the moving hand. The early responses may possibly be induced via cortico-cortical and/or deep T-C projections whereas the following responses via superficial T-C projections according to our previous acute experiments in monkeys (2). It is suggested that neuronal mechanisms preparing these cortices for v-t movements are different from those for s-p movements. (1) Exp.Neurol., 65,218 (79'). (2) Appl.Neurophysiol., 39,239 (76-7').

152

POSTNATAL DEVELOPMENT OF EVOKED RESPONSES IN SOMATOSENSORY, VISUAL AND AUDITORY CORTEX OF THE CAT. S. KAWAGUCHI, T. YAMAMOTO*, A. SAMEJIMA, and H. MIYATA**. Dept. of Physiol., Inst. for Brain Res., Fac. of Med., Kyoto Univ., Kyoto, *Dept. of Physiol., Med. Sch., Mie Univ., Tsu, **Dept. of Hygiene, Wakayama Med. Coll., Wakayama

Ontogenesis of the thalamocortical projection was investigated in the cat by laminar field potential analysis of evoked responses in the somatosensory, visual and auditory cortex. Each sensory area exhibited characteristic features, nevertheless, the general configuration of responses was similar. As are well known, responses in adult cats were a diphasic positive-negative wave in the superficial cortical layers and a negative-positive wave in the deeper cortical layers. By contrast, responses in neonatal animals were negative in the superficial cortical layers and positive in the deeper cortical layers (sN-dP wave). In the early postnatal period, there appeared a potential deflection preceding the sN-dP wave, which was positive in the superficial cortical layers and negative in the deeper cortical layers (sP-dN wave). As animals grew older, the sP-dN wave progressively dominated over the sN-dP wave to become an adult-like configuration in 2 to 3 weeks after birth. The two types of wave components in the evoked response are presumably mediated by two different types of thalamocortical projections since the sN-dP wave could be separable from the preceding sP-dN wave on the basis of different time course of recovery on double shock stimulation.

153

DISFACILITATION IN PYRAMIDAL CELLS OF RABBIT HIPPOCAMPUS. FUJITA, YASUICHIRO. Dept. of Physiol., Nippon Med. School, 1-1-5, Sendagi, Bunkyo-ku, Tokyo.

Fornix stimulation induced a dendritic hyperpolarization in pyramidal cells (Brain Research 175 (1979) 59-69). On the other hand, a spontaneous dendritic hyperpolarization occurred in the hippocampus which was chronically stimulated through implanted electrodes (Neuroscience Letters, Suppl. 2, S46). It was as a rule observed that during the fornix-induced and the spontaneous dendritic hyperpolarizations, depolarizing wavelets were depressed. This phenomenon was observed with both KCl and K-citrate electrodes. Two explanations were possible. One was disfacilitation, i.e., the inhibition of the excitatory interneuron which exerted a tonic depolarizing effect upon the pyramidal cell dendrites. The other was the inhibition of the dendritic potentials by the dendritic inhibitory postsynaptic potential (IPSP). Despite differences in the intrinsic connections according to the location of pyramidal cells, i.e., CA1 - CA4, the suppression of the depolarizing wavelets occurred regardless of the difference in the locations of pyramidal cells. Consequently, the second explanation was favored. Furthermore, in terms of the membrane potential of the cell body, the inhibition of the dendritic potentials by the dendritic IPSP is also a kind of disfacilitation. If this is the case, the dendrites become tantamount in function to the excitatory interneuron.

154

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

Responses of single neurons in the anterior suprasylvian gyrus(ASSG) were analyzed using the electrical stimulation of the horizontal (HC) and the anterior (AC) canal nerves of both sides in the cat under light Nembutal anesthesia. The direction of the ocular deviation was observed, delivering the electrical pulses of 60 Hz, in order to confirm that unwanted branches of the canal nerves were not activated by spread of the stimulus current. The results with the contralateral HC stimulation indicated: 1) Type E (activated) neurons clustered deeper than the layer III of the ventral part of the ASSG, 2) the area where type I (inhibited) neurons were predominant overlay and, in a band-like configuration, surrounded the cruster. With the ipsilateral HC and AC stimulations, a similar organization was obtained. No differences were found in the latencies of the type E responses between ipsi- and contralateral stimulations. The latencies ranged from 5 (at shortest) to 10 msec in the majority of cases.

155

COUPLING AMONG ELECTROCORTICOGRAM, CORTICAL BLOOD FLOW AND CEREBRAL METABOLISM DURING LIDOCAINE SEIZURE. K. SHIMOJI, M. MATSUKI, M. HASHIBA & M. MARUYAMA. Dept. of Anesthesiol., Niigata Univ. Sch. Med., Asahi-machi 1, Niigata, 951

The relationship between electrical activities and regional blood flow has been extensively studied in animals and man. However, sequential and quantitative analyses have not been well documented due to technical difficulties. Here we report the sequential and quantitative relations among seizure activity, cortical blood flow (CBF) and cerebral metabolic rate of oxygen ($CMRo_2$), applying the simultaneous recordings of electrocorticogram, saggital sinus blood flow in dogs. CBF started to increase synchronous with the start of seizure activities. The amount of increase in CBF correlated with the duration of seizure activities. CBF/$CMRo_2$ (cerebral circulatory index) increased during seizures as compared to that before seizures. When halothane anesthesia was deepened (from 0.3 to 0.6 volume per cent, endtidal) or hypercapnia ($Paco_2$ 70 mmHg) was induced, the synchronous increases in CBF were disappeared. Thus, the synchronous increases in CBF responding to the cortical burst activities may reflect the autoregulatory mechanism of CBF.

156

SLOPE OF ALPHA ENVELOPE DURING ALPHA BLOCKING

TATSUNO,J., MORI,J., ASHIDA,H., MARU,E. Dept. of Physiol., Natl. Def. Med. Coll., Tokorozawa, Saitama

Slope of alpha envelope at any moment during alpha blocking was obtainable by differentiation of the envelope curve. Applying flash stimulation, one-second envelopes including blocking and recovery were recorded from 12 locations of five healthy college students, which were divided into three stages: Declining stage (DEC), blocked stage (BLK) and recovery stage (RCV). Steepest slope (SS), time of SS (Tss) and averaged slope (AS) were calculated in these three stages. Besides using the whole data, "sorted" data were also employed. By sorting with BL-TAA (blocking positive and TAA-appearing trial) SS-DEC was turned out to be -0.41 μV/msec at 164 msec, while it was -0.36 μV/msec in the whole. Between two stages, SSs were correlated. In relation between DEC and RCV, the correlation coefficient of the two SSs was -0.18 from the whole data, whereas it became -0.28 by the sorting with BL-TAA. These facts seemed to suggest functional connection of blocking with transient alpha augmentation.

157

DEVELOPMENTAL CHARACTERISTICS OF THE EEG FREQUENCY COMPONENTS ON THE SCALP (2). -INTERREGIONAL RELATIONSHIPS OF THE MENTALLY RETARDED CHILDREN'S EEG-

H.OZAKI, H.SUZUKI, *A.KATADA. Lab. of Physiol., Ibaraki Univ., Mito, Ibaraki, *Dep. of Physiol. & Psychol., Tokyo Gakugei Univ., Koganei, Tokyo.

By means of the spectral analysis of EEG, distribution and interregional relationships of the frequency components were chronologically examined in the mentally retarded children whose ages were ranged from 6 to 16. EEG were led monopolarly from six regions along the midsaggital line of the scalp. Auto- and cross-spectra were obtained for the EEG of 68 normal and 32 mentally retarded children in the waking state.

In 22 cases of the retarded subjects, peaks of the spectra were found within the alpha frequency band. Coherence values of these components were smaller than those of the normal subjects. In the 10 cases of the retarded subjects, dominant peaks were found only within theta frequency band. Some of the theta components appeared most dominantly around central region. The power of these components decreased gradually with the distance from the central region. The other theta components appeared dominantly around occipital region. Their power distribution and interregional relationships were different from the theta components appeared dominantly at central region.

158

STIMULUS-RESPONSE RELATION IN RAT TOOTH PULP-EVOKED CENTRAL RESPONSES

IRIKI, A., ICHIOKA, M., and TODA, K. Dept. of Physiol., Fac. of Dent. Tokyo Med. & Dent. Univ., Tokyo, 113 (Japan)

Stimulus-response relation in the tooth pulp-evoked central responses was investigated using lightly anesthetized Wistar albino rats. Tooth pulp of the lower incisor was electrically stimulated at 1 Hz by intensity-changeable constant current pulses of 0.1 msec in duration. The evoked responses were recorded with glass micropipets from six sites in the central nervous system; that is, 1) the primary and 2) the secondary somatosensory areas in contralateral cortex, 3) the ventrobasal complex and 4) the posterior nuclear group in contralateral thalamus, 5) the rostral and 6) the caudal areas of the caudal spinal trigeminal nucleus of the ipsilateral side. In each relay station and cerebral cortex, the relations of power function were observed over range of lower stimulus intensities, and the stimulus-response curve was gradually saturated with increasing stimulus intensities. The exponent of the power function was smaller and stimulus intensity of the onset of the saturation was stronger in higher level of the central nervous system.

159

HUMAN SOMATOSENSORY EVOKED POTENTIALS ELICITED BY ELECTRICAL SKIN STIMULATION OF VARIOUS PARTS OF THE HAND.

OIKAWA, T.*, FUJITANI, Y.*, ALLISON, T.**, GOFF, W. R.**, Dept. of Physiol.*, Sch. of Med., Tottori Univ., Yonago Veterans Adm. Hospital and Dept.** of Neurol., Sch. of Med., Yale Univ., New Haven

The respective parts of the hand innervated by median, ulnar and radial nerves were electrically stimulated and the elicited somatosensory evoked potentials (SEPs) were recorded by averaging technique from the scalp over the contralateral cortex against the linked ear lobes. The SEPs obtained were compared with one another especially on the spatial distributions of the component which is considered to be the primary response and corresponds to the component N20-P30 in the typical SEP elicited by stimulation of a median nerve. In the results, evident topographical differences of the location showing maximal amplitude in the component N20-P30 seemed not to be detected by electrodes placement of 2 cm in distance on the scalp irrespective of the differences of the innervating sensory nerve stimulated. The mutual interaction of the SEP component was observed between the SEPs elicited by electrical stimulation of two different skin areas and may be a lateral inhibition.

160

Visually Evoked Potentials during Kindling

Kenji Ono, Kazuo Nakatsuka and Hiroshi Baba
Department of Physiology, Nagasaki Univ. School of Med.

The secondarily induced changes of brain function following the repeated electrical stimulation to the visual cortex (Kindling preparation) were studied on the visually evoked potentials (VEPs) in unstrained cats. Following cortical stimulation, gradual development of VEPs into the epileptic discharges was observed with the progressive enhancement in amplitude and prolongation in latency (60 to 200 msec to peak) of the late negative component which was usually not recognized before the cortical stimulation. These ictal discharges synchronized with flash were very similar in morphology through the other brain sites. Furthermore, a marked and long-lasting augmentation of the late positive component (300 msec to peak) which frequently accompanied with the elevation of photosensitivity was observed after the end of seizure discharges. Traces of such enhancement in VEPs as well as the augmentation at the range of 3-5 Hz of frequency characteristics against the repetitive photic stimulation were noted during inter-ictal period after ten successive generalized convulsions.

161

ALTERATIONS OF SPATIAL DISTRIBUTION OF BRAINSTEM AUDITORY EVOKED POTENTIALS IN LESIONS OF THE VIIITH NERVE AND BRAINSTEM.

I. HASHIMOTO*, Dept. of Neurosurgery, Tokyo Metropolitan Hospital of Fuchu, Tokyo
Y. ISHIYAMA*, I. HONMA*, M. EBE**, Dept. of Physiol., Toranomon Hospital, Tokyo

Brainstem auditory evoked potentials (brainstem AEPs) in subjects with lesions in the VIIIth nerve and brainstem have shown different field distributions from those of normal subjects: (1) inversion of polarities of the components after wave I at the ipsilateral earlobe and mastoid, and (2) generalized reduction of amplitude over the scalp. These alterations in the observed field distributions may reflect changes in the spatial properties of the generators for the components due to lesions of the brainstem; such as reduction in the magnitude of currents with possible deviation of the dipole axes assuming that the generator for a given component is approximated by an equivalent dipole layer source.

162

ELECTRICAL ACTIVATION OF REFERENCE ELECTRODE ON RECORDING OF AUDITORY BRAINSTEM RESPONSES

*ISHIYAMA, Y. *HONMA, I. *EBE, M. **HASHIMOTO, I.
*Dept. of Physiology, Toranomon Hospital, Minato-ku, Tokyo
**Dept. of Neurosurgery, Tokyo Metropolitan Hospital of Fuchu, Fuchu-shi, Tokyo

Auditory brainstem responses have the positive deflection to earlobe electrode when they were led over the surface of scalp, and they were numbered as from Ⅰ to Ⅴ. We recorded the propagated potentials on scalp and earlobe by the noncephalic reference electrode method. And, it was presented how the potentials on earlobe influenced to the cofiguration of auditory brainstem potentials led on scalp-surface. 18 normal subjects aged from 18 to 30 years were examined. In the potentials on earlobe the amplitudes of N_1, P_1, N_2, P_2, P_3, P_4, P_5 were 0.34±0.14μv, 0.21±0.11μv, 0.22±0.11μv, 0.21±0.10μv, 0.14±0.05μv, 0.10+0.04μv, 0.10+0.08μv, and the latencies of N_1, P_1, N_2, P_2, P_3, P_4, P_5 were 1.52±0.10msec, 2.0±0.07msec, 2.4±0.08msec, 3.0±0.15msec, 3.7±0.15msec, 4.7±0.3 msec, 5.50±0.27msec respectively.

The amplitudes and the latencies of Ⅰ and Ⅱ waves led on scalp with an earlobe reference were remarkably deformed by those of N_1, P_1, and N_2 on earlobe, but those of Ⅲ, Ⅳ and Ⅴ waves were not affected.

163

FUNDAMENTAL PROPERTIES OF THE MV RESPONSES IN THE EYELID CAUSED BY ACOUSTIC STIMULATION.

HOSHINA, Y.*, TAKEO, T.*, OZAKI, T.* and SASAKI, D.** (Dept.* of physiol., Hirosaki Univ. Sch. of Med., Hirosaki and Dept.** of Internal Medicine, Hirosaki Univ. Sch. of Med., Hirosaki)

The microvibration (MV) responses elicited in the eyelid by acoustic stimulation to both ears were obtained with the summation technique and their physiologic properties were investigated in healthy subjects with eyes closed. In addition to the evoked lid MV responses, the average responses of the lid potential changes, the electrooculogram (EOG) and slow vertex responses (SVR) evoked by stimulation were traced simultaneonsly as well. In awaked resting state, the average lid MV responses were usually characterized by the early rapid component and late slow component. These were observed to appear corresponding to the early and late components of the average lid potential changes, respectively. In addition, the late slow components of the lid MV responses and lid potential changes were detected to correspond to the EOG. The late component related to the EOG were also recognized in the SVR. In moderately deep sleep, the lid MV responses, lid potential changes and EOG were decreased considerably or not observed. From these results, it seems likely that the early components of the acoustically evoked lid MV responses and lid potential changes are caused by the orbicularis oculi reflex, while the late component might be related to the EOG or SVR.

164

PROPERTIES OF THE POTENTIAL CHANGES CAUSED IN THE EYELID BY FLASH STIMULATION, WITH SPECIAL REFERENCE TO THE EYE MOVEMENT.

SASAKI, S.*, OZAKI, T.* and IGARASHI, K.** (Dept. of physiol., Hirosaki Univ. Sch. of Med.*, Hirosaki* and Dept. of Pediat.**, Hirosaki Univ. Sch. of Med., Hirosaki)

The average lid potential changes elicited in the eyelid by flash stimulation are known to mainly consist of electromyographic components due to the orbicularis oculi reflex and electroretinographic component. It is also supposed, however, that there are superimposed the electrooculogram (EOG) due to eye movement in addition to two components mentioned above, because of the approximation of the position of the surface electrodes between the lid potential change and EOG. The present experiments were studied from the standpoint of a relationship between the lid potential changes and EOG under various physiologic conditions. The intensity of a flash stimulus was changed by several grades ranging from about 0.05 to 20 joule. In stimulation of about 4 to 20 joule, the other slow component following principal electroretinographic components appeared in the average lid potential changes. In the sleeping state, on the other hand, only principal electroretinographic component remained in the average lid potential changes. In the occluded eyelid, the electrooculographic component was observed, although the electroretinographic component disappeared. These results suggest the existence of the electrooculographic component in the average lid potential changes.

165

ELECTROPHYSIOLOGICAL STUDY ON THE MECHANISM OF THE LATE COMPONENTS OF PHOTOPALPEBRAL REFLEX.

YASUHARA,M., NAITO,H., NISHIURA,K. and HATTORI,H.
Dept. of Physiol., Kansai Medical Univ., Moriguchi City, Osaka

The late components of PPR7-9 were demonstrated in addition to the PPR1-6 components of photopalpebral reflex through monopolar lead in rabbits. All components of PPR disappeared after an elevation of intraocular pressure(120-160mmHg). PPR and ERG were recorded simultaneously, and the PPR1-4 were found identical with a wave and wavelets(01,02,03) in b wave of ERG. The PPR5-9 disappeared after the optic nerve was cut off. The PPR5-9 disappeared after the destruction of the brain stem reticular formation(RF). The PPR2-9 increased with 100Hz stimulation on RF. The PPR5,9 increased while the PPR6,7,8 decreased after the destruction of the nucl.ventralis anterior(VA). The PPR9 decreased with 3Hz stimulation on VA. Inhibitory effect on the PPR5-9 was observed following the administration of such drugs as barbiturate, chlorpromazine and diazepam. The pulse count histogram of RF unit discharges by photic stimulation is considered to show that appearances of the PPR5-9 were related to the activity of the nerve cells of RF.

166

THE CHANGE OF THE BEHAVIOR TRAIT AND THE TURNOVER OF THE GLIAL CELL IN THE RAT REARED IN THE VARIOUS CONDITIONS. R. KUSUNOSE, T. HIRAO. Dept. of Behav. and Physiol., Gunma Univ. Sch. Med., Maebashi

The trait of the behavior and the reaction in the adult rat rat toward the mirror image stimulation differed by the rearing condition from the individual early period. That is, according to the change of the rearing condition, the corresponding change in the behavior trait was shown 2-4 weeks afterwards. By the administration of the anti-cancer drug, the relationship between the transition of the neuronal glial cell and the change of the behavior trait was investigated.

167

The differences of the apperances in the motion behavior effected with various series of stimulation were studied. The reaction time of key pushing was recorded , assuming it would suggest excitation or inhibition of motor activities.
The stimulations as the signal for the key pushing were arranged in time series and put in spatial orders.
In the cases of companion-stimulation , shorter the time interval more retarded the reaction time , and in IOOOmsec or more shorter interval these time were related in exponential series.
The paticular retardations were found in pushing the key which located near the one engaged not to be react.

168

RELATIVE CONTRIBUTION TO VISUAL PATTERN DISCRIMINATION LEARNING OF ASSOCIATION CORTICES IN THE RHESUS MONKEY.
KIKUCHI, R., YUKIE, M. and IWAI, E. Dept. of Behavioral Physiol., Tokyo Metropolitan Institute for Neurosciences, Fuchu-City, Tokyo

Relative contribution to visual pattern discrimination learning of each of association cortices in the rhesus monkey was assessed in terms of lesion effect (deficit) on the visual simultaneous discrimination learning of plus sign vs. outline square patterns. The data from our studies and the published data from other studies, whose experimental procedures matched well to ours, were used. The main findings were as follows. 1) The inferotemporal areas (TE and TEO) had the highest contribution. 2) The degrees of the contribution by the prestriate cortex (OA and OB) differed from case to case, showing moderate, slight and negligible ones. An analysis indicated that the region adjacent to the foveal representation region of the striate cortex (OC) had moderate degree of contribution, and the others had slight or negligible ones. 3) The convergence areas such as the temporal pole (TG), the fusiform and parahippocampus gyri (TF and TH) and the buried cortex in the superior temporal sulcus had slight contribution. 4) The posterior associative areas other than the areas mentioned above (PE, PG and TA) had negligible contribution. 5) No prefrontal area had even slight contribution.

169

EFFECT OF 6-OHDA-TREATMENT ON BRIGHTNESS DISCRIMINATIVE LEARNING ABILITY IN RATS WITH METHYLAZOXYMETHANOL(MAM)-INDUCED MICROENCEPHALY. MATSUTANI,T. NAGAYOSHI,M. TAMARU,M. NAKAHARA,T and TSUKADA,Y.* Dept.of Dev. Physiol.,Inst.for Comprehensive Med. Sci.,Fujita-Gakuen Univ.,Sch.of Med.,Toyoake, Aichi *Dept. of Physiol., Keio Univ.Sch.of Med., Tokyo

It has been revealed in our laboratory that rats with MAM-induced microencephaly (MAM group)show a significant elevation of monoamine levels in the cerebral hemispheres. Newborn rats of MAM groups(poisoned on day 15 of gestation) and the control groups were divided into two subgroups each(M, M_6 and C, C_6) and 100mg/Kg/day of 6-OHDA was subcutaneously given to the groups M_6 and C_6 for five days after birth. The groups M and C received physiological saline. The effect of 6-OHDA on the monoamine levels in the cerebral hemispheres was most eminent for norepinephrine(NE) at 50 days of age; in the group C_6, the NE concentration was one fifth of that in the group C,and in the group M_6 it was one fourth of that in the group M. The concentrations of NE(μg/g wet wt.) in the groups C, C_6 and M_6 were 50,10 and 25% of that in the group M respectively.
The number of sessions required to complete brightness-discriminative learning test was 16.2±3.9 in the group C and 33.3±2.5 in the group C_6, indicating an evident retardation of the learning. But in the group M_6,there was no significant reduction of the learning ability compared with that in the group M which showed appreciably lowered learning ability as described in our previous report.

170

EFFECTS OF BRAIN TRYPTOPHAN CONCENTRATION ON THE BRIGHTNESS DISCRIMINATION LEARNING TEST. M.NOMURA, Y.NAGATA. Dept. of Physiol.,Sch. of Med., Fujita-Gakuen Univ., Toyoake, Aichi 470-11.

Newborn rats were fed on corn diet, which contains very low concentration of tryptophan, for 3 months since neonatal stage.The increases of body and brain weight of corn fed rats were severely inhibited, but addition of 0.1% tryptophan to corn diet recovered their physical growths.

Corn and corn with tryptophan fed rats took nearly twice as much time as that of normaly fed ones to shape the learning task.
Corn fed rats did not attain to the level of 80% correct response ratio until the 30th session for discrimination of the 1000:1 brightness, reinforcing the task by a pellet in Skinner box. Corn with tryptophan fed rats reached the ratio of 85% level on the 24th session, whereas normaly fed rats reached the ratio on the 19th session.

It might be suggested that the low concentration of tryptophan and its metabolites in rat brain could produce poor ability of learning performance.

171

ASSOCIATIVE CONDITIONING MEDIATED BY THE CORTICO-RUBRAL SYNAPSES IN THE CAT.
Y. ODA, T.NOTSU, N. TSUKAHARA. Dept. of Biophysical Eng., Fac. of Engineering Science, Osaka University, Toyonaka, Osaka.

We examined the probability whether the red nucleus (RN) can be a part of neuronal elements mediating the classical conditioned response. In order to eliminate contribution of other descending fibers other than cortico-rubro-spinal projections, corticofugal fibers were destroyed just caudal to the RN. Conditioned stimulus (CS) was the pulse train to the cerebral peduncle and unconditioned stimulus (US) was the electric shock to the forearm skin. After pairing CS with US for 10 days, conditioned forearm flexions were obtained as manifested by the increase of probability of flexions with the same stimulus intensity of CS or the decrease of the threshold current for eliciting a given probability of flexions. Extinction of the conditioned responses (CR) was achieved by presentation of CS alone or backward pairing of US-CS, suggesting that the association of CS and US was critical for acquisition of CR. Minimum EMG latency of biceps brachii, 8 msec, indicated that the CR was mediated by the cortico-rubro-spinal pathway. The primary site of neural change of this conditioned response was estimated as the cortico-rubral synapse, because stimulation of another monosynaptic input to RN (interpositus nucleus) did not produce any significant changes in the threshold current, thus excluding the contribution of RN-spinal cord.

172

A SILENT PERIOD IN THE CALF MUSCLES PRIOR TO THE VOLUNTARY FORWARD LEANING Y.IWASE, T.UCHIDA, Y.TAKANASHI, N.SUZUKI, M.HASHIMOTO, Y.YAMAMOTO, T.TAKEGAMI & H.KOYAMA. Dept. of Physiol., Kyoto Pref. Univ. Med., Kyoto 602

When the human subject leaned forward voluntarily from the normal standing by ankle rotation, a silent period was observed in the electromyogram (EMG) of calf muscles, especially of soleus. The silence began 125-250 msec before the start of ankle rotation and was terminated by a sudden regaining of the muscle activity after 300-500 msec of its continuation. The silent period was produced at the rotation velocity of the ankle joint faster than 2-3 degrees/sec. There was no raised EMG activity just before the silent period. A passive forward leaning by pushing the waist never caused the silent period, but raised the muscle activity directly after the beginning of leaning. The H-reflex evoked in the calf muscles was strongly or perfectly suppressed during the silent period. Anterior tibial muscle, nearly silent while standing, continued the silence also during leaning or was activated 100-150 msec after the onset of the silent period in the calf muscles. These results indicate that the silent period thus induced is not ascribed to a pause in spindle afferent discharge, an increase in Renshaw cell activity or a reciprocal inhibition from the antagonistic muscle afferent, but may be produced by an inhibition from the higher center on the spinal motoneuron.

173

CHARACTERISTICS OF PURSUIT TRACKING MOVEMENT BY DISPLACEMENT OF CENTER OF GRAVITY (II). 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 moving the body foreward and back in accordance with a target, which was displayed on an oscilloscope, moving in irregular manner. Target signals were 1) band-limited Gaussian white noises, 2) binary pseudorandom signals, 3) symmetric random signals of constant switching pace. Generally, power spectra of responses showed a shoulder at ca. 1.0Hz and the high frequency asymptote of 50-60dB/decade. For lower frequency band signals, coherence was heigher in upper limit of the band and the main peak appeared in the same frequency band and the notches were found in ca. 1.0 Hz region. For heigher frequency band signals these phenomena were more complex than the lower ones. For the case of static equilibrium we have already reported. Dynamically, the calf muscle have a good correlation with the output of force plate with a phase lead of 0.25sec. Analyses of the response curve suggested that the bang-bang control mode was used in this system.

174

THE RELATION BETWEEN THE MAINTENANCE OF THE UPRIGHT POSTURE AND THE RESPONSIVENESS OF THE SACCADIC EYE MOVEMENTS M.HASHIMOTO, N.SUZUKI, T.TAKEGAMI, Y.YAMAMOTO, Y.TAKANASHI, H.KOYAMA, T.UCHIDA & Y.IWASE. Dept. of Physiol., Kyoto Pref. Univ. Med., Kyoto 602

The body sway in upright standing was reduced in amplitude by periodic saccadic eye movements in response to reciprocally lighted targets at the frequency higher than 0.2 Hz. The saccadic latency did not shorten down to 200 msec on repetition of saccades at 0.1 Hz. At 0.5 Hz, on the other hand, the saccadic latency gradually decreased and were almost in step with the targets after several cycles. After drinking alcohol, such a predictive saccadic response was not exhibited, and the body sway was not decreased remarkably by saccades even at 0.5 Hz. These results suggest that the acquirement of a predictive saccadic response play an important role on the reduction of the sway. Reduction of the sway was also observed by the successive visual searches every five sec during which predictive saccades did not occur. The electro-oculogram in each visual search showed that the eyes reached the target through a roundabout complex eye movement which consisted of 3-20 successive saccades. Reduction of the body sway was thought to be caused by the complex eye movement occurring frequently during searching the figure.

175

INITIATION OF LOCOMOTION RELATED TO EXCITABILITY SETTING OF THE BRAIN STEM AND THE SPINAL CORD IN THE MESENCEPHALIC CAT. S. MORI, K. KAWAHARA, M. AOKI, T. TOMIYAMA*
Dept. of Physiol., Asahikawa Med. Coll., Asahikawa; Dept. of Otolaryngol., Asahikawa Med. Coll., Asahikawa*

In the acute precollicular-postmammillary decerebrate cat, the background excitability of the brain stem and the spinal cord has been shown to manifest itself in the degree of postural tonus (PT). In such an animal, stimulation of the mesencephalic locomotor region (MLR) often failed to induce "controlled locomotion" when the PT was not set at an appropriate level. In the same animal, the stimulation delivered to the midline of the dorsal tegmentum (DTF) and to the ventral tegmentum (VTF) just above the trapezoid body decreased and increased bilateral hindlimb PT respectively. Such reduced or increased PT did not recover to the prestimulus level for more than 5 min. Accordingly, in the animal whose PT was exaggerated or weakly developed after decerebration, the stimulation of either DTF or VTF allowed us to set the excitability level of the brain stem and the spinal cord at any desired level. We have analyzed the neuronal mechanism involved in setting the level of PT by means of intracellular recordings. DTF stimulation hyperpolarized and VTF stimulation depolarized the resting membrane potential of motoneurons innervating hindlimb extensor muscles. Functional relations between DTF, VTF and MLR for controlled locomotion were discussed.

176

STIMULUS-DEPENDENT LABELLING OF SINGLE CULTURED GANGLIONIC CELL WITH ^{14}C-DEOXYGLUCOSE. M. SAJI, K. OBATA* Dept. of Physiol., 1st Div., Gunma Univ., Sch. Med., Maebashi, Gunma, *Dept. of Pharmacol., Gunma Univ., Sch. Med., Maebashi, Gunma.

We prepared cultures of dissociated cells from ciliary ganglion(CG) and dorsal root ganglion(DRG) of 10-12 day-old chick embryos, and applied ^{14}C-2-deoxyglucose to the cultured ganglionic cells to examine stimulus-dependent labelling with ^{14}C-2DG at the single cell level. Following current stimulation, the frequency-dependent increase of ^{14}C-2DG uptake always occured. This was potentiated by an application of TEA, but suppressed by TTX. Externally applied potassium ions increased the ^{14}C-2DG uptake, which depended on the potassium effect on the membrane potential. Based on these phenomena, we examined whether putative neurotransmitter such as ACh, glutamate, GABA, glycine and dopamine accelerate an uptake of ^{14}C-2DG into both CG and DRG-cell and estimated the sensitivity of ganglionic cell to the above-mentioned neurotransmitters.

177

EFFECT OF COLCHICINE AND VINBLASTINE ON MACROMOLECULAR SYNTHESIS IN MOUSE BRAIN DURING LEARNING PROCESS. MURAKAMI, T. H.,KISHIDA, A.,YAMAGUCHI, T.,DOI, A. Dept. of Physiol., Okayama Univ. Med. Sch., Okayama

ddN-F16(16th generation) strain mice with high scores were selected for genetic improvement through avoidance training. The experimental animals were 6-8 old. A single 50uCi dose of ^{3}H-leucine, ^{3}H-uridine, and ^{3}H-thymidine was given by intraperitoneal injection to each animal. Five minutes after the injection, one of the mice was trained in the jump box. The others served as the controls, that is, the yoked and silent animals. The training lasted 15 min, during which time an average of 30 trials was completed. One group of mice given a mixture of colchicine and vinblastine(0.25ug each) intracranially one week earlier, could not show learning. Macromolecular synthesis in the brain during learning process was studied.

Incorporation of ^{3}H-leucine into protein was increased in trained animals compared with yoked and silent controls. There was no difference between injected and non-treated animals. Similar results were obtained for RNA and DNA synthesis. Yoked control animals showed a small decrease in incorporation of labeled materials compared with the silent animals.

178

TRANSPORT OF CHLORIDE IN DEVELOPING RAT BRAIN.
H. ASO, Y. TAKAGI, T. KANAMATSU, S. HIRANO, Dep. of physiol., Toho Univ. Sch. Med., Ohmori, Tokyo

The uptake of Cl^- into developing rat brain slices was studied by using $^{36}Cl^-$as a tracer, $^{36}Cl^-$uptake was inhibited by piretanide or furosemide of specific inhibitor to electrochemical Cl^- potential. Inhibition type of piretanide was a mixed of competitive-noncompetitive as same as that of erythrocytes. $^{36}Cl^-$uptake was significantly affected by HCO_3^- acetazolamide and KCN, and unaffected by ouabain. And also, increasing of K^+ concentration in incubation media caused an enhancement of $^{36}Cl^-$uptake and swelling. $^{36}Cl^-$increased according to the development. However, in developing rat brain $^{36}Cl^-$uptake in 3-day old rat brain was predominant compared with that 1-day old or 5-day old rat and swelling effect induced by high-K^+ medium was also predominant in 3-day old.

179

ACTIVITY CHANGES OF MYELIN ASSOCIATED ENZYMES IN THE NERVOUS SYSTEM OF THE MOUSE WITH MUSCULAR DYSTROPHY. SHIGEKATSU TSUJI AND HIROSHI MATSUSHITA. Dept. of Physiol., Wakayama Med. College, 9-bancho, Wakayama

The activities of 2',3'-cyclic nucleotide 3'-phosphohydrolase(CNP) and cholesterol-ester hydrolase(CEH), which are enzymes known to be closely associated with the myelin fraction, are examined in the brain and the spinal cord of dystrophic mice in order to clarify the relationship between the neural abnormality and the development of muscular dystrophy.

The reduction in the activity of myelin CNP in the spinal cord was found to be highly significant in dystrophic mice at 2 months of age. On the other hand, there was no longer a difference in the activity of myelin CNP in the spinal cord from dystrophic mice at 5 months of age compared with those from normal littermates despite of the muscle disease is in serious condition at this time. The activities of the CEH in myelin fraction of the brain and the spinal cord from dystrophic mice at 2 months of age were shown to be 67 % and 50 % of the normal littermates respectively. The results obtained in this experiment provide additional evidence for hypomyelination in the nervous system of dystrophic mice.

180

ACTIVITIES DURING GAZING AND VISUAL RECEPTIVE-FIELD OF MONKEY PREFRONTAL NEURONS.

H. SUZUKI, M. AZUMA & R. HADA. Dept. of Physiol., Hirosaki Univ. Facul. of Med., Hirosaki

The purpose of the present experiments is to find the relation between activities of prefrontal neurons during gaze performance and their visual properties. We recorded the unit activity from prefrontal neurons when the animal gazed at a small light spot (0.2° in visual angle) for several seconds. While the animal gazed at the fixation spot, we also presented the second spot (RF spot) and recorded the responses to the RF spot, thus determining the extent in the visual field where the responses were evoked (receptive field).

We found that neurons in the inferior-dorsolateral (IDL) area about 2 mm far from the principal sulcus increased discharge rates during gaze performance and had receptive fields including the fixation point. On the other hand, neurons in the IDL area near to the principal sulcus or in the superior-dorsolateral area decreased or did not change activities during gazing and had receptive fields excluding the fixation point.

181

DISCHARGE MODULATION OF VISUAL TRACKING NEURONS IN THE MONKEY POSTERIOR PARIETAL ASSOCIATION CORTEX BY NATURAL VESTIBULAR STIMULATION

KENJI KAWANO, MITSUYOSHI SASAKI and MASAYUKI YAMASHITA Dept. of Neurophysiol., Inst. of Brain Res., Sch. of Med., Univ. of Tokyo, Bunkyo-ku, Tokyo

Single unit recordings were made from visual tracking neurons in the posterior parietal association cortex (area 7) of the behaving monkey. These neurons were identified by their discharge pattern during the task of pursuit of moving visual objects. The possibility whether these neurons received vestibular input was tested by sinusoidal rotation of the turntable on which the monkey was seated. The activity of more than half of horizontal tracking neurons was modulated by horizontal rotation in the dark. Activity of some of the neurons during the rotation was studied, not only when the monkey was awake and the vestibulo-ocular reflex (VOR) clear, but also when the monkey was drowsy and the VOR less clear. There were no differences detected between the two states. Therefore, a number of visual tracking neurons receive vestibular signals and not oculomotor signals induced by vestibular stimulation. Most of the tracking neurons which received vestibular input had same preferred directions in both head rotation and visual tracking. These findings indicate that visual tracking neurons are likely to integrate visual and vestibular informations, and play an important role in coordinated movements of eye and head for smooth visual tracking.

182

PLASTICITY IN KITTEN STRIATE CORTEX STUDIED BY SLICE PREPARATIONS.

KOMATSU,Y. Dept. of Physiol., Nagoya Univ., Sch. of Med., Tsuruma-cho, Nagoya

Kitten visual cortex has remarkable plasticity (Wiesel and Hubel, 1963, 1965). It has been hypothesized that the plastic changes occur in synapses between geniculate afferents and striate cells. The present work was designed to test this hypothesis by using slice preparations of kitten (2-5 weeks old) striate cortex. It was demonstrated that conditioning stimulation (2 Hz, 30-60 min) of the white matter at 3 mm below the cortical surface greatly (1.5-4 times) potentiated the negative field potentials evoked in layer IV by test stimulation of the white matter. The potentiation reached a maximum at about one hour after the conditioning stimulation and lasted for several hours. Since the onsets of the negative field potentials agreed with those of monosynaptic EPSP recorded intracellularly from striate cells, the potentiation of the negative field potentials should represent enhancement of the geniculate excitation of striate cells. These finding demonstrated that the geniculo-striate transmission can be remarkably potentiated by activation of the geniculate afferents.

183

COROLLARY INPUTS TO CAT'S STRIATE CELLS; EFFECT OF ABLATION OF CLARE-BISHOP AREA.
SHIBUKI,K. and TOYAMA,K. Dept. of Physiol., Fac. of Med., Univ. of Tokyo, Bunkyo, Tokyo

Passive movement of the eyes produces an illusory displacement of the visual image, while active eye movement results in a stable perception. The image stabilization was explained by a central mechanism integrating retinal signals and motor signals of eye movement.'In an attempt to identify the neuronal correlates of this central mechanism, we have found that a group of cells in cat's striate cortex are excited in absolute darkness in conjunction with saccadic eye movements, and that this non-visual excitation represents the efference copy of the motor command of eye movement. In the previous study we reported that cells in Clare-Bishop area (CB) also exhibited non-visual excitation similar to that in striate cells but with shorter delays to the onsets of saccadic eye movements (10-30 msec) than that for striate cells (50-100 msec). Therefore it is tempting to assume that the non-visual excitation is transfered to striate from CB-cortex. In the present study this possibility was tested by studying the effect of CB-removal upon the saccade-excitation of striate cells. The CB-removal reduced the saccade-excitation under presentation of a checker pattern or in darkness. The effect was much more prominent upon the saccade-excitation in darkness, indicating that the non-visual excitation of striate cells originates from CB-cortex.

184

DEPTH SELECTIVITY OF "VISUAL" NEURONS OF THE POSTERIOR PARIETAL ASSOCIATION CORTEX (AREA 7a) OF THE MONKEY.
H. SAKATA, H. SHIBUTANI, Dept. of Neurophysiol., Tokyo Metropol. Inst. Neurosciences, 2-6 Musashidai Fuchu City Tokyo, 183, K. KAWANO, Dept. of Physiol., Brain Research Inst. Tokyo Univ., T. L. Harrington, Dept. Psychol., Univ. Nevada, Reno.

Many of the "visual" neurons of area 7a (PG) of the monkey were found to have selectivity in depth. We examined their relations to various cues of depth perception.
1) Many of the visual fixation (VF) neurons are activated when the fixation point is near to the animal. When a convex lens was placed in front of the monkey's eye, a couple of such VF neurons were found to reduce their discharge rate, as the focus was shifted to a longer distance with the lens.
2) Many of the passive visual (PV) neurons are activated specifically by movement of visual stimuli in depth. Some of such PV neurons were found to be sensitive to the change of image size. A couple of PV neurons, which were activated by approaching movement of a disk, was found to be excited by the gradual enlargement of a circular image on a fixed screen. In contrast, one PV neuron activated by receding movement of a square was found to be excited by the gradual diminution of a square image.
3) Some of the visual tracking (VT) neurons were also found to be activated by approaching or receding movement of the visual target.

185

LAMINAR DISTRIBUTION OF MORPHOLOGICALLY IDENTIFIED NEURONS OF THE MOTOR CORTEX WHICH RECEIVE VISUAL INPUT IN THE CAT.
OGAWA, T. AND TAKIMORI, T. (Dept. of Physiol., Akita Univ. Sch. Med., Akita 010)

Using micropipettes filled with a procion yellow solution, intracellular recording and staining was performed in motor cortex neurons of chloralose-anesthetized cats to investigate the morphology and laminar distribution of cells receiving visual input. A total of 17 identified cells were checked for their responsiveness to flash lights, to electrical stimulation of visual pathways (OX, SC, VC) and to electrical stimulation of the bulbar pyramid. They were grouped into "flash-responsive" and "flash-unresponsive". The former group consisted of 8 cells and the latter 9 cells. Among the flash-responsive cells, one was located in layer III, six in layer V and one in layer VI. With the nine flash-unresponsive cells, one was located in layer III and the others in layer V. They were all activated by stimulation of visual pathways, but only V-located cells were antidromically activated by bulbar stimulation. All cells were pyramidal in shape.

186

Responsiveness of inferotemporal cortex neurons to visual pattern stimuli in awake monkeys. T. Sato, T. Kawamura, J. Watanabe, E. Iwai. Dept. of Behavioral Physiol., Tokyo Metropolitan Inst.

Four monkeys were trained to choose two out of four two-dimensional patterns presented successively at the center of screen, and then responses of inferotemporal cortex neurons to the patterns were investigated. Of 83 neurons which responded to the patterns, 47% responded to all four patterns, 45% selectively to two or three patterns and 8% specifically to one of the four patterns. Although components of the patterns elicited no response in pattern-specific neurons, some neurons which responded selectively to the patterns showed different sensitivity to pattern components. The neurons which responded specifically or selectively to the patterns usually remained pattern-specific or -selective regardless of pattern size. Then another monkey was trained to gaze a small spot during the pattern discrimination task. In the monkey there were neurons which preserved their selective responses to the patterns that were presented over a wide retinal area including both visual half-fields. This gave an evidence for stimulus equivalence over retina of inferotemporal neurons under the condition that monkey discriminated visual patterns. These results suggest that one function of the inferotemporal cortex may be related to abstract perception or categorization of visual stimuli.

187

RECURRENT INHIBITORY CIRCUIT AS REVEALED IN IN VITRO SLICES OF CAT'S VISUAL CORTEX. KATO,H. ITO,S. AND OGAWA,T. Dept.of Physiol., Akita Univ. Sch. of Med. , Hondo 1-1, Akita City, Akita 010

The present experiments were undertaken to reveal that the recurrent inhibitory circuit is formed among neurons in the visual cortex by using in vitro slices obtained from the posterior lateral gyrus of cats anesthetized with pentobarbital. Most neurons(n=15) gave a train of regularly recurring impulses during a depolarizing current flow delivered through an intracellular microelectrode, but a few showed clusters of impulses interupted by hyperpolarizing potentials during the same condition. These hyperpolarizing potentials occurred without any fixed delay to a preceding spike and were blocked by changing the normal medium to the one containing low Ca^{++}(0.1 mM) and high Mg^{++}(5 mM). We concluded from these findings that these hyperpolarizing potentials are IPSPs and mediated by the recurrent inhibitory circuit via axon collaterals of the impaled cell. The preliminary report has been published elsewhere.

188

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

Properties of 148 striate cortical neurons projecting to the dorsal lateral geniculate nucleus (C-G cells) were studied in Nembutal anesthetized kittens aged from the 8th day to 20th week. In the 2nd week of age, the axonal conduction velocity of all the C-G cells was slower than 1 m/sec. In this stage of development, most of the C-G cells were visually unresponsive, but a few cells already had visual responses of complex type. A C-G cell with simple type responses was first recorded at the end of 3rd week. The axonal conduction velocity of the complex C-G cells became close to an adult value in the 5th week of age, while that of the simple cells much later. The ratio of visually unresponsive cells to the all C-G cells was 76% in the 2nd week and decreased to 42% in the 5th month, but their axonal conduction velocities were not significantly changed. Since in adult cats the complex, simple and visually unresponsive cells correspond to large-, medium- and small-size cells respectively, the present results can be taken to indicate that the large cells matured earlier than the other groups of cells in the cortico-geniculate projections.

189

AMPLITUDE VS. REVERSAL FREQUENCY CURVES OBTAINED WITH CHECKERBOARD PATTERN VECPS TO UPPER AND LOWER HALF FIELD STIMULATION.

E. ADACHI-USAMI and J. CHIBA. First Dept. of Physiol., Hamamatsu Univ. Sch. Med., Hamamatsu, 431-31

The VECP amplitude to checkerboard pattern stimulation of upper and lower half of the visual field vs. pattern reversal frequency was studied in man at four different electrode positions on the midline of the scalp.

It was proved that the lower half field VECP distributed in the posterior direction and the upper half field VECP in the anterior on the midline of the scalp. At any given experimental condition, the pattern of amplitude vs. frequency curves showed the maximum amplitude at a reversal frequency of around 8-10 Hz, with a slight decrease of amplitudes at lower frequencies and a steep fall-off at higher frequencies. With regard to polarity reversal of the upper and lower half field VECPs, the present study suggested that it couldn't be explained simply by a dipole theory. Conduction velocity difference between the upper and lower half field VECP might also concern with this fact, especially at transient state.

190

ANALYSIS OF THE RECEPTIVE FIELD OF VISUAL NEURON USING SPATIOTEMPORAL RANDOM PATTERN

KAJI, SHINJI, YAMANE, SHIGERU, & HAMADA, TAKASHI. Bionics, Electrotechnical Laboratory, Umezono, Sakura-mura, Niihari-gun, Ibaraki.

A new statistical method to analyse receptive field properties of a visual neuron using a spatiotemporal random pattern was developed. A series of 500 independent frames, composed of 45 × 45 light/dark random square elements, were presented sequentially on a CRT every 500 msec. Nerve impulses of every 190 msec from the onset of each frame was considered as the "response list". Although the individual frame looks macroscopically random pattern, locally it looks different "shapes" flashing in turn. To detect whether appearance or disappearance of a certain "shape" or unchange in a defined local area of each frame, gives a set (ON, OFF and unchanged) of "feature lists". The correlation between the "feature list" and the "response list" was calculated for each spatial position, and illustrated in a spatial response pattern. The ON center receptive field of LG neuron showed not only the center excitatory responses, but the reduction of the center discharges to the "OFF feature list", and similar result for the surround responses. From the complex neuron, examined by a "feature list" consist of ON and OFF flanks, a response pattern analogous to that derived from light/dark edge stimulus was obtained. Another "feature list" may realize another property of the neuron responding to the "feature" included in the random pattern.

191

PATTERNS OF RECEPTIVE FIELD IN THE RETINULA CELLS OF THE FLY'S COMPOUND EYE

K.MIMURA. Fac. of Liberal Arts and Sci., Nagasaki Univ., Nagasaki

A shape of the receptive field was contoured by using the intracellular responses to illumination at different positions surrounding the fly. The shapes were classified into six patterns. Type A pattern is roughly round and small, corresponding to the usual, normal receptive field. Type B pattern is resembled in shape with type A, but its size is larger. Type C pattern is wide and star-shaped with spokes radiating along x, y and z axes of alignment of the ommatidia. Types D, E and F patterns are widely long, extended to one direction. Directions of the extension were horizontal, oblique and vertical in types D, E and F, respectively. In these wide fields, two or more areas with high sensitivity were found at extremities of the extending field. The retinula cells of different pattern were found in different positions within the compound eye. The retinula cells of type C pattern were situated at the frons area only, and those of types D, E and F were distributed in lateral area of the compound eye. Results may suggest some of basic mechanisms of pattern recognition and depth vision by the compound eye.

192

VISUAL FIELD OF STEMMATA IN THE SWALLOWTAIL BUTTERFLY, *PAPILIO XUTHUS L.*
ICHIKAWA, T., TATEDA, H. Department of Biology, Faculty of Science, Kyushu University, Fukuoka

PAPILIO larvae have six stemmata (I-VI) on each side of the head. Each stemma has seven retinular cells organized in two tiers, distal and proximal. Proximal retinular cell tier consists of two or three types of receptors with different spectral sensitivities, while distal one consists of a single type. The acceptance angles (α) of single retinular cells and their angular inclinations of visual axes (θ) to the visual axis of a whole stemma were determined electrophysiologically. In stemmata I-IV, distal retinular cells had large visual fields (α=6-13°) and large inclinations of their visual axes (θ=5-11°), while proximal cells had small visual fields (α=2-7°) and small inclinations (θ=0.7-1.6°). In stemmata V and VI, both distal and proximal retinular cells had large visual fields (α=8-26°) and had large inclinations of the visual axes (θ=10-19°) except for one proximal cell (θ=0°). These results suggest that the distal retinular cells may play an important role in detection of objects and proximal cells play a role in color discrimination.

193

EFFERENT CONTROL ON ORB WEB SPIDER EYES.
S. YAMASHITA and H. TATEDA. Dept. of Biol., Fac. of Sci., Kyushu Univ., Fukuoka

Efferent activities have been recorded from the optic nerves of the orb web spiders, *Argiope bruennichii* and *A. amoena*. The action potentials are characteristically of long durations (3 to 10 ms). When the efferent activity increases, the membrane potentials of the photoreceptor cell hyperpolarizes and the saturation amplitude of the light response increases rapidly, and the threshold of the light response decreases gradually. It is suggested that the rapid increase in the light response is mediated by neural process, and the gradual decrease in the threshold may be mediated by hormonal process. The discharge of the efferent impulses is inhibited by illumination of the eyes, showing that the efferent fibers recieve inhibitory inputs from the eyes. When the brain is stimulated by light after isolating the brain, the efferent impulses increase during illumination. In physiological saline containing 2 mM Co^{++}, the efferent impulses during the dark-adapted state were completely lost. Light stimulation, however, elicited the efferent impulses in Co^{++}-saline, suggesting that the efferent neurons were photo-excitive.

194

EFFECT OF INTRACELLULAR INJECTION OF EGTA AND TEA ON THE SENSITIVITY OF LOCUST RETINULA CELLS.
Y. TSUKAHARA. Res. Ctr. for Appl. Inf. Sci., Tohoku Univ., Katahira-cho, Sendai

The depolarizing photoreceptor potential of locust *Valanga irregularis* has an initial transient phase which declines to a stable sustained phase, as other arthropod photoreceptor potentials. In this work, the effect of intracellular injection of EGTA and TEA on these components was studied.

1) Reversal potential of the sustained phase was lower than that of the transient phase.
2) Injection of either EGTA or TEA enhanced both components and the enhancement was more prominent in the sustained phase.
3) Resting potential was slightly elevated by the injection. The amplitude of the maximum response was also increased.
4) Polarization by injected current modified the shape and amplitude of the response, and did not change the effect of the agents.
5) Based on these findings it was suggested that an activation of potassium conductance due to an increase in Ca_i^{++} on illumination may decrease the sensitivity during the sustained phase.

195

CONVERSION OF RIBOFLAVIN IN THE CHOROID TO FMN IN THE RETINA OF FROGS.
FUJISHITA, S., Dep. of School Nurse, Osaka Kyoiku Univ., Hirano-ku, Osaka.

The flavin derivatives in the choroid and the retina of frogs were determined by chromatography with a developing solvent of butanol, acetic acid and water. This method clearly showed that riboflavin (FR) was contained in the choroid and FMN in the retina, respectively. FR in the choroid passes through the boundary between the choroid and the retina where it is converted to FMN by flavin kinase whose action is accelerated by MSH and inhibited by melatonine during dark adaptation. The skins of frogs turn black by MSH and green by melatonine, respectively. The FMN content in the retina of black frogs increased significantly with the progress of dark adaptation, while in that of green frogs it remained unchanged. The FMN content in the retina was apparently influenced by the FR content in the choroid.
These findings suggest that the change in FMN content in the retina is closely related with four factors as follows: FR content in the choroid, skin color, dark adaptation time and experimental temperature.

196

EFFECTS OF CYCLIC NUCLEOTIDE ON THE VISUAL CELL FUNCTION.
T. MATSUURA AND I. HANAWA*. Dept. of Physiol., Kinki Univ. Sch. of Med. Minami-kawachi-gun, Osaka and *Dept. of Physiol., Kobe Univ. Sch. of Med. Ikuta-ku, Kobe

The effects of papaverine, the substance known to elevate cyclic GMP level in cells by inhibiting the phosphodiesterase activity, on the PIII response of the electroretinogram and the dark adaptation process of the visual cells were studied in the isolated, aspartate-treated bullfrog retina. The application of 0.1 mM papaverine led to the enhancement and prolongation of the slow PIII response, but the effect was lost when Ca^{2+} was removed from the bathing fluid. The half-time of recovery of the fast PIII response amplitude after the adapting light was a linear function of the amount of bleached rhodopsin. 0.1 mM papaverine in Ca^{2+}-free medium produced about twofold increase in the half-time of recovery of response, which was not virtually affected by separate application of either papaverine or EDTA. These findings suggest that the combined action of cyclic GMP and Ca^{2+} are implicated in the dark adaptation process of the visual cells.

197

LIGHT INDUCED OSCILLATORY RESPONSE IN RODS OF THE BULLFROG.
YAMADA,M. and TAUCHI,M*. Applied Optics Sect., Electrotechnical Lab., Ministry of International Trade and Industry, Umezono, Sakura-mura, Niihari-gun, Ibaraki 305 and Dept. of Physiol., Tokyo Women's Med. Coll., Shinjuku-ku, Tokyo 162*.

Intracellular responses to flash light were recorded from rods in inverted retinal preparation of the bullfrog (Rana catesbiana). To a test flash which was given at recovery phase of the response to bright conditioning light, response followed by decremental oscillation was observed. Frequency and duration of the decremental oscillation were about 2 Hz and several seconds respectively. Amplitude-frequency relationship of the response was obtained by applying white-noise modulated photostimulus, peak of the amplitude appeared at the frequency of about 2 Hz. This relationship did not change by perfusing the retina with Ringer's solution containing 10 mM sodium-aspartate which was supposed to block transmission from receptors to secondary neurons. It implies that the decremental oscillation exclusively originates in the receptor cells.

198

QUANTUM SENSITIVITY OF SINGLE RODS

TANAKA, I. & TAUCHI, M. Nat. Rehab. Center for the Disabled., Tokorozawa and Dept. of Physiol., Tokyo Women's Med. Coll., Tokyo.

Light induced electrical response was recorded intracellulary from single red rods of isolated retina of the bullfrog. Quantum sensitivities of the rod were studied by varying size and position of the spot of 510nm light lasting 50 ms given to receptor side of the retina. Enlarging the spot centered at the impaled cell to 100 μm in diameter at the same intensity, the response amplitude increased. By correcting the effect of intensity attenuation at the center of small diameter spots, the same qualitative relation was obtained. Quantum sensitivities for to 150 and 30 μm diameter spots were 80 and 20 mV photon$^{-1}\cdot\mu m^2$ and sensitivities for a rhodopsin molecula isomerization (Rh*) were 6.0 and 1.5 mV Rh*$^{-1}$/rod respectively. Responses to 30 μm diameter spot which displaced over a series of steps were compared. The spot presented at a displaced position apart from the impaled cell elicited the response of different shape from that to direct spot. For the equal peak amplitude, rate of rise of the response to direct spot was smaller than that to distant spot. The effect of receptor-receptor interaction on the response would be discussed.

199

QUANTITATIVE STUDIES OF THE CONE MOSAIC IN THE TURTLE RETINA. T. OHTSUKA, Dept. Inform. Physiol., Nat'l Inst. Physiol. Sci., Okazaki

The spatial structure of cone masaic provides the most fundamental information to color as well as form reception. In the turtle, since correlation has been established between the cone type and the color of the oil droplets, the spatial distribution of cones was quantitatively studied using oil droplets as a marker. For red single cones, population was highest (>9000/mm2) in the fovea (<200 μm), and the size of red oil droplets was the smallest. For other types of cones, the distribution was more or less homogeneous. The product of cell number and the mean droplet size, referred to as the receptive ratio, was high along the naso-temporal axis, giving an appearance of red horizontal line, often described as "linear area centralis". However, the present results suggest that it is misleading to call the red line as linear area centralis. An attempt has been made to detect any regular pattern in distribution of each cone type using laser diffractometer, but no definite pattern was found.

200

ACTIVITIES OF ENZYMES RELATING TO SYNTHESIS OF PUTATIVE TRANSMITTER SUBSTANCES IN DEVELOPING RAT RETINA OHNO, TAKUO Dept. of Physiol. Ehime Univ. Sch. Med., Shigenobu, Ehime 791-02

The aim of present work is to evaluate the changes in the neuronal system of rat retina during postnatal growth and, whenever possible, to correlate these changes with the structural and physiological maturation of retina. I studied the activities of enzymes relating to the synthesis of putative transmitter substances, namely glutamate decarboxylase (GAD) for GABA, choline acetyltransferase (ChAc) for acetylcholine and tyrosine hydroxylase (TH) for dopamine. Wister rats bred in this laboratory were used. The retinas were analyzed at 5, 10, 15, 30, 45, 60 and 90 days after birth. Under ether narcosis, the rat eyes were immediately enuculeated, and retinas were taken, measured in weight and homogenized with 0.1 ml of 0.1% Triton X-100 solution for the analysis of the enzymes by radiochemical tracer experiments. During postnatal growth, the enzyme activities of rat retina differs at various developmental stages. The adult level for individual enzymes is reached on the 30th day of maturation. During differentiation, the ChAc and GAD activities increase while TH decreases. Further, the possibility of centrifugal projections to the retina in the rat was analyzed. GAD activity in the optic nerve proximal increased after its ligation, whereas the activities of ChAc and TH remained constant.

201

EFFECTS OF CATECHOLAMINES ON HORIZONTAL AND GANGLION CELLS IN THE CARP RETINA.

SUGAWARA, K. Dept. Neurophysiol., Neuroinformation Res. Inst., Kanazawa Univ. Sch. Med., Kanazawa

Effects of catecholamines (DA and NA) were explored on the horizontal cell membrane potential (photopic L-type) and the ganglion cell spike activity in the carp (Cyprinus carpio) retina. DA or NA, applied in the perfusate (50 μM/l) depolarized horizontal cells, increased in amplitude a center response to spot illumination and decreased a surround response to annular illumination. The same application suppressed spike discharge of most ganglion cells examined. Electrophoretic application of DA or NA in the vicinity of recording ganglion cells (25-50 μm interdistances in the IPL) also suppressed spike discharges of most ganglion cells. In a few cells, however, it accentuated the center response and attenuated the surround, as seen in horizontal cells. This reciprocal influence was easily desensitized with repeated applications, differing from that on horizontal cells. The general suppression of spike discharge is possibly, in part, due to the primary action of the agents on interneurons (INL) and to the direct action on ganglion cells. The reciprocal changes, caused by electrophoretic DA or NA, appear to owing to the direct influence on certain ganglion cells. If this is the case, DA or NA may modulate lateral interactions in the IPL and in the OPL as well.

202

FIELD POTENTIALS INDUCED BY INTRARETINAL K^+ INJECTION.

FUJIMOTO, M. and TOMITA, T. Dept. of Physiol., St. Marianna Univ. Sch. of Med., Takatsu-ku, Kawasaki and Dept. of Ophthalmol. and Visual Sci., Yale Univ. Sch. of Med., New Haven, CT, USA

Using excised frog retinas, the field potential induced by intraretinal injection of high K^+ Ringer's (75 mM K^+) was mapped by a penetrating electrode. The study revealed that (1) a maximum negativity is produced at the depth of K^+ injection and that (2) the negativity subsides in both directions, proximally and distally, but that (3) when recording from the retinal surfaces, the vitreal side becomes positive relative to the receptor side, irrespective of the retinal depth of K^+ injection, excepting for the innermost layer of some 20 μm in thickness where some uncertainty remains. The results indicated that the "neutral zone", as defined as a zone where a high K^+ produces no potential difference between the opposite retinal surfaces, is localized very close to the inner limiting membrane. Recent interpretations of the b-wave on the Müller cell hypothesis are discussed on the basis of our results.

203

OSCILLATION OF MEMBRANE POTENTIAL IN THE GANGLION CELLS OF PHOTOSENSORY PINEAL.

Y. MORITA, M. TABATA, and T. NAKAMURA* First Dept. of Physiol., Hamamatsu Univ., Sch. Med., *Grad. Sch. Electr. Sci. Technol., Shizuoka Univ., Hamamatsu.

Ganglion cell responses were obtained intra- and extracellulary from the isolated pineal organ of lamprey, Lampetra japonica. Most of ganglion cells showed spontaneous firing in darkness and the inhibition of impulses with the hyperpolarization by light. In some ganglion cells, however, oscillatory membrane potentials were found in darkness. The amplitude and the frequency of these oscillations were 5-10 mV and 0.5-1 Hz, respectively. With the increase of background light intensity, the amplitude of the oscillatory potential showed a slight increase at the level of milli lm/m^2, but decreased almost linearly with the log intensity of background light. Complete inhibition of the oscillations was observed at 1-10 lm/m^2. When spikes were on each peak of these potentials, inhibition of spikes and then slow oscillatory potentials were observed. Some extracellular recordings also showed the burst firing in darkness and the supression by light as recorded intracellulary. The study of increasing the external K^+ ion concentration suggested that the oscillation was not caused by the depolarized membrane potential. A possible reverberating interaction among neural elements for these oscillations was proposed.

204

FARADAY EFFECT OF BRIGHTNESS SENSATION

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

It was studied whether the brightness sensation was related with optical activity of the eye. By means of the rotating disc method, the mono-chromatic linearly polarized light at a constant state in the direction of the geomagnetic field was received perpendicularly at the center of a complete dark-adapted eye, at a constant luminance and for a constant period. Red light was felt slightly brighter in the right eye than in the left eye, while blue light was felt slightly brighter in the left eye than in the right eye. A similar result was obtained in the opposite direction. It can be noted that red light into the right eye behave as if dextrorotatory, and blue light into the left eye behave as if levorotatory. A similar trend was also observed for natural light in parallel direction to a magnetic field. Both for plane natural light and linearly polarized light, the brightness sensation was slightly different between the right and left eyes, when they were projected in parallel with the direction of magnetism.

205

RECEPTIVE FIELD ORGANIZATION OF COLOR-OPPONENT BIPOLAR CELLS IN THE CARP RETINA.

G. MITARAI & M. SAKAKIBARA. Dept. of Aerospace Physiol., Res. Inst. Environment. Med., Nagoya Univ., Chikusa-ku, Nagoya.

Sixty six bipolar cells were identified in the isolated carp retina under photopic state and their wavelength dependent receptive fields examined by using procion-dye-filled micropipets for staining and recording. Twenty eight of these cells were the non-color-opponent ON cell (R+/R-) and 4 the OFF cell (R-/R+). Spectral analysis of the other cells revealed that 13 belonged to R+/G-, 8 to R+/R+G-, 8 to R+G-/R-, 2 to double opponent R+G-/R-G+, and 3 to R-/R-G+ type. Most of the color opponent cells were roughly devided into two groups by their size of receptive field center, one having about 0.4 mm dia and the other 0.8 mm. Both were two or three times larger than those of the rod bipolar cells. In contrast, 5 out of 8 R+G-/R- cells and the double opponent cells obtained had a very small center. Their center-opponency was only detectable when stimulated by a spot having dia less than 100 um. The spatial antagonism of the color-opponent bipolar cells found so far was mostly depend on the red cone input. In this respect, cells having the surround-opponency with achromatic center obtained in this study presented some discrepancy. The present results, however, strongly suggested that the opponent-center of the bipolar cell was activated dominantly by the directly connected cones and the surround-opponency by the C-type horizontal cells.

206

EFFECTS OF GABA-ANTAGONISTS ON NEURONAL ACTIVITIES IN THE DISTAL RETINA OF THE CARP;

E.-I. MIYACHI, Y. SHIMODA AND M. MURAKAMI, Dept. of Physiol., Keio Univ. Sch. Med., Shinjuku-ku, Tokyo.

In the previous report (J. Physiol. Soc. Jpn., 1979), we have suggested that, in the carp retina, the feedback pathway from horizontal cells to cones plays an essential role in the neuronal mechanisms of transformation from the trichromatic process in the cones to the opponent colour process in the horizontal cells. This suggestion is now further supported by the present experiment which observed the effects of GABA-antagonists, picrotoxin and bicuculline, on the neurones of the distal retina. Both of the antagonists similarly depolarized the H1 horizontal cells and enhanced the responses to red light. In H2 cells, the membrane potential was also depolarized and the depolarizing responses to red light were selectively suppressed, resulting in monophasic hyperpolarizing spectral response curves in several successful cases. These effects were obviously antagonistic to those observed by GABA application, suggesting that GABA is a putative neurotransmitter mediating the feedback pathway.

207

BIPOLAR, AMACRINE AND IP CELLS IN THE DACE RETINA: - PHYSIOLOGY AND MORPHOLOGY - HASHIMOTO, Y., INOKUCHI, M., UMINO, O. AND KATAGIRI, Y. Dept. of Physiol. Tokyo Women's Med. College, Shinjuku-ku, Tokyo 162.

Bipolar, amacrine and IP cells in the dace retina were studied physiologically and morphologically. 1) Bipolar cells are subdivided into two types, a non-color-coded cells and a color-coded cells. They have an antagonistic center-surround organization in the receptive field. The non-color-coded cells are further divided into two types, an on-center and an off-center cells. The on-center cells are characterized by the terminal of the proximal process is located in sublamina b, while that of the off-center cells located in sublamina a. The color-coded cells are double opponent type, and the terminal of their proximal process is located in sublamina b. 2) Amacrine cells are further divided into two types, a sustained-cells and a transient-cells. The sustained-cells are further divided into on- and off-cells, and responded with steady potentials to light associated sometimes with small oscillation. The processes of these cells are ramified in a single layer of the IPL. The transient-cells are further divided into on-, off-,and on-off-cells. Suppressive effect from surround area is observed in some of the on-off-units. The processes of these cells are bistratified in the IPL. 3) The response pattern of IP cells closely resembles the response of bipolar and amacrine cells (on- and off-types) The perikaryon of most of these cells lies in the amacrine cell layer, and is usually large in size. Distal and proximal processes arise from the soma directly and extends widely in both plexiform layers. The majority of these cells resembles the dopaminergic interplexiform cells in the goldfish retina.

208

IONIC MECHANISMS UNDERLYING THE DEPOLARIZING PHOTORESPONSE OF ON-CENTER BIPOLAR CELLS IN THE CARP RETINA. A. KANEKO, M. TAUCHI. Dept. Inform. Physiol., Nat'l Inst. Physiol. Sci., Okazaki.

In the photopic state, carp bipolar cells receive dominant input from red-sensitive cones. In response to a spot illumination covering the receptive field center, on-center cells show a depolarizing response. The ionic mechanisms underlying this depolarization was studied from the effect of membrane voltage on response amplitude under a voltage clamp condition, and from the effect of external ions. Using double-barrelled microelectrodes, bipolar cells were penetrated in the photopic retina under a constant background (1 lumen/m^2). When the membrane potential was clamped at the dark level (ca -40 mV), spot illumination evoked an inward current with a time course similar to that of the control voltage response. The inward photocurrent was reduced at higher clamping voltages and the polarity reversed at +50 mV: it was enhanced when the membrane was hyperpolarized below the dark potential level. Similar changes were observed when the membrane potential was changed by injecting constant current. When the synaptic input was blocked by adding Co^{2+} in the medium, the cell was depolarized to a potential level close to the peak depolarization produced by spot illumination, and this depolarization was dependent on external Na^+. All these data indicate that the depolarizing response of on-center bipolar cells is produced by increasing membrane conductance to Na^+, as a result of reduction of cone transmitter substance by illumination.

209

ELECTRICAL PROPERTIES OF BIPOLAR CELL RESPONSES TO GLUTAMATE AND ASPARTATE IN THE CARP RETINA

KONDO, H. AND TOYODA, J. Dept. of Physiol., St. Marianna Univ. Sch. of Med., Kawasaki

In order to test the possibility that L-glutamate and L-aspartate act as the transmitter from photoreceptor, their effect on on-center bipolar cells was analysed in the carp retina. These amino acids applied extracellularly by pressure injection produced hyperpolarizing potential changes which were not blocked by Co++. When applied at different retinal layers, they were most effective at the outer plexiform layer. It is suggested from these results that these chemicals act on the subsynaptic membrane. When the reversal potential of glutamate and aspartate responses was studied by polarization of the bipolar cell membrane by current, two different ionic mechanisms were distinguished. In some cells the hyperpolarizing responses appear to be due to an increase in K+ and/or Cl^- conductances, since their polarity was reversed by hyperpolarization of the membrane. In some others they appear to be due to a decrease in Na+ conductances, since they showed a positive reversal potential. These results are consistent with the two ionic channels suggested for rod and cone input; Na+ channels for rods and K+ and/or Cl^- channels for cones. It is suggested that glutamate and aspartate act as the natural transmitter from both rods and cones.

210

Sharpening of the angular sensitivity in the higher order neurons of the compound eye of crayfish. H. SUZUKI and K. TASAKI. Dept. of Physiol., Tohoku Univ. Sch. of Med., Sendai.

Three types of cells, receptor cells, lamina monopolar cells and medulla externa cells in the compound eye of intact crayfish, were identified by the intracellular HRP injection. These cells showed depolarization, hyperpolarization and depolarization superposed by spikes respectively to 1 second light flashes. As the stimulus intensity increased, the responses became larger and then saturated except that the number of spikes decreased suddenly at a certain intensity and maintained a low discharge rate. Aerial acceptance angles, the half value width of angular sensitivity curve, of these cells were 25.2°, 8.8° and 4.9° respectively in dark and 5.0°, 2.5° and 0.9° under the light adaptation which caused prolonged depolarization of 15 mV in the receptor cell. Aquatic acceptance angles of receptor cells were 7.2° in dark and 1.9° in light. These results suggest the existance of sharpening mechanisms which underlie the narrow acceptance angle of the higher order neurons at the level of lamina and medulla externa and the high visual acuity of the compound eye under the normal optical environment in which this animal lives.

211

RELEASE OF TRANSMITTER FROM OPTIC NERVE TERMINALS, SAWADA, S. AND YAMAMOTO, C. Dept. of Physiol., Faculty of Medicine, Kanazawa Univ., Kanazawa.

Thin slices of the lateral geniculate nucleus (LGN) of the guinea pig were prepared and excitatory postsynaptic potentials (EPSPs) elicited by electric stimulation of the optic tract were recorded in vitro from single LGN neurons. Generation of inhibitory postsynaptic potentials was blocked with bicuculline added to the medium at 1 μM. In most neurons, the amplitude of EPSPs decreased successively and approached a steady level during repetitive stimulation at 28 or 56 Hz. On the assumptions that the reduction in successive EPSP amplitude was due solely to depletion of the available pool of the transmitter and that the rate (α) of recovery of the transmitter pool was proportional to the net loss of the pool, the ratio(r) of the amount of transmitter released by a single stimulus to the available pool in the terminals was calculated. The values of r and α varied widely from neuron to neuron, r ranging between 0.32 and 0.9 and α between approximately 0 and 9/sec. In the presence of serotonin (20μM), the amplitude of EPSPs decreased to about 25% of control with a proportional decrease in the value of r. Serotonin, therefore, seems to block transmission in the LGN by reducing the amount of liberation of the transmitter from optic nerve terminals.

212

OPPONENT-COLOR CELLS OF THE CHIPMUNK DORSAL LATERAL GENICULATE NUCLEUS, I. SUMITOMO, M. SUGITANI and K. IWAMA. Dept. of Neurophysiol., Inst. of Higher Nervous Activity, Osaka Univ. Medical School, Nakanoshima, Osaka

Responses to color stimulation of relay cells to the dorsal lateral geniculate nucleus were studied in urethane-anesthetized, immobilized chipmunks (Tamias sibiricus asiaticus). Identification of the relay cells was based on the response patterns to electrical stimulation of the optic chiasm and visual cortex. (1) Of 176 cells, 20 (11.4%) had receptive field centers showing spectrally opponent responses. All these cells were categorized as B/G type; 15 were excited by blue and inhibited by green (+B-G) and the other gave off-responses to blue and on-responses to green (-B+G). (2) Both +B-G and -B+G cells had the neutral point at 480-500 nm. (3) Though response latencies of the non-color cells to optic chiasm stimulation were distributed from 1.3 to 8.1 msec, those of the opponent-color cells were notably concentrated in a range from 2.0 to 3.6 msec.

213

TEMPORAL CHARACTERISTICS OF THE LGB CELLS IN MONKEY FOR MONOCHROMATIC LIGHT STIMULI

M.TAKEBAYASHI, M.TONOIKE, Y.KURIOKA. Electrotechnical Laboratory(Osaka), Nakoji, Amagasaki, 661

The LGB cells in monkey are classified as two main types due to spectral responses ; the Broad-Band and the Color-Opponent type. It is known that these two types of cells have different time courses of responses.

The latencies of two types of cells were measured at several light intensity levels(10^{-1} 10^{3} troland) for each wavelength and were compared. As the results, it is shown that when the light intensity level is changed, the latency of the Broad-Band type cell changes widely for long-wavelengths, while that of the R-G type Color-Opponent cell changes less for any wavelength, and the Y-B type has intermediate performance.

214

VISUAL RESPONSE PROPERTIES OF RAT VENTRAL LATERAL GENICULATE NEURONS RESPONDING TO ELECTRICAL STIMULATION OF THE SUPERIOR COLLICULUS.

T. NAGATA, Y. HAYASHI & F. MORITA. Dept. Physiol., Hyogo College of Medicine 1-1 Mukogawa-cho, Nishinomiya, Hyogo

Visual and electrical response properties of neurons in the ventral lateral geniculate nucleus(LGV) were studied in rats anesthetized with urethane by recording single units and applying visual stimulus and electrical stimulation of the rostral(SCr) and caudal parts(SCc) of the superior colliculus.

Receptive field properties of visual neurons in LGV were divided into 5 types: ON-tonic(62.7%), ON-inhibited(9.0%), ON-OFF-inhibited(4.5%), OFF-inhibited(1.5%) and movement sensitive(22.4%). Most of LGV neurons especially those with receptive field of ON-tonic type were activated antidromically and/or orthodromically by stimulation of SCr and SCc. Antidromic response latencies ranged from 0.8 to 15ms (mean 2.6ms) and orthodromic ones from 0.9 to 14ms with two distinct groups, short- and long-latency. No difference were found in effectiveness of activating LGV neurons between SCr and SCc stimulation.

215

NORADRENERGIC INFLUENCE OF LOCUS COERULEUS STIMULATION ON LATERAL GENICULATE NEURONS IN RATS.

NEGI, T., SUGITANI, M. and IWAMA, K.
Dept. of Neurophysiology, Inst. of Higher Nervous Activity, Osaka University Medical School, Kita-ku, Osaka 530.

In urethane-anesthetized rats, effects of electrical stimulation of the locus coeruleus (LC) on neuronal activity of the lateral geniculate nucleus (LGN) were examined. Stimulation of LC with a train of pulses lasting for several seconds strongly increased discharges of the majority of LGN cells. This facilitatory influence was blocked by iontophoretic application of phentolamine, an α-blocker. Propranolol, a β-blocker, was ineffective. After a treatment with α-methyl-p-tyrosine, few cells were facilitated upon LC stimulation. In some LGN cells LC stimulation acted first to depress the discharges temporarily and then to facilitate them. Though few in number, some cells recovered from the LC-originating depression after a treatment with α-methyl-p-tyrosine. These results suggest that LC yields a facilitatory influence on LGN cells via α-adrenergic receptor, and an inhibitory influence on some cells.

216

RESPONSE PROPERTIES OF THALAMIC RETICULAR CELLS IN CATS. HADA, J., HAYASHI, Y., YAJIMA, Y. & NAGATA, T. Dep. of Physiol., Hyogo Coll. Med., Nishinomiya, Hyogo.

The response properties of thalamic reticular(TR) cells, which may be responsible for inhibition induced by stimulation of the orbital cortex(OCx) of relay cells in the lateral geniculate nucleus(LGN), were studied in cats anesthetized with N_2O/O_2. TR cells were identified by repetitive discharges in response to stimulation of the optic chiasm (OX) and the visual cortex(VC) and histologically by depositing fast green dye. Response latencies of initial spikes to OX stimulation ranged from 1.1 to 8.9 msec(mean 3.9 msec) and those to VC stimulation from 0.5 to 8.1 msec(mean 3.2 msec). Conduction velocities of the optic tract fibers ranged from 2.4 to 32.1 m/sec(mean 11.7 m/sec). Most of TR cells showed binocular visual responses of the ON-OFF phasic type. The average size of the receptive field center was 93.2 deg.^{2}. Among 40 TR cells 21 fired with a single or burst discharges to OCx stimulation. However, no significant difference was seen in response properties between TR cells which responded to OCx stimulation and those did not. Unitary discharges satisfying the same criteria as TR cells were also encountered in the LGN and found to have similar response properties.

217

DEVIATION OF AVERAGE EYE POSITIONS IN OPTOKINETIC NYSTAGMUS OF CATS. T. HAMADA . Bionics Sec., Electrotechnical Lab., Umezono 1-1-4, Sakura-mura, Niihari-gun, Ibaraki 305.

Cats with restrained head motion faced a large screen on which a visual noise pattern was projected and moved horizontally at a rate of 1.5-17 °/sec. Horizontal electro-oculogram showed elicited optokinetic nystagmus.

Because almost every amplitude of quick phases predominated slightly over that of slow phases, the average eye position shifted gradually in the direction of the quick phases untill the limitation of natural eye movements. When vertical stripes were employed, the optokinetic nystagmus were unstable but the predominance of quick phases was still apparent. In vestibuloocular reflex with passive head rotations in dark , the average eye position shifted gradually in the direction of quick phases in a similar way.

These observations indicated that the predominance of quick phases was attributable not to the visual system but to the oculomotor one.

218

BAND OF NOISE UNITS IN THE CAT AUDITORY CORTEX. SAITOH, K., KUDOH, M. and MARUYAMA, N. Dept. of Neurophysiol., Brain Research Inst., Niigata Univ., Niigata.

We have already reported that about 50% of the auditory cortex units responded better to bands of noise than pure tones in cats paralyzed with flaxedil. Based upon the best bandwidth (B.B.W.), these units were divided into 3 types; N type (B.B.W. < 50 Hz), M type (B.B.W. ≃ 180 Hz) and W type (B.B.W. > 1,000 Hz). For these units, bands of noise of FM type (FM-BN; where frequency fluctuates in a random way) had almost the same effect as those of AM type (AM-BN; where amplitude fluctuates in a random way). In the present experiments, some of N type units responded only to the amplitude change of the stimulus. Therefore, N type units should be divided into 2 subgroups. The responses to AM- and FM-BN were compared for M and W type units; the inputs to these units may consist of frequency-domain-dependent inputs and time-domain-dependent ones. In addition, for some band of noise units, amounts of responses of each unit to AM-BN at the B.B.W. were represented as iso-spike-count contours on a frequency-intensity plane, i.e., a 3-dimensional figure. It exhibited several summits and, therefore, it was suggested that the band of noise unit receives inputs from several different populations.

219

A STUDY ON THE MECHANISM OF VOICE DISCRIMINATION. — FORMANT DETECTORS IN THE AUDITORY CORTEX — MARUYAMA, N., SAITOH, K. and KUDOH, M. Dept. of Neurophysiol., Brain Research Inst., Niigata Univ., Niigata

In the present experiments, units responsive exclusively to synthesized formants were found in the auditory cortex of the cats paralyzed with flaxedil. The synthesized formant was generated by using a low-pass filtered white noise to modulate an amplitude of a saw-toothedly frequency-modulated tone. The spectrum of the synthesized formant mimics one of the formants in a spectrum of a cat's cry. The results were based on a study of 199 units. Out of 50 units, to which both pure tones and bands of noise were not at all or hardly effective, 15 were found to be responsive to the synthesized formants, in terms of sustained response. The effective range of formant frequency in each unit was so restricted that 2 - 10% deviation of the formant frequency made the stimulus ineffective. These units might act as formant detectors in the auditory cortex.

220

A SUPPRESSIVE FUNCTION OF THE CORTICOFUGAL PROJECTION UPON THE INFERIOR COLLICULUS STUDIED BY THE [^{14}C]DEOXYGLUCOSE TECHNIQUE. IKUO TANIGUCHI. Dept. of Physiol., Dokkyo Univ. Sch. of Med., Mibu, Tochigi.

Cortical neurons with axons reaching the inferior colliculus were identified by the retrograde tracing with horseradish peroxidase. When the cortical regions containing these neurons were stimulated by electric shocks simultaneously with sound stimulation to the ear, a decrease in the uptake of [^{14}C]deoxyglucose occurred in the ipsilateral inferior colliculus, but metabolic activity increased in the ipsilateral medial geniculate body. These results suggest that the auditory cortex is perhaps exerting a suppressive influence on the inferior colliculus.

221

ORIGIN OF THE DECREMENT RESPONSE IN THE AUDITORY NERVE FIBER

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

It is well known that the firing rates of spontaneous and sound evoked afferent impulses in auditory fibers are depressed for a while upon cessation of the stimulus sound or reduction of its intensity in various animals including the mammals. In the present study carried out on goldfish, the same line of events was demonstrated in the large auditory nerve fibers lacking spontaneous firing and the small ones with spontaneous activities. As a next step, excitatory post-synaptic potentials (epsps) were recorded from afferent fiber terminals under local application of tetrodotoxin. In some cases, intramacular microphonics, i.e., receptor potentials were also recorded concomitantly with the epsps. Then, parameters of quantal release for the chemical transmission at the synapses were estimated by binomial analysis on the distribution of the epsp size. Results of these analysis indicated that receptor potentials showed no apparent decrease in association with the special decrement response, and the decrement response was ascribed to the reduction in the size of the mean quantal content (m) produced by the reduction in the size of immediately available quanta (n), but no apparent change was observed in the release probability (p).

222

EFFECTS OF COMBINED APPLICATION OF KANAMYCIN AND FUROSEMIDE ON THE AUDITORY BRAIN STEM RESPONSES

T. TOKIMOTO, S. MATSUURA & Y. MINOWA* Dept. of Physiol. & Dept. of Otorhinolaryngol. Osaka City Univ. Med. Sch., Abeno-ku, Osaka

Aminoglycoside antibiotics are well known to produce permanent hearing loss when daily applied intramuscularly for many days, but they show no effect at a single administration. Furosemide is also known to produce temporary hearing loss which recovers to control level within a few hours. In this study, changes of auditory brain stem responses (ABRs) were examined in guinea pigs following the combined application of kanamycin and furosemide with different time intervals between the single applications of the both drugs. Permanent loss of ABR or decrease in the amplitude was observed when a single intramuscular dose of kanamycin (400 mg/kg)was followed within a few hours by a single intravenous application of furosemide (60-100 mg/kg). With longer intervals than about 4 hours between their applications, transient decreases ascribed to the effects of furosemide alone were demonstrated in the amplitude of the ABRs. Examination of kanamycin concentration in the blood at the time of furosemide application showed that the permanent damages of hearing relate more intimately to the concentrations (more than ca. 300 ug/ml)than the time intervals between the drug applications. A discussion was conducted on the origin of the severe hearing loss.

223

ACTION OF DIVALENT CATIONS INJECTED INTO THE SCALA MEDIA ON COCHLEAR POTENTIALS.

A. ASANUMA and K. YANAGISAWA. Dept. of Physiol., Tsurumi Univ. Sch. of Dent. Med., Tsurumi-ku, Yokohama. Y. TANAKA. Dept. of Otolaryng., Dokkyo Univ. Sch. Med., Mibu, Tochigi.

It has been known that divalent cations regulate the mechano-sensitivity of lateral-line organs. Actions of divalent cations on cochlear potentials were investigated. Divalent cations such as Ca^{2+}, Mg^{2+}, Sr^{2+}, Ba^{2+}, Mn^{2+} and Cd^{2+} were iontophoretically injected into the scala media of guinea pigs' cochlea. The cations decreased microphonic potentials in the order of Mn^{2+}, $Cd^{2+} > Ba^{2+}$, Mg^{2+}, $Ca^{2+} \gtrsim Sr^{2+}$. This decrease was a truncation in input-output functions of cochlear microphonics. However Ca^{2+}, Sr^{2+}, Mg^{2+}, Ba^{2+} increased the negative summating potentials in the scala media, whereas Mn^{2+}, Cd^{2+} decreased the summating potentials and endocochlear potentials. These results suggest that divalent cations may change the membrane properties binding with anionic sites of the hair cell membrane.

224

EXCITABILITY CHANGES FOLLOWING A SINGLE CYCLE SOUND WAVE OF THE AMPHIBIAN PAPILLA NERVE FIBERS OF THE FROG OR TOAD. OOYAMA, H., SUGAI, T., YANO, J. and CHUJO, T. Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa

The firing probability(FP) following a single cycle sine wave conditioning sound(CS) is determined by a single cycle sine wave test sound(TS). A single cycle of the characteristic frequency(CF) is used as each stimulus. Our previous study, in which the intensity of the CS was kept near the threshold, suggested the presence of a mechanical damped oscillation following the CS.

Increased intensity of the CS suppresses the FP to the TS. When the TS is a little over the threshold, at the CS/TS intensity ratio of 10, the suppression is complete during 10 to 20 msec after the CS, then the FP recovers gradually. Complete recovery takes from 100 to 200 msec. No damped oscillation of the FP is observed during the recovery except in a small number of low CF units and for a rather weak CS. It seems that the recovery takes longer in low CF units than in high CF units.

The long and monotonic recovery and the dependence of the recovery time on the CF seem to indicate that the suppression is due to some biological process central to the initial site of mechanobiological transduction.

225

ABSENCE OF TONOTOPIC ORGANIZATION OF BASILAR PAPILLA NERVE BUNDLE IN BULLFROG. YANO, J., OOYAMA, H., SUGAI, T. and CHUJO, T. Dept. of Physiol., Kanazawa Med. Univ., Uchinada, Ishikawa

The basilar papilla of the bullfrog consists of a cartilage oval ring, with long axis oriented mediolaterally. About 60 hair cells lie on the medial inside surface of the cartilage ring. The myelinated nerve bundle divides into three or four smaller branches near the papilla and they arrive at the sensory epithelium through the cartilage tissue. Single unit discharges were recorded from the nerve branches and recording sites were marked with dye (Alcian blue) ejected from the same micropipette. The characteristic frequencies (CF's) of single units range from 1800 to 2000 Hz, and fall within rather narrow band in comparison with those of the amphibian papilla (60-1200 Hz). Locations of 15 dye-marked spots scatter at random in relation of CF when they are represented on a drawing of the outline of the papilla and nerve. The results seem to suggest that the basilar papilla has a poor adility of frequency analysis and is specifically sensitive to sounds within a particular narrow frequency range.

226

NEURAL REPRESENTATION OF SPEECH PARAMETERS.
HASHIMOTO, TORU. Div. of Biocybernetics, Inst. for Medical and Dental Engineering, Tokyo Medical and Dental Univ., Surugadai, Kanda, Chiyoda-ku, Tokyo.

The neural representation of speech parameters was investigated in the higher parts of the auditory pathway, namely at the inferior colliculus and the medial geniculate of a guinea pig. A synthetic speech-like sound was used as the stimulus. It has a formant structure superimposed on the harmonic fine structure and the formant transition is also simulated though not refined enough. The speech parameters of the stimulus were easily adjusted to fulfill the frequency requirement of the auditory neuron maintaining the essential feature of human speech sounds.

The formant pattern, that is a combination of several formant frequencies specified by each speech sound, was closely related to the responsiveness of the neuron. The formant which coincided with the CF of the neuron was caused an inhibitory interaction by the nearby formants, higher or lower, of the stimulus sound, even if those frequencies were located at the range outside the conventional tuning curve. From a different standpoint it could be said that the neuron would get sensitivity to the higher or lower formant, which was otherwise ineffective to the neuron without the aid of the formant near CF in the given speech sound.

227

CHANGES OF NEURAL ACTIVITIES IN THE BRAIN STEM AUDITORY PATHWAY OF THE RAT AFTER COCHLEAR DESTRUCTION: K. MURATA, J. HORIKAWA and H. FUNAI, Dept. Neurophysiol., Med. Res. Inst., Tokyo Med. & Dent. Univ., Tokyo.

Immediately after the unilateral cochlear destruction, uptake of [14C]-2-deoxyglucose in the cochlear nucleus ipsilateral to the intact ear(iCN), the contralateral superior olivary complex(cSO), and the contralateral inferior colliculus(cIC) was higher than that in cCN, iSO, and iIC. After four weeks, however, the uptake in the iSO and iIC recovered to some extent. The unilateral destruction reduced an amplitude of the evoked potential of the iIC, while it caused little change in that of the cIC. The reduced potential began to recover about ten days after the destruction and attained to 60% of the control after four weeks. The ipsilateral stimulation excited 20% of the IC neurons, inhibited 32%, and gave no effect to 48% in the intact rats. More than one month after the destruction the proportion was changed to 65, 12, and 23% respectively. From these facts, the recovery of the iIC activity might result from the reduction of inhibition and the augmentation of excitation in the pathway to the iIC.

228

DEPENDENCE OF CM INPUT-OUTPUT FUNCTION ON SOUND-PRESSURE LOADING RATE.
H. UCHIYAMA. Dept. of Neurophysiol., Medical Research Institute, Tokyo Med. & Dent. Univ., Kanda Surugadai, Chiyoda-ku, Tokyo

For understanding of the process underlying CM response dependent on sound-pressure loading rate, observations were made on the time-dependent response under high constant SPLs. CM was recorded on guinea-pigs with an intracochlear(ST) electrode, 1.2 - 1.3 mm distant from the RW edge. CRO picture of CM to repeated 1 sec. tone bursts(2 dB step or 5 sec. interval) showed a systematic envelope change with SPL or time: monotonic reduction, its increase in rate and depth, transition from fall to rise, decrease in interval until this minimum with increasing rise-rate and then disappearance of the preceding fall. The last was recovered to the above different stages according to resting interval. The minimum formation was confirmed in 5 min.-post-mortem CM. The above phenomena are to be ascribed to configuration change of linear molecules of an elastic substance under consideration, in which resistance against motion of the segments decreases by uncoiling and elastance increases by cristallization. In our nonlinear Voigt model(1970), the dash-pot thus represents such resistance and the spring concerns entropy force. If it exists in Corti-Tectoria complex, probably in the cilia, the apparent elastance changes control the stress changes inside of the hair cell to induce correspondent CM changes. The situation should be same in the input-output function also.

229

ADAPTATION IN HAIR CELL ORGANS
FURUKAWA, T. Dept. of Physiol., Tokyo Med. & Dent. Univ., Sch. of Med., Bunkyo-ku, Tokyo 113.

Excitatory postsynaptic potentials were recorded from afferent fiber terminals in goldfish's ear, and their amplitude was used to plot input-output functions for the start of sound and for intensity increment or decrement imposed on adapting sound. The procedure gave a series of sigmoid curves which ran almost parallel. It was found that saturation of responses was brought about by non-linear summation of excitatory postsynaptic potentials, and that adaptation produced a rightward shift of response curves along the intensity axis. Clearly adaptation served to expand the dynamic range of fibers and gave them the ability to respond sensitively to changes in sound intensity. The reasoning was supported by increment threshold curves which indicated that the Weber's law held for a wide range of sound intensities. A great deal of similarities existed between adaptive behavior of the present material and that of photoreceptor cells, although the underlying mechanisms seem quite different. Adaptation in hair cell organs could mostly be attributed to modifications in the process of transmitter release from hair cells.

230

PERIPHERAL RESPONSE OF MONGOLIAN GERBIL TO ULTRASONICS. T. KAMADA, N. YONEZAWA and K. KAMEDA. Dept. of Physiol., Hokkaido Univ. Sch. of Dentistry, Kita-ku, Sapporo

Rodents communicate using ultrasonics (J. Physiol. Soc. Japan, 41:355). To elucidate the mechanism of hearing the ultrasonics, we examined the cochlear microphonics (CM), compound action potentials (N_1, N_2) and single unit activity of the auditory nerve. Adult mongolian gerbils (Meriones unguiculatus) of about 50-60 g weight were used. CM was recorded at the round window by Pt-electrode. Compound action potential was obtained by averaging round window responses using ATAC-250 (Nihon Kohden). Unit activity was recorded through glass microelectrode aimed at the auditory nerve as described by Sokolich (J. Acoust. Soc. Amer. 54:283).

Threshold of CM was lowest around 2-8 kHz, and higher at ultrasonic range, although well within the response area. Threshold curve of action potential was similar to that of CM. The analysis of unitary discharge is still under way, and not a very large number of units were obtained. Response areas of units with characteristic frequency higher than 10 kHz seemed to be narrower than those of lower characteristic frequency, but we need further analysis to be conclusive.

231

AN INVESTIGATION OF SOUND EFFECT ON THE PHYSICAL STRENGTH
ITOW, H. and FUJITA, Y. Physical Education, Education, Waseda Univ., Tokyo

For physical strength we preferred the static physical strength (here we chose the grasping power), and for the sound we used that from the recorded tape (of the headphone) which originally produced by a metronome.

The measurement was done after the sports test system of Ministry of Education. During the measurement we let the subjects keep the utmost efforts relating to the existence or non-existence of the sound, and we recorded the change of the power in the curved line.

Now we are convinced that sound has a certain effect on physical strength.

232

DISTRIBUTION AND FINE STRUCTURE OF TASTE BUDS IN FISH. KITOH, J., KIYOHARA, S.* AND YAMASHITA, S.* Dept. Anat., Sch. Med., Nagoya Univ., Nagoya, * Biol. Inst., Lib. Arts Col., Kagoshima Univ., Kagoshima

The distribution of taste buds and their fine structure in the minnow, Pseudorasbora parva, were studied light-(LM), scanning electron-(SEM) and transmission electron-microscopically(TEM). LM and SEM observations indicate that the taste buds are widely distributed on the skin, lips, mucosa in the oro-pharyngeal cavity, esophagus and branchial apparatus. The total numbers of external and internal taste buds in a specimen of 6 cm in length were 1,486 and 6,600, respectively. High concentrations of taste buds to reach over 140 per mm^2 were found on the inner lips, gill arches and rakers, and palatal organ. Three different cell types, tubular(T-cell), filamentous(F-cell) and basal cells were recognized in the buds with TEM. In the central part of the bud, each T-cell is surrounded by F-cells which are characterized by the bundles of filaments and electron opaque granules. T-cells have many tortuously tangled tubules in the supranuclear region. Some tubules extend to a rod-shaped apical process which protrudes slightly beyond the general epithelial surface, and it was detected that they open to the apical surface.

233

ADENYLATE CYCLASE ACTIVITY IN SOME MAMMALIAN TASTE BUDS
NOMURA, H. AND ASAMUMA, N. Dept. of Oral Physiol., Matsumoto Dental Coll., Shiojiri

The localization of adenylate cyclase activity in the fungiform, foliate and circumvallate papillae of rats, rabbits, dogs and cats was determined by light and electron microscopic histochemistry using a newly deviced incubation medium, the pH of which was 8.9. Light microscopic study revealed that adenylate cyclase activity is localized not only at the apex of taste buds but also in the endothelial cells of blood vessels or capillaries and in the Ebner's gland cells. The adenylate cyclase activity present at the apex of taste buds was detectable in all the papillae of rats, rabbits, dogs and cats except for the fungiform papillae of rabbits, but the amounts of reaction product were varied in different papillae in parallel with the sensitivity to NaCl. When 0.4M NaCl, KCl, Na benzoate, choline Cl, Na acetate or urea was added to the incubation medium, the formation of reaction product for adenylate cyclase activity was depressed by the former four salts. Since Na benzoate gives only a weak salty taste, the depression of adenylate cyclase activity by salts may not be related to the sensitivity to salty substances. These results suggest that cyclic nucleotide may be involved in the common transduction process of taste cells in mammals.

234

ANALYSIS OF THE INITIAL CHORDA TYMPANI RESPONSE TO GUSTATORY STIMULI. HARADA, S. and Y. KASAHARA. Dept. of Oral Physiol., Kagoshima Univ. Dent. Sch., Kagoshima

Taste response recorded from the rat chorda tympani was integrated by using 0.1 sec time constant. Taste stimulus was applied by a flow chamber style taste stimulator with two magnetic valves which could switch over rinsing water and taste solution instantly. Obtained integrated response was A-D converted using 2 msec sampling time and analyzed by an ATAC-2300 computer system.

Each time from the start of the stimulation to the appearance of the response (lag time) for NaCl, KCl, $CaCl_2$,HCl and Quinine-HCl of varying concentration was ranged in one lag time-concentration curve, and it was about 150 msec for 0.01 M. Whereas the lag times for acetic acid and sucrose were much longer than that for the other stimuli (0.01 M acetic acid:290 msec, 0.3 M sucrose:650 msec), and the lag time-concentration curves for them were widely separated from that for the other. The time from the start of the stimulation to the peak of the response for NaCl at different concentration were similar to each other (about 550 msec), though that to the other stimuli had a tendency to decrease with increasing concentration. This tendency was much clear for acid stimuli as HCl and acetic acid.

These difference in time course might be important to the discrimination between taste qualities.

235

INFLUENCE OF EXPERIENCE OF SUCROSE INTAKE ON GUSTATORY NERVE RESPONSES TO VARIOUS SUGARS IN PREWEANING RATS.

YAMADA, T. and UMEZU, M., Physiol. Lab., Japan Women's Univ., Bunkyo-ku, Tokyo

The influence of experience of sucrose intake on the rat taste sensitivity during the period from the 17th to the 23rd postnatal day was studied by recording the impulses of chorda tympani nerve to lingual stimulation with sucrose, maltose, lactose, galactose, glucose and fructose. For the experience of sucrose intake a filter paper soaked in 40% sucrose solution was applied to the tongue of half pups in each litter ranging from 2 to 15days. The control half were given only water by the same method.

The results obtained were as follows: (1) The mean relative magnitudes of neural responses to six sugar solutions of 0.3 M obtained from control group were sucrose: maltose: lactose: galactose: glucose: fructose = 100: 87: 72: 65: 47: 44. (2) In the test group which was subjected to sucrose, gustatory neural responses to sucrose and maltose became larger than those in the control group, but no significant differences in the responses to other sugars (lactose, galactose, glucose and fructose) were found between the two groups.

236

ENHANCEMENT OF FROG GUSTATORY NERVE RESPONSE TO SALT STIMULI AFTER ADAPTATION TO ACID SOLUTION.

SUGIMOTO, K., SATO, T. and OHKUSA, M. Dept. of Physiol., Fac. of Dent., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo

After the frog tongue was adapted to acid solutions for 10 sec, change in gustatory nerve and cell responses to a variety of salt stimuli was investigated. Action potentials in gustatory nerves and receptor potentials in taste cells were recorded with silver wire electrode and glass capillary microelectrode respectively. The phasic gustatory nerve responses to various salt stimuli such as 0.1 M solutions of NaCl, LiCl, KCl and NH_4Cl, 0.01 M $CaCl_2$ and 0.03 M $MgCl_2$ were potentiated remarkably after adaptation to 1 mM solutions of HCl and acetic acid in comparison with the responses after water and Ringer adaptation. The enhancement of phasic neural responses to salt stimuli became larger as the concentration and presentation period of adapting acid solutions increased. The tonic responses to 0.1 M NaCl, 0.1 M LiCl, 0.1 M KCl and 0.03 M $MgCl_2$ of six salt solutions were enhanced following 1 mM HCl and 1 mM acetic acid adaptation compared with those after water and Ringer adaptation. In receptor potentials of taste cells, the magnitudes of initial responses to 0.3 M NaCl after 10 sec adaptation to 1 mM HCl were significantly larger than those after water and Ringer adaptation. This potentiation of initial responses in taste cells may correlate with the enhancement of phasic neural responses to salt stimuli.

237

TEMPORAL PATTERNS OF THE GUSTATORY IMPULSE TRAINS - A CLASSIFICATION OF UNIT TYPES.

UEDA, K. AND NAGAI, T. Zool. Inst., Fac. Sci., Univ. Tokyo., Bunkyo-ku, Tokyo and Dept. Physiol., Teikyo Univ., Sch. Med., Itabashi-ku, Tokyo

Impulse discharges of 27 rat chorda tympani nerve fibers elicited by the gustatory stimulations (0.1 M NaCl, 0.5 M sucrose, 0.01 N HCl, 0.02 M quinine-HCl, 0.3 M KCl, and 0.02 M saccharin-Na) were recorded. The interspike interval histogram, joint interval histogram, serial correlogram, and autocorrelogram were made to study the temporal patterning of impulses, while the number of impulses during the first 5 sec after stimulation was counted to examine the across-fiber patterning of responses. We classified the chorda tympani nerve units into three types according to the temporal patterns of impulse discharges and the magnitude of responses. The units predominantly responsive to NaCl and irresponsive to sucrose were classified as type I. The remaining units, which moderately responded to both NaCl and sucrose, were further divided into type II and type III depending on their temporal patterns of impulse discharges. The type II units tended to show the rhythmic or burst-like firing of impulses in response to more than one kind of taste stimuli. The type III units showed the different temporal patterns between 0.1 M NaCl and 0.5 M sucrose stimulation. The results show that the taste quality is represented in the characteristic temporal patterning of impulses as well as in the across-fiber patterning of responses.

238

CYCLIC AMP—NOREPINEPHRINE CONCERNING WITH TASTE RECEPTOR MECHANISM.
SHIMOTAHIRA, K. AND Y. KASAHARA, Dept. of Oral Physiol., Kagoshima Univ. Dent. Sch., Kagoshima

Previous reports from our laboratory have indicated cyclic AMP, theophylline and norepinephrine had increased summated responses of chorda tympani to four basic taste stimuli in the rat. In the present study, it is demonstrated by using 50 male rats that this effect is closely connected with α-adrenergic action of the catecholamines. When α-receptor blocking agents (i.e. naphazoline 100μg/kg, ergotamine 1.3mg/kg or yohimbine 390μg/kg) were administered, taste enhancing effects of cyclic AMP and norepinephrine were vanished. It took about 15 min. to show maximum efficacy of these drags and effects continued 30 min. or more. On the contrary, β-adrenergic agents (epinephrine, isoproterenol 200μg/kg) and β-receptor blocking agent (propranolol 2mg/kg) had not any effect on taste receptor. All drugs used in this experiment had no effects if they applied directly on the tongue. These results indicate the cyclic AMP—norepinephrine and α-receptor may have some role in taste reception.

239

ANTIDROMIC INHIBITION ON AFFERENT RESPONSES IN THE GLOSSOPHARYNGEAL(IXth) NERVE IN FROGS.
N. MURAYAMA, N. ISHIKO. Dept. of Physiol., Miyazaki Med. Coll. Miyazaki

The depressant effect of antidromic stimulation of the bullfrog's IXth nerve on the responsiveness of the fungiform papillae to 4 qualities of taste stimuli was studied. As antidromic stimuli, electric pulses of 100 Hz in repetition rate was applied for 10sec. They depressed the IXth nerve responses to NaCl, acid and water to 40-50% of the control. The depression was less than 10% in quinine response and was little in tactile response. To clarify the type of IXth nerve fibers contributing such the depression, a single papilla receiving sensory fibers from the two IXth nerve branches was stimulated by perfusing taste solutions through a suction electrode. Following antidromic stimulation of a IXth nerve branch consisting of fibers of known type, NaCl response of the other branch was compared with the response without the stimulation. Antidromic volleys mediated through slow-adapting mechano-, quinine-, NaCl- and acid-sensitive fibers were found capable of depressing NaCl response by 35, 20, 16 and 7%, respectively.

240

RESPONSIVENESS TO TASTE STIMULI OF THE SOLITARY TRACT NUCLEUS NEURONS AND THEIR PROJECTIONS TO THE DORSAL PONS.
H. OGAWA, T. IMOTO, T. HAYAMA. Dept. of Physiol., Kumamoto Univ. Med. Sch., Honjo, Kumamoto.

While stimulating the tongue with taste solutions, 67 taste neurons in the solitary tract nucleus of anesthetized SD strain rats were recorded and tested for their projections ipsilaterally to the parabrachial nucleus. Nineteen neurons among them received antidromic invasions (1-7 msec in latency) from the parabrachial nucleus, but 35 neurons did not. The rest could not be classified into either group. Both relay and inter-neurons were classified according to the responsiveness to four basic taste stimuli based on number of impulses in 5 sec after onset of stimulation. Sucrose-best neurons were relatively frequent but no quinine-best neurons were found among relay neurons. Spontaneous discharges in most of the neurons were very low. Sixteen neurons were also excited by mechanical stimulation of the tongue, and 5 of them were relay neurons. Forty-two of 46 taste neurons examined had receptive fields at the part anterior to the intermolar eminence. Relay and inter-neurons were found intermingled in the nucleus.

241

PERCEPTION OF HARDNESS AS A FACTOR OF BITING FORCE AND MOUTH OPENING SIZE.

M. WATANABE, M. TAKAFUJI, K. KARITA* and A. KANUMA. Dept. of Prosthet., Tohoku Univ. Sch. of Dent., Dept. of Physiol., Tohoku Univ. Sch. of Dent*., Sendai

Discrimination of the form and characteristics of the food is important for mastication. We performed 2 experiments in order to clarify the relationship between biting force and hardness discrimination ability. Five normal subjects were asked to bite between the incisors on a U-shaped stainless steel test piece with a rubber test plates. First, the subjects bit a reference plate, then, test plates of different degrees of hardness. The subjects assessed whether the given test plate was "harder", "softer" or "equal" to the reference plate. Comparison of the biting force and the % of misestimation for all subjects when the difference in rubber hardness was in 10° increments (Ex A) and in 5° (Ex B), showed that both the overall biting force and the overall % of misestimation was greater in B than it was in A. However, comparison of the reference plate alone in A and B showed that only the overall biting force was increased in B, but that the overall % of misestimation was not increased (2/5 increased; 2/5 decreased). The mouth opening size did not appear to influence the trend of these results. Our results generally indicate that the mechanism for the reduction of the % of misestimation is related to hardness discrimination ability. We can speculate that the receptor of the periodontal membrane performs the compensatory activity in hardness perception.

242

RESPONSE OF ENCAPSULATED ENDINGS IN THE CAT ORAL MUCOSA TO VIBRATORY STIMULATION

SAKADA, S., IIZUKA, M., AND YAMAZAKI, S. Dept of Physiol., Tokyo dent. Coll., Chiyoda-ku, Tokyo

The rapidly adapting encapsulated endings in the cat oral mucosa were divided into five classes according to the branching of the axon and the inner core. Class I followed a vibratory stimulus with 1 : 1 response from the minimum frequency ranging between 10 and 43 Hz up to the maximum frequency range between 117 and 356 Hz and had the minimum point in the frequency range from 69 to 135 Hz. The slopes of the low-frequency limbs of these tuning curves were from -0.43 to -0.96 in logarithmic coordinates. The tuning curves of classes II-V were similar to those of class I ; the minimum frequency, the maximum frequency, the minimum point and the slope were 6-40 Hz, 155-359 Hz, 54-130 Hz and -0.25--0.94, respectively. The slopes of single triangle-wave tuning curves for 22 class I endings and 7 Pacinian corpuscles in the cat penis were -0.77 ± 0.10 and -0.88 ± 0.23, respectively.

In conclusion, the encapsulated endings in cats' oral mucosa had similar threshold-frequency relationships to those of the Pacinian corpuscles in other tissues.

243

MECHANICAL SENSORY HAIRS LOCATED IN THE TIP SURFACE OF THE OVIPOSITOR AND THEIR ROLES TO OVIPOSITION IN CRICKETS.

N.AI, K.HIRAMURA, N.YAMAGUCHI. Dept. of Biol., Tokyo Gakugei Univ., Koganei-shi, Tokyo

Several kinds of short sensory hairs are observed in the tip portion of the ovipositor by SEM. Being delivered the egg to the ground, untreated female laid each egg separately. But female, whose sensory hairs were removed completely, laid the eggs with a group into the ground. These abnormal oviposition seems to be owing to the sensory neuron activity of the ovipositor. When these tip sensory hairs are stimulated mechanically with eggs, afferent impulses seems to be evoked in the tip portion of the ovipositor invaded to the 5th abdominal ganglion by the 7th lateral root. Then, adductor muscles of the ovipositor caused the phasic contraction and these movements give rise to be laid the eggs with normal orientation to the ground. Because, in the motoneurons innervated to adductor muscles(M-3) of the ovipositor, impulse burst was induced by mechanical stimulation to the tip portion of ovipositor respectively and repeatedly.

245

INHIBITION OF SELF-STIMULATION OF VENTRALIS POSTEROMEDIALIS IN THE ENCÉPHALE ISOLÉ CAT.

IKEGAMI, S. and KAWAMURA, H.* Lab. of Physiol. Psychol. and *Lab. of Neurophysiol., Mitsubishi-Kasei Institute of Life Sciences, Machida-shi, Tokyo

Effects of self-stimulation in ventralis posteromedialis (VPM) of thalamus were studied on an operant conditioning of vertical eye movements in the encéphale isolé cats. The VPM stimulation had significant inhibitory effects on eye movements, associating with significant contraction of the facial muscles. After blocking both the trigeminal (5N) and facial nerves (7N), VPM stimulation produced no suppressive effects on eye movements, abolishing facial EMG activity. Also, extracranial blockade of the 7N alone, which induced facial muscle paralysis, had the similar effects of eliminating suppression of the eye movements by VPM stimulation, although the suppressive effects were slightly less marked than after blockade of both the 5N and 7N. The blockade of all cranial nerves between the acoustic (8N) and hypoglossal nerves (12N) had no significant effects on the avoidance conditioning. The mass neural activity recorded from the 5N showed that VPM stimulation induced an increase in 5N discharge which was markedly reduced after 7N blockade. These results strongly suggest that presumably aversive or noxious effects of brain stimulation may depend on feedback circuits via the peripheral organ (muscles, blood vessels and viscera), whereas the reward effects essentially depend on neural circuitry confined within the forebrain above the rostral pons.

246

SINGLE UNIT DISCHARGES OF GLABROUS SKIN MECHANORECEPTORS IN MAN.

T. MANO and T. MIYAOKA* Dept. of Physiol. and Dept. of Psychol.*, Hamamatsu Univ. Sc. of Med., Hamamatsu

To clarify the mechanism of skin mechanoreception in man, single unit discharges of glabrous skin mechanoreceptors in the palm were recorded by a tungsten microelectrode inserted percutaneously into the median nerve in healthy human subjects. 57 identified mechanoreceptive units were classified into three types based on their responses to quantitative skin mechanical stimuli : 1) 22 slowly adapting type I units (SA-I), 2) 13 slowly adapting type II units (SA-II) and 3) 20 rapidly adapting units (RA). SA-I showed clear dynamic and static responses which increased the discharge frequency depending on the stimulus velocity and amplitude. SA-II presented mainly regular static responses which increased the frequency depending on the stimulus amplitude. The threshold of static sensitivity was higher in SA-II than in SA-I. RA showed distinct dynamic "on-off" responses of which frequency depended on the stimulus velocity until it reached the plateau frequency of 300 - 400 impulses/sec. Among these three unit types, the vibratory sensitivity was highest in RA in which vibratory 1 : 1 responses were seen up to the frequency of 500 - 550 Hz. Mean conduction velocities of the afferent fiber were 55.2 (S.D. 4.4) m/sec in 22 SA-I, 51.0 (S.D. 3.4) m/sec in 10 SA-II and 49.3 (S.D. 5.4) m/sec in 20 RA. The difference of conduction velocity between SA-I and SA-II was statistically significant ($p < 0.025$).

247

PERIODONTAL MECHANORECEPTIVE RESPONSES IN THE MESENCEPHALIC NUCLEUS V OF THE RAT

N. AMANO. Dept. of Oral Physiol., Gifu Coll. of Dent., Motosu-gun, Gifu.

The purpose of this study was to examine the response characteristics of primary periodontal mechanoreceptive neurones in the mesencephalic nucleus V (MeNV). In 17 lightly-anesthetized rats spike discharge of 35 single units was recorded using glass-coated elgiloy microelectrodes from the caudal part of the MeNV when a trapezoidal pressure and high-frequency tapping were applied to the right upper incisor, respectively. Identity of each unit as a primary periodontal one was established by brevity in the latency for single tap trials and action potential reproducibility exactly corresponding to repetitive tap stimulation of 30 Hz and more for periods of 2 sec. The results were as follows: 1) All of primary periodontal units in the rat MeNV were very rapidly-adapting, namely, they responded with a transient discharge of one or a few spikes to dynamic phases of a trapezoidal pressure stimulus. 2) No response could be elicited from the unit when the trapezoidal pressure stimulation was applied more slowly than 65 g/sec. 3) In regard to the unit's responses to high-frequency tap stimulation of the incisor, one to one following took place up to a frequency of 100 Hz. 4) Spontaneous resting discharges could be observed in 30 percent of 27 units.

248

A POSSIBLE RAT MODEL FOR CHRONIC PAIN

Y. YAMAGUCHI. Lab. of Clin. Physiol., College of Biomedical Technol., Osaka Univ., Machikaneyamacho Toyonaka Osaka

Chewing, self-mutilation of the deafferented limb and episodic abnormal scratching occurred in rats after dorsal rhizotomy from C5-T1. The areas affected were not limited to the anesthetized ones, but often extended to the adjacent regions. It was reported that such behaviors were significantly inhibited by hemisection of the spinal cord at the level of C4 or by administration of anticonvulsant drugs, being supposed to be a result of abnormal sensation, including chronic pain. The author examined effects of peripheral electrical stimulation, which are considered to be effective for reducing pain in man, applied to limbs contralateral to the deafferentation under fluothane anesthesia. The stimulation was given for 30 minutes a day during 3 weeks from the next day of the deafferentation. They clearly delayed onsets of the syndromes as well as their developments, which developed rather rapidly after cessation of the stimulation. The protective effect of peripheral electrical stimulation is another reason to believe that we have a model for chronic pain similar to that occurring in man.

249

PARTICIPATION OF POLYMODAL RECEPTORS IN ACUPUNCTURE ANALGESIA.

K. KAWAKITA AND M. FUNAKOSHI, Dept. of Oral Physiol. Gifu College of Dentistry, Hozumi, Motosu, Gifu.

In man, impulses of the nerve were recorded with tungusten microelectrode from an acupuncture point (Chu-tse) when the subject experienced a particular acupuncture sensation, and electrical stimulation to the point induced analgesia. In rats, the latencies of tail flick were prolonged during electrical stimulation of the common peroneal nerve as well as electro-acupuncture. The optimal intensity of stimulation for analgesia after section of the nerve at the distal to the stimulating electrode increased about 4 times that before section. Selective stimulation of the A-delta group of the nerve by triangular pulses depressed jaw opening reflexes induced by tooth pulp stimulation. In addition, either thermal (43°C), chemical (4.5% NaCl) or mechanical stimulation to the same point in the muscle produced analgesic effect. These results indicate that acupuncture stimulation is stimulating the nerve and the possible receptor related to the acupuncture analgesia is polymodal thin fiber receptor in the muscle.

250

CENTRAL AFFERENT PATHWAYS OF ACUPUNCTURE ANALGESIA

LUO, C.P., HISAMITSU, T., SATO, T., KOBORI, M., MERA, H. & TAKESHIGE, C. Dept. of Physiol., Sch. of Med., Showa Univ., Shinagawa-ku, Tokyo

Acupuncture stimulation caused evoked potentials in dorsal part of periaqueduct central gray(PAG), lateral septal nucleus(lSep), cingulate bundle(CB), hippocampus and medial part of centromedian nucleus of thalamus(mCM) of rats.

Lesions with 0.5mm electrode insertion to d-PAG, lSep, CB, mCM abolished both acupuncture analgesia and morphine(0.5mg/kg) analgesia which were measured by tail-flick test.

The d-PAG stimulation-produced analgesia was abolished by naloxone(1mg/kg), lesion of CB or lesion of mCM. Sham operation, insertion electrode just above these regions, did not show any difference in acupuncture and morphine analgesia.

Stimulation of lSep or mCM caused long lasting analgesia which were abolished by naloxone.

These data indicate that acupuncture afferent pathways were coincident with paleospinothalamic and motivational-affective pain pathways and endogenous morphine like factors might be liberated by combined activation of both pathways since lesion of one of the pathways abolished acupuncture analgesia.

251

RELATIONSHIP BETWEEN ACUPUNCTURE, MORPHINE AND PERIAQUEDUCT CENTRAL GRAY STIMULATION-PRODUCED ANALGESIA.

MURAI, M., TANAKA, M., HACHISU, M., KOMUGI, H. & TAKESHIGE, C. Dept. of Physiol., Sch. of Med., Showa Univ., Shinagawa-ku, Tokyo

Acupuncture stimulation is not effective to cause analgesia in all animals. Rats were classified to acupuncture effective and non-effective animals by a significant increase($P < 0.05$) of tail-flick latency.

The individual variation in effectiveness of acupuncture analgesia(AA) is corresponded fairlly well to that of morphine analgesia(MA)(0.5mg/kg), of analgesia caused by stimulation of dorsal part of periaqueduct central gray(d-PAG-SPA) and of contents of morphine like factors(MLF) in the brain.

Both AA and d-PAG-SPA were abolished by 1 mg/kg naloxone. D-phenylalanine, an inhibitor of peptidase, enhanced AA, MA, d-PAG-SPA and abolished the individual variation in effectiveness of AA, MA and d-PAG-SPA.

Both AA and MA were abolished by lesion of acupuncture afferent pathways.

These data indicate 1) AA, MA and d-PAG-SPA might be caused by MLF and 2) individual variation of effectiveness of three kinds of analgesia might be attributed to that of peptidase activity.

252

TOPOGRAPHIC CORTICAL REPRESENTATION OF THE ORAL CAVITY AND THE LIP OF THE CAT.

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

Applying the tactile stimuli to the oral structures such as gingiva, tooth and lip, the multiple unit responses of the cortical neurons in the first somatosensory area(SI) were recorded by a glass-enclosed tungsten microelectrode(tip diameter; 30μ) and displacement of the compuond receptive fields was studied. The projecting area of the oral structures was placed in a circumscribed region(3x3 mm^2) of the anterior half of the coronal gyrus. A detail of the representing mode found in the projecting area was as follows. 1) Within the projecting area, the neurons responded preferentially to the contralateral part of the lip were found to be located mostly in the caudal region of the area. 2) The neurons responded preferentially to the ipsilateral lip being located more rostrally than those mentioned above. 3) The ones responded to the central part of the lip were located in the intermediate region. 4) The neurons responded to the lower lip were located near the coronal sulcus and more medially than those responding to the upper lip. 5) The findings suggested that there was a topogrphic representation of the oral structures and that the contour of the projection was represented on the cortical surface as an inverted image of the mouth.

253

RESPONSE CHARACTERISTICS OF THE PULPAL NEURONS AND ITS FUNCTIONAL COLUMNAR ARRANGEMENT IN THE SOMATOSENSORY CORTEX (I) OF THE CAT.

N. MATSUMOTO, K. TAIRA, T. TAKAMATSU, K. HAYASHI, T. SATO, T. A. SUZUKI. Dept. of Oral-physiol., Sch. of Dent., Iwate Med. Univ., Morioka, Iwate

Single unit responses, evoked in a part of the coronal gyrus by electrical and tactile stimulations applied to the tooth pulps and the oro-facial skin, were analyzed by extracellular recording techniques. The neurons excited by the tooth pulp stimulation appeared at a rate of 17.1% of all neurons examined. The majority of these neurons responded polymodally to several kinds of non-noxious stimuli. Although they seemed to receive randomly afferent inputs from more than one tooth pulp, the neurons specific to the particular tooth found to be arranged in a column perpendicular to the cortical surface and fired with a similar type of pattern. On the other hand, overlapping of the tactile receptive fields of the pulpal neurons arranging in the same column revealed that the neurons clustered togather forming a functional aggregate. This perpendicular arrangement of the pulpal neurons was confirmed histologically by reconstructing the identified recording sites in the serial sections. These data indicate that this columnar arrangement is a common structural characteristics observable in other sensory cortex and that the specific pulpal neurons participate in neural mechanisms mediating the place-discrimination of the toothache.

254

REPRESENTATION OF HAND AND FINGERS IN DIFFERENT CYTOARCHITECTONIC AREAS OF THE MONKEY SOMATOSENSORY CORTEX(SI). IWAMURA, Y., TANAKA, M., HIKOSAKA, O. Dept. of Physiol., Toho Univ. Sch. of Med., Ota-ku, Tokyo.

The representation of hand and fingers in different cytoarchitectonic areas of the somatosensory cortex(SI) was studied by single unit recording in unanesthetized monkeys. The receptive field, submodality, and other properties of neurons were examined. In area 3, ulnar side of palm, V, IV, III, II fingers, radial side of palm, and I finger were somatotopically represented in medio-lateral sequence. In area 1 and 2, multiple loci from different fingers or palm converged to single neurons in various extent, and such neurons were scattered all over the hand and finger region. Thus the projection areas of palm and fingers overlapped considerablly and consequently a strict somatotopic representation did not exist in area 2 any more. We conclude that the posterior part of SI is organized not in terms of somatotopy nor submodality, but rather in terms of multiple functional clusters of neurons to process the complex somatosensory information concerning tactile perception or movement of hand and fingers.

255

NEURONAL MECHANISMS FOR THE RHYTHMIC DISCHARGE OF THE MITRAL CELL IN THE CARP OLFACTORY BULB YAMAGUCHI, K., SATOU, M. and UEDA, K. Zool. Inst., Fac. Sci., Univ. of Tokyo, Bunkyo-ku, Tokyo

Extracellular spike activities and field potentials in the carp olfactory bulb were analyzed in order to clarify the neuronal mechanism for the rhythm generation of the bulbar neurons. The depth analysis of the field potential following to the olfactory tract stimulation suggested the presence of the dendrodendritic reciprocal connection between the mitral cell and the granule cell.

The depth analysis of induced waves suggested that the main current origin of the induced wave is the e.p.s.p. of the granule cell dendrites. A synchronization of the rhythms observed between the induced wave and the mitral discharge indicated that the common mechanism underlies their rhythm generation.

Stimulus conditions which caused the rhythmic discharge in the mitral cell was examined, and it is concluded that stimuli which elicited the sustained response with high discharge rate (more than about 50 impulses / 10 sec) could cause the rhythmic discharge.

256

THE SOME PROPERTIES OF RANA OLFACTORY MUCOSA TO THE STIMULATIONS OF ACETIC ESTERS.

M. IIJIMA AND Y. AMAGAI Dept. of Physiol., Tohoku Dental Univ., Koriyama, Fukushima.

We used Rana catesbeiana and recorded EOG, which responded to double stimulations of esters. N- and iso- amyl, butyl and propyl acetate were used for both continuous conditioning stimuli(duration is 20 sec.) and puff, which was overlapped at 10th sec. from the start of conditioning. The concentration of puff was 0.72 ml and of the conditioning was ranged from 0.5% to 3.6% of saturated vapor. NB(n-butyl acetate) was most effective among these odors, and followed by NP,IP, IB,NA and IA. This order seems to have close relation with adaptation. In self adaptation, the largest EOG was evoked by NB puff(conditioning is 0.3% saturated vapor), and the smallest one by IA. Also another odors were just the reverse order of the excitability. However, in cross adaptation, the results are complicated. We also observed positive EOG, which appeared when the base odor was NP or IP, and increase it's hight according to the base concentration. In other pair of odors, only abserved in self-adaptation of NB or IB.

257

EFFECTS OF THE METHODS OF STIMULUS PREPARATION AND STIMULUS DELIVERY TO THE RECEPTOR ON THE THRESHOLD CONCENTRATION TO DETECT ODOR. F. MOTOKIZAWA AND R. MAEZAWA. Dept. of Physiol., Nara Medical College, Kashihara, Nara

Eighty-six medical students and student nurses, 64 male and 22 female aged between 18 -32 yr, served as subjects. The odorants used were β-phenyl ethyl alcohol, iso-valeric acid and γ-undecalactone. The desired concentration of these odorants were prepared by the air dilution method(AD) and the solvent dilution method(SD) using highly refined paraffin oil as a diluent. Two delivery systems were employed; one is an open system(OS) in which the subject sniffs the odors from a filtration paper containing the odorant's solution, the other is a closed system(CS) in which the subject sniffs the odors from an odor bag filled with the odorant's vapor diluted by pure air. The odorants of several steps of concentration were presented in ascending(AS) and descending(DS) series. When delivered with CS, the threshold concentration was lower in SD than in AD. This may indicate that the mole fraction of the odorant in the head space above the solution was different from that in the solution in the case of SD. As expected, the threshold concentration was distinctly lower in CS than in OS. There was no significant difference between AS and DS. All of these results were held for all odorants used in the present study. It is concluded that in SD and in OS it is impossible to present an odorant's vapor of the desired concentration to the receptor surface.

258

THE TEMPORAL FIRING PATTERN OF ANTERIOR OLFACTORY NUCLEUS NEURONS IN RABBITS,
N. ONODA. Dept. of Physiol., Sch. of Med., Gunma Univ., Maebashi

The temporal firing pattern of anterior olfactory nucleus neurons during the artificial intake of deodrized air was investigated. Nine rabbits anesthetized with 30% urethane were used. Artificial air intake was produced by applying negative pressure pulse to a cannula inserted to a postnasal cavity through the larynx. Sixty anterior olfactory nucleus units whose discharge rate changed consistently in relation to air intake pulse were isolated. According to the number of bursting activities during each air pulse, anterior olfactory nucleus neurons were classiffied into 'single peak' units and 'multiple peak' units. The temporal pattern of 45 units (75%) showed the former pattern. With increasing in intensity of air pulse, units of 65% did not increased spike frequency, but increased the duration of bursting activity.

260

WAVEFORMS OF OLFACTORY EVOKED POTENTIALS FOR VARIOUS TYPES OF ODORANTS

TONOIKE, M. , TAKEBAYASHI, M. AND KURIOKA, Y. Electrotechnical Laboratory (Osaka), Nakoji, Amagasaki, 661

Olfactory evoked potentials (OEPs) for eleven odorants were recorded from the human scalp C_z with a monopolar electrode. Synchronizing with a subject's respiration, an Elsberg-type olfactometer generated the stimuli.

Concentration of each odorant was set to give an equal intensity determined by a sniffing method. Waveforms of the OEPs were summed twenty times with signals sent from a subject when he felt smell. Two subjects were used.

In the OEP waveforms olfactory peaks were found for Amyl-acetate , dl-Camphor, Vanillin , Menthol , Anisaldehyde and γ-Undecalactone.

261

PROPERTIES OF ON-BURST AND OFF-SILENCE OF THE INFRARED RECEPTORS OF CROTALINE SNAKES.
SHIN-ICHI TERASHIMA & RICHARD C. GORIS. Dept. Physiol. Sch. of Med., Tokyo Med. & Dent. Univ., Bunkyo-ku, Tokyo 113

A radiation stimulus from a halogen lamp was applied to the pit organ while recording responses from single infrared afferent nerve fibers. The slope of the stimulus was varied with a shutter (for fast rise) and a switch (for slow rise). We changed the heat capacity of the pit membrane by putting water in the pit and compared the responses thus obtained with the normal responses. The initial burst in response to a sharp-fronted stimulus was greatly reduced in amplitude by the increase in heat capacity. There was a short after-discharge at OFF, which was followed by an off-silence. When a slow-rising stimulus was used, the initial burst was further reduced, the off-silence was eliminated, and the after-discharge was lengthened by the increase in heat capacity. Previous workers have suggested that this variety of response types indicates that there is more than one class of receptors, but we have shown here that the various response types can be obtained from the same neuron by varying the type of stimulus and the heat capacity of the membrane.

262

MECHANISM OF CONTRACTION IN HORSESHOE CRAB STRIATED MUSCLE. H. SUGI, S. GOMI. Dept. of Physiol., Sch. of Med., Teikyo Univ., Itabashi-ku, Tokyo

Bundles of myofibrils dissected from glycerinated telson depressor muscles of the horseshoe crab (Tachypleus tridentatus) were made to contract by iontophoretic application of Ca ions. The resulting changes in sarcomere length were observed under a phase-contrast microscope, and recorded with a 16mm cine-camera at 64 frames/sec. When the middle part of a long segment of myofibrils was adtivated, the activated sarcomeres shortened from 7-11μm to less than 4μm while the A-band width (3-3.5μm) remained unchanged. If, on the other hand, a short segment of myofibrils was activated fairly uniformly, the extent of sarcomere shortening was very limited because of the absence of relaxed sarcomeres which can be readily stretched by activated ones; after a slow, limited shortening, the length of each sarcomere within the short segment stayed constant due to the balance of force between the sarcomeres. In such an "isometric" condition, the A-band width increased by about 10%, and the extent of this elastic extension of the A-band could account for the elastic extension of the series elasticity at P_o determined in intact horseshoe crab muscle fibres, suggesting that the series elasticity in arthropod striated muscle may originate mainly from the elasticity of the A-filaments.

263

STIFFNESS AND TENSION TRANSIENTS IN INSECT FLIGHT MUSCLE. T. TSUCHIYA. Dept. of Physiol., Sch. of Med., Teikyo Univ., Itabashi-ku, Tokyo

Single glycerol extracted insect fibrillar muscle of Lethocerus were reactivated by Mg-ATP solution. The fibres were activated by stretch to an higher tension level (stretch activation). Quick release of the fibre during the stretch activation caused a rapid fall in tension followed by a quick tension recovery. After these two phases, the tension decreased again (release deactivation). During this phase, the stiffness of the fiber was measured by superimposed sine-wave (2.4 KHz) in case of small release. For larger release, the stiffness was measured by restretching the fiber. The time course of the decrease in stiffness could be fitted by single exponential, which was found to be slower than that in stiffness. The velocity and the amplitude of the decrease of the stiffness became larger, the larger the release amplitude. This work was done with Drs. K. Güth, H.J. Kuhn and J.C. Rüegg in University of Heidelberg.

264

COMPONENTS OF THE HEAT OF BINDING OF Ca^{2+} TO TROPONIN-C RELATING TO THE ACTIVATION HEAT PRODUCTION OF MUSCLE. K. YAMADA AND K. KOMETANI. Dept. of Physiol., Medical College of Oita, P.O. Box 37, Oita 870-91

Microcalorimetric titrations have been performed to study the binding of Ca^{2+} and Mg^{2+} to isolated troponin-C (TNC) at pH 7 and at different temperatures of 5°, 15° and 25°C. Titration curves show a biphasic or triphasic increase with added Ca^{2+}. The results show that the entropy changes for Ca binding are characteristically positive as has been reported previously. For the binding of 1st 1 mole of Ca^{2+} to TNC in Mg-free solution, ΔH values decrease with temperature, indicating that ΔCp of Ca^{2+} binding to TNC is negative (about -1.1 kJ mol^{-1} K^{-1}). For the further binding of Ca^{2+} the ΔCp shows moderately positive values. Thus the process where one of the 2 high-affinity sites of Ca- and Mg-free TNC binds Ca^{2+} induces a prominent hydrophobic effect. The binding of Mg^{2+} to Ca- and Mg-free TNC also shows a characteristically negative ΔCp.

These results indicate that the binding of 1 mole of Ca^{2+} or 1 to 2 moles of Mg^{2+} per mole of metal-free TNC induces the transition to the native conformation. The further binding of Ca ($-\Delta H \simeq 8 \sim 9$ kJ mol^{-1}) is possibly related to the regulatory function of contraction.

265

UNIFORMITY OF MECHANICAL RESPONSE IN EACH ELEMENTARY PART OF SKELETAL MUSCLE DURING EXPERIMENTS ON MUSCLE MECHANICS.

T. KOBAYASHI, A. KAMIYAMA, N. HIRAO, H. SUGI.
Depts. of Clin. Physiol. and Physiol., Sch. of Med., Teikyo Univ., Itabashi-ku, Tokyo

The interpretation of experimental results on muscle mechanics rests on the assumption that the mechanical response is uniform in each elementary part of muscle. To examine the validity of this assumption, we performed experiments in which a number of markers were attached to the surface of frog skeletal muscle to detect the movement of each elementary part during various mechanical experiments. The response in each elementary part was fairly uniform along the muscle length in the case of isometric and isotonic twitches. In isometric tetani, however, there was always a marked non-uniformity in the response along the muscle length; some parts shortened by stretching others. Such a non-uniformity persisted in isotonic shortening (or lengthening) precedded by isometric tetanus; some parts shortened while others did not shorten at all or even lengthened. These results indicate that considerable care should be taken of the uniformity of the response, especially in the case of X-ray diffraction and heat measurement experiments in which data are obtained from a limited area of preparation.

266

BEHAVIOUR OF MYOSIN PROJECTIONS IN FROG STRIATED MUSCLE DURING ISOMETRIC CONTRACTION.

N. YAGI, I. MATSUBARA. Dept. of Pharmacol., Univ. of Tohoku Sch. of Med., Seiryo-machi, Sendai

The movements of myosin projections during isometric contraction have been studied with the time-resolved X-ray diffraction technique. The intensity of the first-order myosin layer line at 42.9 nm decreases both during twitch and tetanus. This indicates that the myosin projections move out of the helical positions characteristic of the resting state. The movement seems to require the presence of actin since the layer line does not change its intensity when there is no overlap between the thick and the thin filaments. The meridional reflection at the third order (14.3 nm) increases its intensity when the muscle is producing a steady tetanic tension; this disagrees with a previous report in which the intensity decreased. The present observation suggests that there is no significant axial movement of myosin projections during steady isometric contraction; the projections maintain the axial ordering inherent in the thick filament. However, the projections appear to move axially when there is relative sliding of the thick and the thin filaments during contraction.

267

TIME-RESOLVED X-RAY DIFFRACTION OF CONTRACTING SKELETAL MUSCLE.

H. TANAKA, T. TAMEYASU, H. SUGI. Central Laboratory and Dept. of Physiol., Sch. of Med., Teikyo Univ. Itabashi-ku, Tokyo

During an isotonic twitch in frog skeletal muscle under a load of about $0.3P_o$, the minimum value of the intensity ratio between two equatorial reflections ($I_{1,0}/I_{1,1}$) was reached at the early shortening phase to be maintained until the beginning of relaxation. During a twitch under an inertial load, on the other hand, the force exerted by muscle was not constant but showed a peak at the early shortening phase, and the change in the intensity ratio was roughly a mirror image of the change in force. When a quick release was applied during an isometric twitch to cause a transient fall of force to zero, the intensity ratio showed no appreciable change. The relation between the minimum value of the intensity ratio attained in an isometric twitch and the peak twitch force was studied by changing temperature. The intensity ratio decreased from about 2 to about 0.5 with increasing twitch force from zero to about $0.5P_o$, but did not change appreciably with further increase in twitch force. The shape of the above intensity ratio versus twitch force relation was different from that of the intensity ratio versus caffeine contracture tension relation reported by Podolsky *et al*.

268

SARCOMERE DISORDER IN SKINNED FIBERS DURING CONTRACTION. Y.UMAZUME, N.KASUGA and T.YOSHIOKA*. Dept. of Physiol., Jikei Univ. Sch. of Med., Minato-ku, Tokyo and Dept. of Physiol., Tokai Univ. Sch. of Med., Isehara, Kanagawa*

It is well known that the intensity drop of optical diffraction lines of muscle fibers occurs during isometric contraction. As a possible cause of this intensity drop, the occurrence of small random movements of A- and/or I-band positions has been proposed.

In order to visualize the disorder of the sarcomere structure, the dispersions of Z-to-Z and M-to-M distances in skinned fibers at rest, during contraction and in rigor have been examined by means of electron microscopy combined with optical diffractometry. Disordering not only interfibrillar but also intrafibrillar Z- and M-line register was observed on electron micrographs taken from sections of the contracting fiber. The excess dispersions of both Z-to-Z and M-to-M distances compared with those at rest were estimated to be 0.2 μm (during contraction) or 0.1 μm (in rigor), both of which are comparable to the precious suggestion from optical diffractometry.

Although preliminary, the present method seems to provide useful information about dynamic/static disorder in the sarcomere structure at various conditions.

269

ACTIVATION OF SR AND INHIBITING FACTORS ON RAPID COOLING CONTRACTURE(RCC) SAKAI,T.,USUI,S.,AND TAKAHASHI,A. Dept.Physiol. The Jikei Univ.Sch.of Med. Tokyo.

It has been argued that caffeine-RCC of skeletal muscle is mainly induced by Ca^{2+}-release from SR. To analyse the RCC, it is practical method to use the parameters such as dose-response relation, peak tension and rate of rise of tension. These parameters were influenced by the change of $[K^+]o$ and $[Ca^{2+}]o$ concentration, pHo and sarcomere length. In the present work, it has been studied that the Ca^{2+}-releasing mechanism of SR on the RCC was considerably influenced by physiological change of the T-tubles. The RCC wasn't changed in the Chandler's solution. However, it was inhibited by Ca^{2+} removal from the medium. The RCC wasn't so influenced by change of pHo at 1.0mM caffeine, while at the lower concentration of caffeine the RCC was dependent upon the pHo from 5.0 to 9.0. The RCC was inhibited in the Ringer's solution in which Cl^- was substituted for propionate. From these results, it is probable that the activation of the RCC which is generated by the Ca^{2+}-release from SR may be influenced by the functional change of the T-system, the T-tubular membrane to the terminal cisternae through the triadic junction.

270

ULTRASTRUCTURAL STUDIES ON COUPLING BETWEEN T-TUBULES (T) AND LATERAL SAC (LS) IN FROG SARTORIUS MUSCLE. M. FUJINO, T. ARIMA, Y. SATO, H. TAKAI. 1. Dep. of Physiol., Natl. Def. Med. Coll., Tokorozawa.

To know the structural basis for excitation-contraction coupling in triadic junction, observations were made on intracellular occurrence of ruthenium red(RR) applied extracellularly in hypertonic sucrose-Ringer. 1. The procedure resulted in the occurrence of RR in LS. The occurrence rate fluctuates seasonally: higher in summer, lower in winter. The rate increases by treatment of frog with ATP, decreases in hypophysectomized frog, and increases due to application of RR in hypertonic solution containing elevated Ca^{++} or SCN^- substituted for Cl^-. 2. Electron-dense structures were often showed between T and LS by electron-staining. 3. Application of RR in isotonic Ringer did not result in the occurrence in LS. Conclusion: Structures between T and LS seems to be different considerably between under hypertonic and isotonic conditions.

271

RELATIONSHIP BETWEEN MEMBRANE POTENTIAL AND CALCIUM ION FLUXES IN THE FRAGMENTED SARCOPLASMIC RETICULUM

KOSHITA, M., HOTTA, K. Dept. of Physiol., Nagoya City Univ. Med. Sch., Mizuho-ku, Nagoya

Relationship between membrane potential and Ca^{2+} fluxes in the fragmented sarcoplasmic reticulum(FSR) isolated from frog skeletal muscle was investigated using cyanine dye(diS-C_3-(5)) as a potential probe(excitation-620nm; emission-660nm). Ca^{2+} uptake and release were measured by Millipore filtration method. Change of membrane potential and Ca^{2+} release were induced by changing ionic environment of the medium. It was revealed that there was no correlation between depolarization and Ca^{2+} release. So-called "depolarization induced Ca^{2+} release was due to osmotic effect which was inhibited in the presence of sucrose. Ca^{2+} uptake by FSR created the positive inside potential which was reversed by application of A23187. Valinomycin, Nigericin and replacement of Cl^- with gluconate affected potential formation due to the Ca^{2+} uptake. These facts suggest that Ca^{2+} uptake is accompanied by either K^+ efflux or Cl^- influx for partial compensation of the charge.

272

EXCITATION-CONTRACTION (E-C) UNCOUPLING DUE TO FORMAMIDE (FAM) AND ACROLEIN IN SINGLE MUSCLE FIBERS OF XENOPUS LAEVIS.

M. FUJINO, Y. SATO, T. ARIMA, H. TAKAI. 1. Dep. of Physiol., Natl. Def. Med. Coll., Tokorozawa.

1. Upon return to normal Ringer after brief exposure of single muscle fibers to Ringer containing high concentrations of FAM, E-C is uncoupled. 2. In the uncoupled state; negative afterpotential (NAP) and membrane capacity decrease, and horse-radish peroxidase is not recognized in T-tubules. 3. The uncoupling does not appear, if the return to normal Ringer proceeds gradually. 4. If the treatment with FAM-Ringer is made in hypertonic sucrose-Ringer, E-C is uncoupled, while NAP remains almost normal. Conclusion: FAM can exerts an inhibitory influence upon E-C coupling process by two ways; 1. a direct action on triadic junction-lateral sac-system, 2. detubulation, a similar action to glycerol. In addition, about 1 - 2 mM acrolein were showed to have a typical action to cause E-C uncoupling.

274

INACTIVATION OF CAFFEINE CONTRACTURE IN TWITCH MUSCLE FIBERS OF THE FROG.

OOTA, I., NAGAI, T. and *NAGAI, I. Dept. of Physiol. and *Dept. of Oral Surgery, Sapporo Med. Col., Chuoku, Sapporo, 060.

The recovery of caffeine contracture from the refractoriness and the effect of the conditioning with subthreshold concentration of caffeine on the caffeine contracture were examined on single fibers or thin bundles consisting of 2 or 3 fibers which were isolated from semitendinosus muscle of the frog. Caffeine contracture induced by 7.5 mM caffeine was biphasic: the phasic contraction developed almost immediately after the addition of caffeine and then relaxed spontaneously, and the sustained contraction developed following the phasic contraction. The contracture relaxed completely when the bathing solution containing 7.5 mM caffeine was replaced with normal Ringer solution during the phasic contraction, but it took a long time (60 min) to regain the second contracture. The recovery of caffeine contracture was accelerated by brief exposure (30 sec) to 190K-solution without caffeine. The peak tension of caffeine contracture was inhibited by conditioning with subthreshold concentration of caffeine (3 mM). The inhibition progressed gradually with monophasic time course, depending on the prolongation of the conditioning time. From these results, we concluded that an inactivation exists in caffeine contracture.

275

AFFECTED SITE OF THE SKELETAL MUSCLE CELL BY DANTROLENE-NA YAMAGUCHI, TOSHIO. Dept. of Biol. ICU, Coll. Lib. Arts, Mitaka, Tokyo 181.

In order to examine the affected site of skeletal muscle cell by dantrolene-Na (dan), twitch responses of single muscle fibers of frog to repetitive stimulations were recorded in rapidly applied solutions containing 10 μM dan. Irrespective of stimulation frequencies (0.2, 0.5, 1, 2, 3, 5Hz), the peak tensions of twitches decreased in the same time course. Even if the relative viscosity of the external medium was made twice of the standard one by addition of 10% dextran T 10, the twitches decreased almost in the same way as of the control. From the results, dan seems to act directly to the SR membrane, resulting in the decrease in tension, if the effect of dextran on the T-system is negligible.

276

CONTRACTILE RESPONSES TO A-C FIELD STIMULATIONS AND THE DYNAMIC CONSTANTS OF THE LONGITUDINAL AND CIRCULAR MUSCLES OF GUINEA PIG STOMACH. M. MORIYA, M. ISHIZAWA, H. YABU and E. MIYAZAKI, Dept. of Physiol., Sapporo Med. College, Sapporo.

The longitudinal muscle preparations responded sufficiently to the A-C field stimulations between 20 - 2000 cycles/sec. The contractile responses to higher than 400 cycles /sec remained unchanged under the influence of TTX (10^{-7}g/ml) and atropine (10^{-6}g/ml). Meanwhile, the circular muscle preparations showed peak response around 200 cycles/sec, with extremely decreasing responses to both sides of the frequency. Almost all the responses of the circular muscle to the field stimulations diminished with TTX and atropine. These data indicate that the longitudinal muscle cells, but not the circular muscle cells, are directly stimulated by the field stimulation. The maximum tension and the highest rate of tension development were given at the stimulating condition of 200 cycles/sec, 5 V/cm, for 5 sec in both kinds of muscles, and the condition was used to investigate the force-velocity relationship in each muscle. The maximum shortening velocity was 0.211 ± 0.050 L_o/sec (n=16) in the longitudinal muscle and 0.580 ± 0.171 L_o/sec (n=17) in the circular muscle. The faster velocity of the circular muscle was due to the smaller heat constant (a/P_o) derived from Hill's equation. The two muscles had nearly the same rate constant of energy liberation, b (L_o/sec).

277

A NEW PHYSIOLOGICAL METHOD FOR DETERMING FUNCTIONAL ORIENTATION OF ARTERIAL SMOOTH MUSCLES. T. FUKUSHIMA, T. OHHASHI, T. AZUMA.
Res. Lab. Cardiovasc.Dis. and Dep. Physiol.,Shinshu Univ. Med. Sch.,Matsumoto, 390

The response of a helical strip dissected from a canine muscular artery to noradrenaline depended upon its sectioning angle from transverse axis of the vessel. An appreaciable relaxation of longitudinal strips isolated from the femoral artery was induced by the drug, making a sharp contrast to the contractile response in circumferential strips. This phenomenon may be due to architectural arrangement of vascular smooth muscles.

A theoretical study was carried out to determine the pitch angle of a helical alignment of smooth muscles in the wall. A vascular wall was assumed to be constructed by numerous cylindrical contractile segments which formed several lines arranged in a certaine direction. An assumption also made that these segments contracted isovolumetrically. Comparison between the calculated and experimental results revealed that the media of the femoral artery was composed of the helices of smooth muscles which were symmetrical with respect to the cross-sectional plane of the vessel. The helix angle was estimated to be 30°. The angle in the renal artery was considered to be 15°.

278

ANTAGONISTIC ACTION OF EXTERNAL CALCIUM IONS ON THE MEMBRANE CURRENTS OF STRONTIUM IONS IN THE INTESTINAL SMOOTH MUSCLE. INOMATA,H.,MARUYAMA,Y. AND MIMATA,T. Dept. of Applied Physiol., Tohoku Univ.Sch.Med.,Sendai,980.

The characteristics of Sr ion influxes in the guinea-pig taenia coli was examined as a fuction of external Sr ions in the absence and presence of external Ca ions by application of current and voltage clamp using double sucrose gap method. Throughout all the experiments, solutions containing TEA as substitute for Na ion were used. Under current clamp condition, overshoot and maximum rate of rise of Sr dependent spike in Sr ions media ranging 2.5 to 20 mM were lineally related to the concentration of external Sr ions. The duration of their repolarization phase were rather shorten by increasing concentration of external Sr ions. Under voltage clamp condition, Sr inward current increased proportionally to increase in the concentration of Sr ions without changing the conductance, $\bar{g}a$. The late outward current carried by K ion and $\bar{g}K$ enhanced by increasing concentration of external Sr ions. This fact shows that Sr ions mediated K ion activation system might play in Sr media in similar manner to that in Ca media.

The addition of Ca ions at concentration of 1 or 2.5 mM to media containing 2.5 or 20 mM of Sr ions, partially reversed the above effects of Sr ions. The maximum inward current was reduced because of a reduction in $\bar{g}a$, while Ea remained fixed. The outward current is reduced because of a reduction in $\bar{g}K$.

279

RELAXATION BY ISOPRENALINE IN SMOOTH MUSCLE OF GUINEA-PIG TAENIA COLI AND STOMACH.
NASU, Y., SAKAMOTO, Y., IMANAGA, I. AND TOMITA, T.* Dept. of Physiol., Fukuoka Univ. Sch. Med., Nishi-ku, Fukuoka, Dept. of Physiol., Nagoya Univ. Sch. Med., Showa-ku, Nagoya*

Isoprenaline probably acts through regulation of intracellular Ca concentration, rather than through the mechanism which controls the electrical excitability. It is difficult to propose the mechanism only based on the mechanical experiments. If relaxation by isoprenaline is mediated by Na-pump in some way, a concentration of intracellular Na has to be maintained beyond some level for the pump activation. Intracellular Na concentration may not be reduced too low in Na-free solution, after short application of Na during prolonged exposure to Na-free solution, or pretreatment with K-free solution or ouabain. However, more direct evidence is needed. Blockade of isoprenaline response by ouabain can be explained by this hypothesis. Another possibility which is a Ca-pump or a Na-Ca exchange may not be ruled out.

280

EFFECTS OF PHOSPHOLIPASE C AND OUABAIN ON Ca MOVEMENT OF STOMACH SMOOTH MUSCLE
SAKAI, Y., YOSHIDA, M. AND ICHIKAWA, S. Dept. Physiol., Showa Univ. School of Med., Shinagawaku, Tokyo, 142

Extra- and intracellular Ca uptake and efflux by guinea pig pyloric muscle were studied after phospholipase C (PLC) or ouabain treatment. Exchange of intra- and extracellular Ca was suppressed by PLC. Ca uptake was decreased by ouabain, but Ca efflux was unchanged. PLC and ouabain may act at sequestering sites. Two early effect factors may be : 1) PLC splits probable Ca binding sites in phospholipids; 2) effective Ca movement may be limited by decreased binding. Two probable Ca sources are high affinity plasma membrane, and intracellular binding sites. Linear uptake increase could be due to passive Ca entry after membrane breakdown by PLC, if normal Ca pump depends on ATP. Contracture due to DNP in Ca-free colution increases after PLC treatment, but is unchanged after ouabain treatment. Ca uptake is unchanged in K-free solution, or if Na is replaced by Li, but increases if Na is replaced by sucrose. Conclusions: PLC increases intracellular Ca binding and suppresses efflux. Ouabain slightly suppresses Ca uptake and promotes efflux. Na-Ca exchange not affected, but Ca-Ca exchange and Ca leak may be related.

281

EFFECTS OF ESTRADIOL-17β ON THE MEMBRANE RESPONSE AND K-CONTRACTURE IN THE UTERINE LONGITUDINAL MUSCLE OF OVARIECTOMIZED RATS.
KATO,S., OGASAWARA,T. and OSA,T. Dept. Physiol., Yamaguchi Univ. Sch. Med., Kogushi, Ube 755

Estradiol-17β benzoate (5 μg/day) was injected into ovariectomized rat for 5 days, and the membrane response and K-contracture in the uterine longitudinal muscle were investigated. The membrane potential was increased slightly and repetitive spike potentials were generated on a plateau potential, until the steady effect was build up in 3-4 days. The phasic contraction resulted in a relaxation upon exposure to the isotonic K-solution, then a tonic contraction developed in ovariectomized uterus. The phasic contraction proceeded into a tonic contraction in estrogen-treated uteri. The amplitude of the tonic contraction became larger when the external Ca concentration was raised. In the Ca-depleted solution, the tonic contraction subsided. The change in the configuration of the K-contractures depending on the estrogenic treatment was ascribed to an increase in the Ca-influx upon K-depolarization forming greater tonic contraction.

282

CONTRACTION BY WARMING IN DEPOLARIZED SMOOTH MUSCLE. SATORU SUNANO and EISAKU MIYAZAKI, Dept. of. Physiol. Sapporo Med. College, Chu-o-ku, Sapporo.

Rewarming the smooth muscle from low temperature to 35° C caused a transient contraction. In the taenia coli, a reduction of tension was observed by lowering the temperature. Contraction by rewarming was dependent on the degree of conditional reduction in temperature. In ureter, increase in tension was observed by lowering the temperature. Rewarming the preparation caused a phasic contraction followed by oscillation of tension. These contractions by rewarming were sensitive to extracellular Ca, and disappeared by Ca-removal or in the presence of verapamil.

In vas deferens, the increase in tension was observed by lowering the temperature. No contraction but relaxation was observed by rewarming. However, in the presence of 2 to 5 mM Mn or La, relaxation was observed by lowering the temperature and rewarming the preparation caused phasic contraction. The phasic contraction became larger with the number of the repetition of the experiments. These contractions were also observed in the absence of Ca. Similar effects were observed in ureter. The roles of Ca in rewarming-induced contraction were discussed.

283

MECHANICAL RESPONSES OF THE BODY WALL MUSCLES OF AN ANNELIED, URECHIS UNICINCTUS, TO POSTULATED NEUROTRANSMITTERS. Y. MUNEOKA, Y. SHIBA AND Y.KANNO. Lab. Physiol., Facul. Integrated Arts Sci., Hiroshima Univ., Hiroshima 730, and Dept. Physiol., Hiroshima Univ. Sch. Dent., Hiroshima 734.

Several amino acids and ACh produced contraction in the longitudinal and circular body-wall strips of Urechis unicinctus. The most effective agent was L-proline. Its threshold concentration was less than 10^{-6}M in both of the strips. The threshold concentration of ACh was 10^{-4}M in the circular strip and 10^{-3}M in the longitudinal one. The extract of body wall produced a contraction similar to that by L-proline in both of the strips. Some amine substances modulated the contraction of the strips in response to L-proline, body-wall extract and electrical pulse of stimulation. Serotonin potentiated the contractions. Farther, in the circular strip, it enhanced the relaxation of twitch contraction. Octopamine also potentiated and noradrenaline inhibited the contractions in both of the strips. Three possible sites of action of the above agents are considered :muscle fibres, nerve elements and sensory cells.

284

EFFECT OF IONOPHORE ON THE GUINEA PIG TAENIA COLI
NAKAYAMA, Y. Dept. of Anat. and Physiol., Kyoritsu Coll. of Pharm., 1-5-30, Shiba-koen, Minato-ku, Tokyo 105

The effect of Ca ionophore, A23187, on the E-C coupling system of smooth muscle was investigated by the mechanogram. Muscle was suspended in a smaller chamber, 0.05 ml, and was stimulated by A.C. (50 Hz, 5V/cm, 5sec) with platinum electrodes in chamber, and tension was recorded on a recticorder with mechano-electric transducer.

Caffeine intensified the tension trangiently and after its occurrence reduced it progressively for depletion of the intracellular released Ca. This evidence was suppressed remarkably by pretreatment of A23187. Similar result was obtained from the following. When the extracellular Ca was increased successively from 5 to 10 and to 15 mM, tension decreased progressively for the membrane stabilization, but A23187 inhibited the decrement of the tension. Some lectins, Con.A and WGA, were also used as chemical agents, as they may augment Ca influx as well as Ca ionophore. Tension under Con.A or WGA was potentiated gradually by pretreatment of A23187.

285

OPTICAL RECORDING OF EXCITATION SPREAD IN VERY EARLY EMBRYONIC CHICK HEART. K. KAMINO, A. HIROTA, S. FUJII, Dept. of Physiol. Tokyo Med. & Dent. Univ. Sch. of Med., Bunkyo-ku Tokyo.

Using an optical method for measuring membrane potential with a voltage sensitve merocyanine-rhodanine dye, we monitored action potential activity in embryonic chick hearts in the early phases of cardiogenesis. The rhythmical action potential appeared spontaneously at 7 somite developmental stage (corresponding to 25-30 hours after incubation). The number of the electrical active cells increased dramatically throughout the 7-9 somite developmental stages, and the number differed among the various regions of an embryonic heart; the largest was exhibited in the right ventricular region . Signals resembling the cardiac action potential and the pacemaker potential were first detected already at 8 somite stage. At this stage, however, pacemaker type signals were specially unlocated. Furthermore, we tried to monitor action potentials from five different portions in an embryonic heart simultaneously, and we found that the active cells were almost electrically synchronized with each other accompanying by small latency at the 7-8 somite developmental stages. The ability to record activity in more portions at once would allow the construction of a detailed developmental map of the generation of cardiac function, and should enhance our understanding of the functional basis in cardiogenesis.

287

THE VENTRICULAR FIBRILLATION POTENTIALS INDUCED BY REDUCED SALTS-RINGER'S SOLUTION PERFUSION. M. KASEDA, Y. KUMAGAI. Dept. of Biol., National Defence Med. Coll., Tokorozawashi, Saitama. Y. TSUMURAYA, S. WADA. Dept. of Physiol., Nihon Univ. Sch. Med., Itabashiku, Tokyo.

The whole heart isolated from *Rana Catesbeiana* was perfused with reduced Ringer's solution (made isotonic, adding with glucose), and on the occurred ventricular fibrillation, both ventricular potentials and aortic pressure waves were recorded synchronously. If the concentration of $CaCl_2$ in the perfusate is replaced to normal level, the fibrillation was maintained. If the concentration of KCl, the fibrillation was recovered to normal. Therefore, at the occurrance of ventricular fibrillation, the concentration of KCl must be reduced below 1/10 as that of normal Ringer's solution. Further, in fibrillation potentials, the plateau potential is recorded only its phase 0. Therefore, the disappearance of plateau potential initiates fibrillation potentials.

288

INFLUENCES OF GIK ON THE MEMBRANE CURRENT AND TENSION COMPONENTS OF BULLFROG ATRIUM. K, KINOSHITA, A. YATANI* and M. GOTO*. Dept. Cardiovasc. Surg. and *Dept. Physiol., Fac. Med., Kyushu Univ., Fukuoka 812, Japan.

GIK solution has been used as clinical cardioplegia during open heart surgery. The present study aimed to clarify the after-effects of GIK fundamentally, on the membrane potential, current and tension components of bullfrog atrium with the double gap method. After reperfusion following GIK, action potential almost recovered to control level, although a slight decrease of plateau and resting potential were noticed. The recovery of twitch contraction was incomplete and suppressed less than 50% of control level. Voltage clamp study revealed that after GIK, slow inward current (I_s) and I_{Ca}-dependent tension were markedly depressed, while delayed outward current (I_x) was augmented. The fast inward current (I_{Naf}), background current (I_{kI}) and I_{Ca}-independent tension readily recovered to control level. Perfusion of low Ca Ringer for 10 min at initial reperfusion phase significantly improved the recovery of I_s and I_{Ca}-dependent tension. These results suggest that lowering of transmembrane Ca influx at the initial phase has beneficial effects on cardiac function after GIK.

289

EFFECTS OF pH ON TWITCH AND Na-WITHDRAWAL CONTRACTURE IN THE BULLFROG ATRIUM.

K. OCHI AND M. MATSUMURA Dept. of Physiol., Kawasaki Med. Sch., Kurashiki

Combined effects of the changes in pH and Ca concentration were investigated on twitch and Na-withdrawal contracture in the isolated bullfrog atrial muscle. When pH was changed from 7.2 to 9.2, twitch tension at 6 beats/min was increased with a half time of 1 - 2 min. When Ca concentrations were increased at pH 7.2 the twitch tension attained to the maximum at 14.4 mM Ca, but it was further increased by a rise in pH to 9.2. Twitch tension was increased (i.e. staircase) with increase in contraction frequency from 6/min to 60/min at pH 7.2 and 1.8 mM Ca. Development of staircase at pH 9.2 and 1.8 mM Ca was different from that at pH 7.2 and 7.2 mM Ca. Tension in Na-withdrawal contracture was increased and accelerated by a rise in pH from 7.2 to 9.2 at any Ca concentrations between 0.9 and 88.2 mM. On the contrary, tension was rather decreased by a rise in pH at low Ca concentrations below 0.45 mM. Although not explained clearly, tension produced by a simultaneous rise in pH to 9.2 with Na removal was larger than tension produced by Na removal after equilibration of muscle in pH 9.2 Ringer solution. The relationship between a reciprocal of tension and a reciprocal of Ca concentration was not linear at pH 7.2, but it was illustrated to be linear at pH 9.2, suggesting that the first order reaction between external Ca and cellular reactive sites dominates the tension development if pH is as high as 9.2.

290

THE POTENTIATING EFFECT OF HYPERTONIC SOLUTION ON THE POTASSIUM CONTRACTURE IN THE BULLFROG'S ATRIA

H. KAWATA, M. OHBA, T. HORI and M. KISHI*. Dept. of Physiol. and Lab. of Human Biol.*, Fukuoka Univ., Sch. of Med., Nishi-ku, Fukuoka.

The effects of raising the tonicity of bathing medium on the potassium contracture were investigated in the bullfrog's atrial strips. The contracture induced by low Na (16mM)-high K (100mM) solution was profoundly augmented either when the tonicity was raised (2 or 3 times) simultaneously with high K-application or when it was increased prior to high K-application. The contracture augmentation seen in the former condition could be due to an increase in the rate of membrane depolarization while that in the latter could be attributed to both an elevation of the amount of Ca stored intracellularly and a facilitation of the membrane potential-dependent Na-Ca exchange mechanism. The facts that the pattern of the staircase phenomenon was changed from positive type to negative one during a hypertonic perfusion and that the hypertonic contracture was strongly sensitive to the external Na concentration would support this possibility. It was also suggested that the change in the intracellular Na concentration during the shrinkage of cells may play a some role.

291

SECOND DEPOLARIZATION OF ACTION POTENTIAL OF CANINE SUBEPICARDIAL MUSCLE AND CONTRACTION IN THE LOW Ca MEDIUM.

A. KAMIYAMA, R. SHIBAYAMA. Dept. Physiol., Teikyo Univ. Sch. Med., Itabashi-ku, Tokyo

Spike and dome type action potential in the subepicardial muscle of canine right ventricle has been already reported. In the present experiment, this action potential was analysed at first. Rapid repolarization of phase 1 of the action potential was eliminated by the replacement of Cl^- by $NaCH_2SO_4$. Rate of rise of the second depolarization was decreased by the reduction of external Ca^{++} concentration or by the addition of Ca^{++} current suppressors. But the second depolarization was not changed by the reduction of external Na^+ concentration. Secondly, the force of isometric contraction was best related to the rate of rise of the second depolarization in the various measurements of action potentials. Moreover, when the various degree of second depolarizations appeared on the same specimen in the low Ca^{++} medium, isotonic shortening also paralleled with the rate of rise of the second depolarization. From the results mentioned above, it was concluded that the second depolarization consisted of mainly Ca^{++} current and that the contraction was dependent on the Ca^{++} inflow following the action potential.

292

ISOTONIC SHORTENING OF HEART MUSCLE IN CONTRACTURE

SAEKI,Y.,SHIBATA,T*.,AND YAMADA,E. Dept. of Physiol., Tsurumi Univ. Sch. of Dent. Med., Yokohama and Dept of Pediat., Sch. of Med. Yokohama City Univ., Yokohama*

To characterize mechanical properties of activated heart muscle, tension of kitten papillary muscle in Ba^{2+}-contracture was quickly decreased stepwise and the length response was analyzed. The length response to step reduction in tension showed four different phases. The first phase was a prompt length shortening during the tension reduction. The second phase was a slow further shortening and the third a small delayed lengthening. The fourth is an extremely slow shortening toward a new steady length at a given tension. These transients appear to be consistent with those which might be expected as the mirror image of the transient tension response observed in our previous study to step length change. Amount of shortening in the first and second phases increased with the increase of steo tension reduction. But these relationships were independent of the initial muscle length when the shortening was plotted against the reduced tension relative to the initial isometric tension. These results suggest that the series elasticity in the present preparation is uniformly distributed along the length of the preparation. This is in contrast to previous finding which suggested that the series elasticity in the living cardiac muscle was localized at the damaged end of the preparation.

293

MODELING OF CARDIAC MUSCLE CONTRACTION BASED ON THE CROSS-BRIDGE THEORY.

H. MASHIMA, K. KABASAWA AND K. AKAZAWA* Dept. of Physiol., Sch. of Med., Juntendo Univ., Bunkyo-ku Hongo, Tokyo and *Dept. of Elec. Engr., Fac. of Engr., Osaka Univ., Suita-shi, Osaka

A mathematical model for the cardiac muscle contraction was developed, assuming the cross-bridge cycle as a force generator. The model consists of three subsystems: (i) the release and uptake of internal Ca ions, (ii) the kinetics of cross-bridge cycle and (iii) the dynamics of contraction. The variables in the whole system are factored into a series of realizable functions, assuming that the rate constant for the movement of active cross-bridge is proportional to the shortening velocity. The input of the whole system is the rate of Ca release and the output is the change in tension of the muscle. Most parameters were determined from the dynamic constants of the force-load-velocity relation and the tension-extension relation of the series elastic component for the steady tetanic contraction of frog ventricular muscle at 20°C. Using this model, estimated Ca transient as well as release and uptake curves during isometric twitch were calculated by fitting the output with the experimental tension curve.

294

SLOW CURRENT SYSTEMS IN THE ATRIOVENTRICULAR NODE OF THE RABBIT HEART.

Kokubun,S. H.Kotake, A.Noma and H.Irisawa National Institute for Physiological Sciences, Myodaiji, Okazaki, 444 Japan.

Small A-V node specimen having a final dimension 0.2x0.2x0.2 mm was dissected from the rabbit A-V node region. Most of small A-V node specimens exhibited spontaneous rhythmicity. The maximum rate of rise of action potential was 12 v/sec in 63 examples. When the membrane potential was held at -40 mV and test pulse of -10 mV was applied, the inward current was registered immediately after the capacitive surge, the peak of this inward current was about 10 msec after the onset of the test pulse, and the current was inactivated with the time constant of approx. 20 msec, which is similar to the slow inward current of the S-A node. The outward current was also a slow phenomenon. Depolarization caused a slow increase in the outward current, whereas on repolarization, a gradual decay of this current was observed. The inward current changes were observed with hyperpolarization -70 mV, may be analogus to the i_h current of S-A node cell. These facts would clearly indicate the presence of a common mechanisms underlying A-V node rhythmicity.

295

EFFECTS OF INTERNAL Ca^{++} ON K CONDUCTANCE OF VENTRICULAR MUSCLE FIBERS

HIRAOKA, M., OKAMOTO, Y. AND IKEDA, K. Inst. for Cardiovasc. Dis., Tokyo Med. and Dent. Univ., Bunkyo-ku, Tokyo

There has been shown in nerve cells that increased internal Ca^{++} produces membrane conductance changes. Evidences demonstrating this process in heart muscles are rather few and are not well-established. We studied this problem using dog ventricular muscle fibers in different K^+ and Ca^{++}. When muscle fibers were immersed in the K^+-free • Ca^{++}-free solution, the resting potential depolarized to -75.0 ± 2.44 mV (mean ± S.D., n = 8) from -83.4 ± 1.92 mV in the control solution (2.7 mM-K^+, 1.8 mM-Ca^{++}). When $(Ca^{++})_o$ was raised to 5.4-7.2 mM in the K^+-free condition, the resting potential hyperpolarized to -96.9 ± 5.31 mV. Hyperpolarization was also seen in low Cl^- solution or at reduced temperature (27°C). Hyperpolarization was preceded by an increase in the tonic tension, which suggested an increase in internal Ca^{++}. In the K^+-free • Ca^{++}-free solution, an addition of 2.7 mM-K^+ caused hyperpolarization of resting potentials by 9 mV (a mean of 5 cases), suggesting the decreased K conductance and/or the reduced Na pump activity in this condition. Voltage clamp experiments revealed an increased steady-state K^+ current in high-Ca solutions. The results indicated that increased internal Ca^{++} caused an increase in the K conductance.

296

Effect of amiloride on the membrane potential of ventricular muscle fibers of the dog.

T. YANAGISAWA AND N. TAIRA Dept. Pharmacol., Tohoku Univ. Sch. Med., 2-1 Seiryo-machi, Sendai, 980

The effect of amiloride on the membrane potential of ventricular muscle fibers of the dog was studied with conventional microelectrode technique. Amiloride produced prolongation of the action potential duration (APD) which became marked as the period of exposure to amiloride was increased. The resting membrane potential (RMP), the amplitude (APA) and maximum rate of rise (Vmax) of the action potential were not affected by 1 hour perfusion with the Tyrode solution containing 0.1 mM amiloride, but APA and Vmax were slightly decreased by 2 hour perfusion. The prolongation of APD by amiloride was markedly blocked by 2-nicotinamidethyl nitrate (SG-75) whcih increases potassium conductance of cardiac muscle fiber membrane. The prolongation was affected neither by verapamil which decreases the slow inward current nor by changing the extracellular potassium concentration. These results show that the effect of amiloride on the membrane potential of ventricular muscle fibers differs from the action on epithelia to decreases sodium conductance of membrane.

297

THE INTERACTION BETWEEN CALCIUM AND BARIUM ON THE MEMBRANE SLOW CHANNEL IN GUINEA PIG VENTRICULAR MYOCARDIUM.

M. INAZAWA and T. EHARA Dept. Physiol., Fac. Med., Kyushu Univ., Fukuoka 812 Japan

Effects of Ca and Ba on the electrical and mechanical activity were studied in partially depolarized guinea pig papillary muscles. In Ca-free, K-rich (27 mM-K) Tyrode containing 0.6-1 mM Ba, the muscles generated Ba-dependent slow action potentials (BAP). These action potentials were accompanied by a rise in resting tension (sustained contracture), which probably resulted from the intracellular action of Ba. Under this condition, addition of a small amount of Ca (0.05-0.2 mM) was found to depress BAP and to relax the contracture. This inhibitory action of Ca on BAP was considered to be not due to an increased membrane outward conductance, since there was little change in the membrane resistance in the presence or absence of Ca. At $[Ca]_o$ above 0.3 mM, on the other hand, the electrical activity behaved nearly like a Ca-electrode irrespective of the presence of 0.6-1 mM Ba. These results suggest that there is a competition between Ca and Ba for the membrane slow channel and that the affinity of the channel is higher for Ca than for Ba. However, the mobility of Ba within the channel could be larger than that of Ca.

298

IONIC MECHANISM FOR THE CHRONOTROPIC EFFECT OF EPINEPHRINE ON THE RABBIT SINOATRIAL NODE CELL. NOMA,A.,KOTAKE, H., & IRISAWA,H. National Inst. for Physiological Science. Myodaiji, Okazaki.

Voltage clamp experiments using the two microelectrode technique was conducted in the rabbit sinoatrial node. Epinephrine (5.5×10^{-7} M) increased the slow inward current (i_s) by about 1.3, the potassium current (i_k) by 1.1, and the hyperpolarization-activated current (i_h) by 1.2. No significant change in the kinetics of i_s and i_k was detected. The increase in the rate of slow diastolic depolarization was not observed in the S-A node whose slow inward current was blocked by an application of D 600. Thus, the increase of i_s was considered to be the most important factor in generating the chronotropic effect of epinephrine.

299

CONTRIBUTION OF ELECTROGENIC Na PUMP ON VENTRICULAR ARRHYTHMIA IN ACIDOSIS SAWANOBORI, T. AND ADANIYA, H. Inst. for Cardiovasc. Dis., Tokyo Med. and Dent. Univ. Bunkyo-ku, Tokyo

Isolated canine Purkinje fibres exposed to reduced pH (pH 6.0) caused marked decrease in maximum diastolic potential (MDP) and abnormal automaticity. MDP in low pH was -50.2 ± 10.1 mV (n = 64). This MDP significantly hyperpolarized in high potassium (K = 10.8 mM), which means the increased pK and/or the activated Na pumping. Neither lidocaine (2×10^{-6} g/ml) having increased pK at steady state nor TTX (10^{-5} g/ml) with inhibition of background Na current at steady state changed the MDP in low pH. Addition of g-strophathidin (g-stro) (10^{-5} g/ml) and replacement of Na with Li had the partial inhibition of the high-K induced hyperpolarization in low pH. The hyperpolarization following cessation of rapid stimulation was also studied at different pH. Acidosis caused the decrease of hyperpolarization of MDP at the end of rapid drive (3 Hz) and inhibited the hyperpolarization of MDP of first beat, which suggest partial inhibition of the electrogenic Na pump in low pH. Rapid stimulation hyperpolarized low pH-induced depolarization of MDP. G-stro. inhibited this hyperpolarization. These results suggest that electrogenic Na pump contributes the reduction of MDP in low pH.

300

GENTAMICIN BLOCKADES OF THE SLOW INWARD CURRENT AND THE TIME-DEPENDENT OUTWARD CURRENT IN MAMMALIAN VENTRICULAR MUSCLE. N. HINO, R. OCHI and T. YANAGISAWA*. Dept. Physiol., Sch. Med., Juntendo Univ., Bunkyo-ku, Tokyo and *Dept. Pharmacol., Tohoku Univ. Sch. Med., Sendai

Gentamicin(GM), one of the representative aminoglycoside antibiotics, is known to have a negative inotropic action. The effect of GM on the membrane currents in guinea-pig papillary muscle was studied by the single sucrose-gap voltage-clamp method. The slow inward current(i_S), when its amplitude was estimated as the difference between the peak of i_S and the current at 150msec, was reduced by GM to 48% at 0.1mM, 20% at 0.3mM and was mostly suppressed at 1mM, with little change in its time course. The time-dependent outward current(i_K) was altered by GM at higher concentration. The amplitude of the positive tail current of i_K was reduced to 84% at 0.1mM and 54% at 1mM. The time-independent current(i_{K1}) was little affected. The reductions in the amplitudes of i_S and i_K by GM were observed at all potentials, in a proportional manner. It was concluded that GM diminishes i_S and i_K by blocking their channels. The dose-response curves of GM suggested that two molecules of GM act at i_S channel and one molecule at i_K channel, with dissociation constants of 3.73×10^{-5}M and 3.0×10^{-4}M, respectively.

301

THE SECONDARY FLUCTUATION OF PACEMAKER POTENTIAL. K.GOTO, S.MIYAMAE & T.KANEDA. Dept. of Physiol. Kanazawa Med. Univ. Ishikawaken.

Pacemaker cells of the isolated sinus node of the guinea pig were exposed to Ca-rich, Ca-free, K-free, cyclic-AMP(5×10^{-4}M), 2,4-Dinitrophenol (10^{-4}M), Acetylcholine(10^{-6}M) and Ouabain(10^{-6}M) solutions. Potentials were recorded by means of a microelectrode technique. 1) When the pacemaker cells were perfused in K free, Ach, DNP solutions for a while, their potentials showed a decreasing oscillatory pre- or after-potentials just before the disappearance. 2) The automatism showed a waxing and waning oscillation at the potential level under -40mV in the K free, Ouabain and Ca-rich solution(-60mV). 3) These oscillations were enhanced by the application of isoproterenol, adrenalin and noradrenalin. 4) The phenomena were suppressed by the Ca deficiency and ethylenediaminetetraacetic acid (EDTA 10^{-4}M). 5) Replacing Ca by Sr(2mM) didn't lead to any suppression of the Ca deficiency. 6) Adding Mn(2mM) suppressed the fluctuation of potentials. Results suggest that the inward Ca current plays an important role when the function electrogenic pump was decreased.

302

INTERACTION BETWEEN THE EFFECTS OF ADENOSINE AND ACETYLCHOLINE ON THE BULLFROG ATRIUM. M. GOTO, A. YATANI, M. URATA and T. FUJINO. Dept. Physiol., Fac. Med., Kyushu Univ., Fukuoka 812 Japan

A possible interaction of adenosine with the effects of acetylcholine (ACh) in myocardium was studied on the membrane potential, current and tension components of the bullfrog atrium by the aid of double sucrose-gap method. Adenosine ($1 \sim 3 \times 10^{-3}$ M) augmented the twitch contraction in the presence of ACh ($10^{-9} \sim 5 \times 10^{-7}$ M), by lengthening the duration of action potential. Dose-tension response curve for ACh was modified with adenosine, increasing the threshold of inhibition and producing a steep fall of tension with a rise of ACh concentration, and the modification showed their non-competitive interaction. Under voltage clamp, ACh-induced steady current (I_{ACh}) was depressed by adenosine strongly and non-competitively. The known inhibition of slow inward current (I_s) by ACh was enhanced after addition of adenosine, while delayed outward current (I_x) which was insensitive to ACh was markedly suppressed. I_{Ca}-dependent and independent tension components were both inhibited by adenosine. The strong suppression of I_{ACh} and I_x by adenosine, however, appeared to mitigate the inhibitory action of ACh on AP and twitch contraction.

303

THE MEMBRANE POTENTIAL AND MEMBRANE RESISTANCE OF AUERBACHER'S PLEXUS CELLS OF HUMAN SMALL INTESTINE IN CULTURE.

T. MARUYAMA, Y. NAKAI AND T. SUZUKI. Depart. of Applied Physiol., Tohoku Univ. Sch. of Med., Sendai.

The cultured Auerbacher's plexus cells which were derived from human small intestine were employed in this study. These cells have maintained cell proliferation, exhibit a hyperdiploid karyotype, and show neuron-like processes. The membrane potential and membrane resistance of these cells were measured by the intracellular microelectrode techniques. The resting membrane varied from -30 mV to -65 mV. The input resistance varied from 35×10^6 ohm to 450×10^6 ohm. The electrical properties of these cells during the culture showed two types of spike generation by intracellilar applied currents.
Group 1: an evoked graded potential was elicited with depolarizing currents. Tetrodotoxin(10^{-6} g/ml) was ineffective in suppressing the evoked graded potential, but these potentials were inhibited bu 1.8 mM Co^{2+}, 3.6 mM^{2+} and 1.2 mM La^{3+}.
Group 2: an action potential, which was all-or-nothing overshooting potential, occurred to both depolarizing and hyperpolarizing currents. The action potential was followed by a hyperpolarizing after-potential and delayed rectification was seen. The action potential was abolished by tetrodotoxin(5×10^{-7} g/ml).

These results suggest that there are two groups in the Abuerbacher's plexus cells in culture, one involves Ca ions and the other Na ions.

304

CONTRACTIONS OF SMOOTH MUSCLE PRODUCED BY AC STIMULATION.

A. TAKAI and T. TOMITA. Dept. of Physiol., Sch. of Med., Nagoya Univ., Showa-ku, 466 Nagoya

The isolated guinea-pig vas deferens was stimulated by AC (20-5,000 Hz, 1-25 V/cm, o.5-4 sec), and relationship between tension development and frequency of stimulating current of a constant potensil field was studied. When potential field was low, the contraction was larger with lower frequencies. However, with increasing the intensity, higher frequencies became more effective than lower frequencies, so that the frequency, at which the maximum contraction was produced, was shifted from 20 Hz to 1 K Hz by increasing potential field from 1 V/cm to 25 V/cm. Tetrodotoxin (TTX) suppressed more strongly the contractions produced by lower intensity and lower frequency stimulation. In the presence of TTX, large contractions appeared at 200-500 Hz when the potential field was 10-20 V/cm, and these contractions were not modified by alpha-receptor blocking agents, reserpine treatment, or cold storage (7-12 days). These augmented contractions were inhibited by indomethacin and potentiated by prostaglandins D_2 and $F_{2\alpha}$. It seems that strong high frequency stimulation liberates prostaglandins.

305

ADRENERGIC INNERVATION OF THE CIRCULAR SMOOTH MUSCLES OF THE GUINEA-PIG SEMINAL VESICLE

Ohkawa,H. Dept. of Physiol.,Yamaguchi Univ.Sch.Med.,Ube.

Spontaneous contractile activity of the circular smooth muscles consists of twitch-like contractions(2.7/min). The amplitude of responses to repetitive stimulation depended on the frequency and pulse durations. Mechanical summation in the tension was observed at low frequency of repetitive stimulation. Ad,NAd and phenylephrine increased the frequency and amplitude of spontaneous contractions. Those excitatory actions of Ad and NAd were antagonized by phentolamine and phenoxybenzamine. Isop, at high concentractions, enhanced the spontaneous activity. Tyramine enhanced the spontaneous activity and its action was antagonized by phentolamine. Evoked responses to repetitive stimulation were blocked or suppressed by TTX,yohimbine, guanethidine and phentolamine. These results provide the conclusion that the innervation of the circular smooth muscles is mainly alpha-excitatory adrenergic.

306

COMPARATIVE PHYSIOLOGY OF THE INTERNAL ANAL SPHINCTER. S. NAKAYAMA AND M. MIZUTANI
Dept. of Physiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama

In cats, rabbits, rats, and guinea pigs, rhythmic fast contractions were recorded from the internal anal sphincter(7-23c/min) in vivo and in vitro, while in dogs slow contractions(2-3c/min), on which small fast contractions superimposed infrequently. Efferent sympathetic nerve stimulation or intravenous infusion of adrenaline and phenylephrine induced invariably contractions of the internal anal sphincter in cats and dogs, while in rats and rabbits efferent stimulation of the nerve caused relaxation. In guinea pigs, colonic nerve stimulation produced its contraction, whereas the hypogastric nerve its relaxation, and intravenous infusion of phenylephrine increased its tone and adrenaline induced an initial slight relaxation followed by increased contractions or an inhibition of rhythmic contractions. In isolated sphincter muscles of dogs, rats, guinea pigs and pigeons, phenylephrine and adrenaline increased the sphincter tone, while in rabbits phenylephrine increased the tone and adrenaline elicited an initial inhibition of rhythmic contractions followed by an increased tone. After phentolamine(α-blocker) the contractile response induced by adrenaline reversed to an inhibitory response. Isoprenaline caused relaxation of all the sphincter strips. It is concluded that there are excitatory α- and inhibitory β-adrenoceptors in the internal anal sphincter of all the experimental animals. Effects of afferent sympathetic nerves on the internal anal sphincter were also investigated.

307

SYMPATHETIC ACTIVITY IN RECTO-RECTAL REFLEX. M.TAKAKI, T.NEYA and S.NAKAYAMA. Dept. of Physiol., Okayama Univ. Med. Sch., Shikata-cho, Okayama

Our previous study revealed that not only mucosal intrinsic and sacral excitatory reflexes via pelvic nerves but also the sympathetic inhibitory reflex in the recto-rectal reflex occur in the guinea pig. The aim of this study is to determine the inhibitory reflex pathways. The propulsive contractions of the rectum produced by rectal distension were abolished after transection of Th 13 and/or L4 segment. This response was reproduced again after removal of lumbar segments(L1-4), division of lumbar dorsal roots(L1-4), lumbar splanchnic nerves or lumbar colonic nerves(LCN), but was not reproduced after division of hypogastric nerves. Thus, afferents and efferents of the inhibitory reflex are contained in the LCN and the reflex center is located in the upper lumbar segments(L1-4). Furthermore, the frequency of efferent discharges of LCN was increased slightly by rectal distension and markedly increased after Th 13 and/or L4 transection. The spontaneous discharges of the LCN were depressed initially by electrical stimulation of rectal mucosa and markedly increased after Th 13 and L4 transection. These results suggested that the supraspinal center inhibits the activity of the lumbar inhibitory reflex center during rectal distension in normal animals. Thus, as an overall effect, it seems that only the excitatory response is induced by rectal distension, since the inhibitory reflex response is masked by them.

308

THE DISTRIBUTION OF VAGAL AFFERENT TERMINALS AND FIBERS IN RABBIT STOMACH BY RADIOACTIVE ANALYSIS. M.SATO, J.IWAMOTO. K.YOSHIZAKI. H.KOYANO. Dept.of Physiol., Akita Univ. Sch. of Med., Akita 010.

It has already been established that radioactive amino acid applied to neuron soma was carried by axonal flow and reached to the nerve terminals or endings. The radioactive analysis was adopted to determine the distribution of vagal afferent fibers and terminals in gastric wall.

^{3}H-leucine was injected directly into the nodose ganglion after supranodosal vagotomy. As control, ^{3}H-leucine was administered into vein in different animal to determine some "leakage" contamination of radioactive materials. Specific radioactivity in mucosal layer was higher than that of control. Specific activity in serosa and muscle layer was almost same to that of control. It might be considered that radioactivity in serosal and muscle layer was deduced not only from the radioactive material by axonal flow but also by systemic circulation. The reproducibility of the experiment of this kind was so poor that it might be needed further investigation to determine the precise fiber distribution in the stomach wall.

309

THE EFFECT OF CATECHOLAMINES ON THE SLOW GANGLIONIC TRANSMISSION. USHIJIMA, H., KATAYAMA, Y. & NISHI, S. Dept. of physiol., Kurume Univ. Sch. Med., Kurume

The effects of catecholamines on the early and late afterdischarges of bullfrog paravertebral ganglia which are respectively triggered by slow EPSP (muscarinic) and late slow EPSP (non-cholinergic) have been studied. Catecholamines inhibited both the early and late afterdischarges during their application, while they enhanced and prolonged the late afterdischarge following their withdrawal. The order of enhancing potency was isoproterenol, adrenaline, noradrenaline, dopamine and phenylephrine, and was what would be anticipated for the involvement of a beta receptor. Indeed, beta adrenergic blockers, but not alpha blockers, antagonized the augmentative action of catecholamines. The ganglionic discharges induced by luteinizing hormone releasing hormone (LHRH) which has recently been suggested to be the mediator for late slow EPSP (Jan, Jan and Kuffler, 1979) and those elicited by Substance P were also enhanced and prolonged by beta adrenergic stimulants. Moreover, isobutyl-methylxanthine (10 μM), a potent phosphodiesterase inhibitor, and dibutyryl cyclic AMP (1 μM) could mimic the augmentative action of catecholamines. These drugs per se at the concentrations used did not depolarize the ganglion cell membrane. The results altogether suggest that the enhancement and prolongation of late afterdischarge by catecholamines is due to an increase in cytoplasmic cAMP caused by activation of a beta receptor.

310

EFFECTS OF METHIONINE-ENKEPHALIN ON THE GUINEA-PIG SYMPATHETIC GANGLIA. YAGISHITA, Y. (*), YONEMURA, K. and TANAKA, I. Dept. of Anesthesiol.(*) and Physiol., Kumamoto Univ. Med. School, Kumamoto

The effects of methionine-enkephalin (M-Enk) on the isolated superior cervical ganglia were studied by means of intracellular microelectrode techniques. M-Enk was dissolved in distilled water and injected into the perfusion current for the test. When applied at the bath concentrations between 1-400 μM, M-Enk produced either depolarizations (5-29 mV) in 17 out of 72 cells tested or hyperpolarizations (5-8 mV) in 5 cells. No consistent results were obtained in the measurements of membrane resistances associated with the depolarizing or hyperpolarizing effects. In a few cells, M-Enk blocked synaptic transmission with concomitant reduction in the amplitudes of action potentials of ganglion cells or excitatory postsynaptic potentials (EPSPs). Neither amplitude nor frequency of spontaneous EPSPs were affected by M-Enk application. However, evoked transmitter release from the presynaptic nerve terminals was appreciably reduced by M-Enk in all the cells tested in a low calcium and high magnesium solution (n = 4).

311

SYNAPTIC CONNECTIONS ON CELIAC GANGLION NEURONS

J.IWAMOTO, M.SATO, K.YOSHIZAKI, H.KOYANO. Dept.of Physiol., Akita Univ. Sch. of Med., Akita 010.

The left celiac ganglion and its nerves, removed from anesthetized rabbit,were placed in physiological saline flowing under paraffin oil. The nerves, lifted into the oil, were used for either electrical stimulation or recording of compound action potential. Intracellular recordings were obtained from individual neurons. The synaptic connections with pre-(splanchnic) and post-(left celiac) ganglionic nerves were examined.

The majority of neurons (70%) have synaptic input from postganglionic fibers. Intracellulary recorded neurons conducted antidromically at 0.78-0.33 m/s. The conduction velocity estimated on preganglionic fibers was 0.76 m/s on an average. The postganglionic fibers connecting synaptically to the neurons conducted at 1.2-0.13 m/s. The extremely small nerve fibers may be included in the postganglionic nerves. Some neurons showed many components of EPSPs that indicate so-called convergence from either pre-or postganglionic nerve fibers. The physiological role of postganglionic fibers which connect synaptically to the neurons in celiac ganglion was discussed.

312

EFFECT OF PROSTAGLANDIN E RELEASED INTO THE AQUEOUS HUMOR BY SYMPATHETIC STIMULATION IN THE RABBIT EYE. YAMAMOTO, S. and ITOH, Y* National Institute of Industrial Health, Kawasaki, *Dept. Physiol., Sch. Med., Nagoya Univ., Nagoya.

Facilitatory effect of PGs, released into the aqueous humor(AH) after sympathetic stimulation, on protein permeability through the blood-aqueous barrier(BAB) was investigated as follows. Rabbits were anesthetized with an intraperitoneal injection of 1g/kg of urethane and fixed on a stereotaxic apparatus in the supine position. Bilateral cervical sympathetic trunks were exposed surgically and severed 40 min before nerve stimulation. After intravenous injection of ^{131}I-labeled serum albumin, posterior-anterior chamber perfusion was carried out with a saline solution containing ^{59}Fe-β-globulin to measure bulk flow of AH and albumin flux through BAB. Albumin permeability was estimated graphically by the tangent of bulk flow-albumin flux curve. Electrical stimulation of a peripheral cut end of the cervical sympathetic trunk(10V,0.1msec,10Hz; for 25 min) caused an increase in albumin permeability. Intracameral injection of PG E_2(3-5μg/ml) and noradrenaline(1μg/ml) in the perfusion fluid caused also an increase in albumin permeability. It was shown by a radioimmunoassay method that concentrations of PG Es in the AH-perfusate mixtures increased during and after the above sympathetic stimulation.

313

INFLUENCE OF CIMETIDINE AND CEPHARANTHINE ON NEURO-HUMORAL EXCITATORY RESPONSE OF GASTRIC ACID SECRETION IN DOG. FUJII'K.& TAKASUGI'S*. Dept.of Physiol.&*Dept.of Surg., Hiroshima Univ.,School of Med.,Kasumi,Hiroshima.

The influence of administration of cimetidine(CIM) and cepharanthine(CR) on augmentation of acid secretion from the denervated corpus pouch caused by stimulation of vagal nerve or splanchnic nerve whose celiac ganglion had been nicotinized and administration of tetragastrin or histamine were investigated,respectively. Dogs were anesthetized with nembutal, and also immobilized with gallamine triethioid.
(1). The serum gastrin,gastric mucosal histamine content and acid secretion from the denervated pouch were increased by stimulation of vagal or splanchnic nerve.
(2). Administration of CIM(histamine H_2-receptor antagonist) inhibited the augmentation of acid secretion from the denervated pouch caused by stimulation of vagal or splanchnic nerve and tetragastrin or histamine.
(3). Augmentation of acid secretion from the denervated pouch caused by nerve stimulation and tetragastrin was inhibited by CR(inhibitor of histamine release), however, no influences of CR were observed on augmentation of acid secretion caused by histamine.
These results suggest that histamine is a final common chemostimulator of the acid secretory cells in the neuro-humoral excitatory mechanism.

314

VASODILATOR RESPONSES IN THE TONGUE AND NOSE TO ELECTRICAL STIMULATION OF THE BRAINSTEM IN THE DOG. NAGAI, M† and PLESCHKA, K†† †Dept. Physiol., Tokyo Metropolitan Inst. Gerontol., Tokyo, Japan. ††MPI für Physiol. und Klin. Forschung, Bad Nauheim, BRD.

Central and peripheral mechanism for vasodilation in the tongue and nose in response to electrical stimulation of the brainstem was investigated. Results: 1) Vasodilation in lingual(tongue) and/or infraorbital(nose) arteries was induced by electrical stimulation of the ventral part of brainstem from the hypothalamus to the upper pontine regions. 2) Vasodilation was not correlated with skin temperature changes. 3) Blood pressure and heart rate remained constant or decreased during stimulation. 4) Vasodilation in the infraorbital artery was not altered by atropine, but abloished by vagosympathectomy. 5) Vasodilation in the lingual artery was not blocked by atropine, vagosympathectomy, transection of cervical spinal cord at C2 and pretreatment with reserpine, but abolished by ganglion blockade with hexamethonium. It is suggested that vasodilation in the tongue is partly induced by a non-cholinergic and non-adrenergic mechanism mediated by fibres running partially apart from the cervical sympathetic trunk. The vasodilator response in the nose is mediated by adrenergic fibres which are situated in the cervical sympathetic trunk. This dilator mechanism would participate in the performance of increased heat loss during thermal panting of the dog.

315

PROJECTIONS OF SUPRASPINAL NUCLEI TO THE SPINAL CARDIOREGULATORY STRUCTURES: HRP STUDY IN THE CAT (THE FIRST REPORT)

ONAI,T., OKADA,J. AND MIURA,M. Dept. of Physiol., 1st Div., School of Med., Gunma Univ., Maebashi

Small amount of HRP was iontophoretically injected into the small area (300 μm x 300 μm) located in the lateral funiculus (exp.A) or the intermediolateral nucleus (exp.B) of T2 segment of the cat. Electrical stimulation of these area elicited cardio-acceleratory or -inhibitory responses. After 2 days' survival, animals were perfused transcardially and brains were processed. In exp.A, labelings were mainly distributed in the nucleus raphe pallidus and nucleus gigantocellularis of the medulla and the nucleus paraventricularis of the hypothalamus. In exp.B, labelings were smaller in number and distributed mainly in the nucleus tractus solitarii and nucleus medullae oblongatae centralis subnucleus ventralis. Against the results of similar experiments with the rat, the solitario-spinal projections pertaining cardioregulatory role is strongly suggested. Consequently, further electophysiological confirmation is needed.

316

THE CARDIO-CARDIAC REFLEXES

SATO, A., SATO, Y. and NAKAMURA,H. 2nd Dept. of Physiol, Tokyo Metro. Inst. Gerontol., Itabashi-ku, Tokyo

It is of interest to know if there are any reflex pathways originating in the heart and reflexly returning to the heart through the central nervous system. The present results, in anesthetized cats, show that electrical stimulation of two different types of afferent fibers (myelinated and unmyelinated) along the cardiac sympathetic nerve can evoke two different types of the reflex discharge potentials in the contralateral cardiac sympathetic nerve respectively.

317

IDENTIFICATION OF AFFERENT FIBER GROUP AND ADEQUATE STIMULUS INITIATING THE TRIGEMINAL DEPRESSOR RESPONSE (TDR).

N. TERUI, Y. NUMAO and M. KUMADA Inst. Basic Med. Sciences, Univ. Tsukuba, Ibaraki-ken 305

In order to identify afferent fiber groups initiating hypotension and inhibition of sympathetic vasoconstrictor discharges underlying the TDR electrical stimulation of variable intensities was applied to the infraorbital nerve of anesthetized rabbits, while recording arterial pressure (AP) and renal sympathetic nerve activity (RNA). Excitation of A-β fibers by low frequency stimuli (5-20 Hz) caused little or no falls in AP (<5 mmHg) and RNA (<20% of control). Recruitment of A-δ fibers resulted in greater falls in AP and RNA (up to 30 mmHg and 75% of control, respectively). Decreases in AP and RNA were augmented by additional excitation of C fibers, although at stimulus frequencies higher than 30 Hz they were often converted to increases. Hypotension and inhibition of RNA could be elicited by any of the following noxious stimuli applied to the hairy skin near the upper lip. (a) Pricking by pins, (b) pinching by serrated forceps, (c) heating above 43°C by a thermode and (d) burning by a heated soldering iron. Tactile stimuli to the face did not cause changes in AP and RNA. We conclude that A-δ and C fibers responding to noxious stimuli to the face elicit hypotension and inhibition of the sympathetic nerve activity in the TDR.

318

EFFECTS OF PHARYNGEAL STIMULATION ON AUTONOMIC NERVE ACTIVITIES TO THE DISTAL COLON IN DOGS. H.OKADA and K.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 pharyngo-colonic reflex in unanesthetized and decerebrated dogs.

Water pouring to the pharyngeal cavity elicited constantly a reflex increase in P outflow which was followed by the transitory inhibition during each swallowing. While reflex responses in S outflow were various by different nerve strands; an increase following by a transitory inhibition during swallowing, decrease and no change. Reflex responses in DCM were frequently an augmentatory effect preceded by a decrease.

Afferent stimulation of the superior laryngeal nerve (SLN) also produced similar responses in P, S and DCM. Reflex increases both in P and DCM were abolished after the mid-pontine transection at the level immediately caudal to the pontine defecation reflex center, but a decrease of DCM was still obtainable after such procedures. The afferent pathway was involved in SLN.

319

ROLES OF LARYNGEAL WATER FIBERS IN WATER INTAKE AND URINE FLOW IN RATS. SHINGAI,T. AND IKUNO, H. Dept. of Physiol., Niigata Univ. Sch. of Dent., Niigata.

Water fibers (sensory fibers responding to water) have been found in the superior laryngeal nerve (SLN) of the rat. The role of the water fiber in the regulation of body water balance was studied by measuring water intake and urine flow before and after the transection of the SLN. Water intake was measured daily for 1 week before and 6 weeks after the SLN transection. Rats were housed individually and water was not available except during drinking tests (10:00 - 17:00). After the nerve transection, the animals showed a significant reduction of water intake over the subsequent 2 weeks. Sham operated rats did not show noticeable changes of water intake. Effects of water stimulation to the larynx on urine flow were examined using water deprived rats anesthetized with pentobarbital. When water drops were applied on the exposed epiglottis, urine flow gradually increased. After SLN transection, water stimulation failed to increase urine flow. These results suggest that water fibers in the SLN may participate in the regulation of water balance.

320

NEUROMECHANISMS OF LACRIMATION INDUCED BY NOXIOUS STIMULATION OF THE CORNEA. N. ARAIE, T. YAMAMOTO, Y. KAWAMURA. Dept. of Oral Physiol., Osaka Univ. Sch. Dent., Kitaku, Osaka.

Physiologic backgrounds of lacrimal reflex were studied in anesthetized rabbits. The lacrimal reflex is, more or less, induced by noxious stimulation applied to various parts of the body. The volume of lacrimal secretion varies depending on the stimulated site. The most dominant lacrimation was usually induced by electrical stimulation of the cornea. Lacrimation showed a rapid flow (6-13 μl/min) during the initial 30 sec after onset of stimulation of the cornea, and lacrimal flow decreased greatly and persisted for 3-5 min with a slow flow (1-2 μl/min). The rapid flow was inhibited by atropin (i.v.), and the continuous flow was inhibited by sympatholytic agents (i.v.).

The volume of lacrimal secretion increased following increase of intensity of corneal stimulation. Meanwhile, efferent nerve activities of lacrimal nerve consisted of two components; i.e., the fast component with shorter latency (50 msec) and lower threshold, and the slow component with longer latency (150 msec) and higher threshold. When the stimulation was stronger than the threshold of slow component, volume of lacrimation increased abruptly.

321

THE CUTANEO-ADRENAL MEDULLARY REFLEXES

ARAKI, I., KUROSAWA, M., and SATO, A. Dept. of Biology, Ochanomizu University, Bunkyo-ku, Tokyo and 2nd Dept. of Physiol, Tokyo Metro. Inst. Gerontol., Itabashi-ku, Tokyo

The effects which stimulation of various segmental skin areas had on adrenal medullary sympathetic efferent activity were investigated in anesthetized rats.

In rats with the central nervous system intact, various segmental skin stimulation was effective in producing reflex increase in sympathetic activity. Paticularly, stimulation of the lower chest and abdomen was more effective than stimulation of other skin areas. After acute spinal transection at the cervical level, stimulation of the lower chest and abdomen maintained its strong effectiveness, while response to stimulation of other skin areas disappeared.

322

TONIC MODULATION EFFECTS OF THIN-FIBER MUSCULAR AFFERENTS ON THE RESPIRATORY OUTPUTS.

T.KUMAZAWA, E.TADAKI, K.MIZUMURA, K.KIM. Dept. of Physiol., Sch. Med., Nagoya Univ., Nagoya.

In anesthetized, paralysed, and artificially ventilated dogs, stimulation of thin-fiber muscular afferents increased respiratory outputs indicated by phrenic nerve discharges. After the cessation of stimulus, respiratory outputs were suppressed below the pre-stimulus level within several minutes in some cases, while in the other cases they remained above the prestimulus level. Intravenous administration of naloxone, a strong opiate antagonist, did not change the pattern of returning phase of the response in the latter case, on the other hand, in the formar cases, the after-suppression was significantly reduced by naloxone.

The present results suggest that endogenous opiates play a role in setting the level of respiratory outputs and that in addition to facilitatory effects on respiration, thin-fiber muscular afferents drive a negative feedback system via neurohumoral mechanisms.

323

FUNCTIONAL CORRELATIONS BETWEEN THE HYPOTHALAMUS AND AUTONOMIC BRANCHES TO THE PANCREAS

OOMURA, Y., *NIIJIMA, A., KITA, H.,ISHIZUKA, S., YAMABE, K., YOSHIMATSU, H., AOU, S., Dept. of Physiol., Fac. Med. Kyushu Univ. 60, Fukuoka,*Dept. of Physiol., Fac. Med. Niigata Univ., Niigata

Ventromedial hypothalamic nucleus(VMH) lesion causes hyperphagia and obesity due to hyperinsulinemia. Obesity is provented by pancreatic vagotomy. This suggests hypothalamic neural control of pancreatic nerve activity. This possibility was examined using anaesthtized rats. Efferent activity of the pancreatic vagal nerve was decreased by repetitive bilateral stimulation of either the VMH or the dorsal part of the lateral hypothalamic area(LHA). Ventrolateral LHA facilitation of the vagal nerve was observed . Efferent activity of the pancreatic splanchnic nerve was decreased by the LHA stumulation. In some cases both vagal and splanchnic nerve activity responded in a complex manner. Facilitation or inhibition was induced by low frequency stimulation; high frequency stimulation reversed the effects. The results clearly indicate hypothalamic control on pancreatic hormone secretion.

324

VESTIBULO-SYMPATHETIC NERVE RESPONSE AFTER DECEREBRATION AND DECEREBELLATION.

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

In chloralose anesthetized cats mass reflex discharges of the renal sympathetic nerve were recorded low intensity stimulations in vestibular and superficial peroneal nerves. Reflex responses caused by stimuli applied to both nerves were quite similar; a brief excitatory phase was followed by a long inhibitory phase or "silent period". Decerebration did not have any appreciable effects on either reflex but decerebellation (in addition to decerebration) greatly increased the excitatory response and shortened the inhibitory phase or "silent period" of the vestibulo-sympathetic reflex. When a vestibular nerve stimulus, given as a conditioning shock, preceded a testing stimulus applied to the cutaneous nerve by less than 300 msec, the test response was completely inhibited. The "recovery curve" of thes conditioning-testing response showed that after decerebellation the inhibitory effect of vestibular conditioning stimulus on testing response was much reduced.

325

ACTIVITIES OF RETICULAR RESPIRATORY NEURONS DURING INTERRUPTION OF BLOOD SUPPLY TO THE BRAIN IN RABBITS.

K. KANAI, K. MIYAKAWA. Dept. of Physiol., Shinshu Univ., School of Medicine, Matsumoto

When the blood supply to the brain is completely interrupted, systemic arterial pressure rises twice as high as its control value, being accompanied by complete arrest of respiratory movement at expiratory position in rabbits. Unit discharges of reticular respiratory neurons in the medulla were recorded with floating microelectrodes during the interruption of blood supply to the brain. Inspiratory neurons stopped their discharges during the interruption, while expiratory neurons maintain their discharges even in the hypoxic conditions. The discharge pattern of these respiratory neurons can be related to the complete arrest of respiratory movement at expiratory position during the interruption. The arrest of the respiratory movement during the ischemia of the medulla can not be ascribed to the overall abandonment of the activities of the respiratory neurons but to the disturbance of the balance between the expiratory and the inspiratory neurons, namely to the extreme shift of the balance to the expiratory situation.

326

CERVICAL SYMPATHETIC AND VAGAL EFFERENT DISCHARGES DURING THE THERMOREGULATORY RESPONSE.

MIYAMOTO,J.K., ANDO,A AND KIMURA,Y. Dept. of Physiol., Saitama College of Health, Kami-Okubo 519, Urawa-shi, 338.

Changes in cervical sympathetic and vagus efferent nerve discharges produced by increasing the body temperature and by injection of warm and cold blood or ringer into the internal carotid artery were studied in nitrous 65%, oxygen 35% anesthetized rabbits.

The increase of the body temperature from 37°C to 40°C produced a sustained increase of both cervical sympathetic and vagal background discharges. Decerabration produced a substantial decrease of these responses.

Injection of warm (40-42°C) blood or ringer into the internal carotid artery produced a transient increase of the cervical vagus efferent discharges and simultaneously a transient decrease of the cervical sympathetic activity. These responses were followed by a decrease of the arterial blood pressure. Cold blood or ringer produced a reverse response. Decerabration made disappear completely the responses produced by intracarotid injection of warm and cold blood or ringer.

Thus, it is concluded that changes of body temperature produce responses in the vagal and sympathetic nerves which are integrated at different levels of the central nervous system: one which represents the main outflow and mediated by the hypothalamus, and the other which is probably integrated by the ponto-bulbar brain stem.

327

FLOW BEHAVIOR OF SHAPE TRANSFORMED PORCINE RED CELL SUSPENSIONS.

YAMASHITA, Y., KUSACHI, R. and KOMATSU, A. Dept. Physiol. Tokyo Wom. Med. Coll., Shinjuku-ku, Tokyo

Effects of red cell shape transformation induced by amphiphilic agents on the suspension viscosity were studied with a capillary viscometer. Compared with normal discocyte, echinocyte suspensions exhibited increased viscosity, while stomatocyte suspensions exhibited decreased viscosity. When these cells were fixed by glutaraldehyde, the suspensions of the cells changed from non-Newtonian fluid to Newtonian regardless of cell shape. The relationship between cellular morphology and flow property of the suspension was discussed in terms of cell to cell interaction and cell deformability.

328

FINE STRUCTURE OF BLOOD FLOW NEAR AN ATHEROSCLEROTIC PLAQUE-LIKE WALL

Niimi,H. and Yamakawa,T. Dept. of Vascular Physiol., National Cardiovascular Center Research Institute, Suita, Osaka

In order to study the thromboatherosclerotic process, the fine structure of blood flow near an atherosclerotic plaque-like wall was examined using the model experiment. The model plaque was made of flint glasss; a typical model of plaque was of Gaussian form. The red cell suspensions in normal saline and dextran solutions were flowed through the test section in the steady and pulsatile state. The motion of red cells near the plaque-like wall was observed in the microscopy-TV monitor-video recorder system; the flow structure was analysed from the motion picture photography.

The motion of red cells showed that a vortex was formed near the plaque-like wall; the flow was separated near the vertex of plaque and reattached at the wall distal to it. The region of flow separation was linearly proportional to the flow velocity. This relationship was valid in the pulsatile state as well as in the steady state.

Our findings suggest that a micro-protuberance of arterial wall may influence the flow structure markedly within the limited region near it. It is concluded that the endothelial cells near a raised atherosclerotic plaque may be injuried or damaged under the micro-fluid mechanical interaction, which may in turn lead to the formation of thrombosis near the plaque and then the development of atherosclerosis.

329

EFFECTS OF SPINAL TEMPERATURE CHANGE ON THE LYMPH-HEARTS AND ANTERIOR LYMPH-CARDIAC SPINAL CENTER IN THE BULLFROG.

M.YAMANE. Dept. of Physiol. (2nd), Kawasaki Med. School, Kurashiki

When the temperature of the anterior spinal cord(ASC) was increased with the perfused Ringer's solution within the range from 8 to 30°C, a rhythm of the anterior lymph-heart(LH) increased almost linearly and its Q_{10} value between 15 and 25°C was 1.60±0.21. Further, an increase of amplitude and a shortening of duration in its contraction occurred. In the posterior LH, its rhythm was similar to that of the homolateral anterior LH, while recognizable changes both in amplitude and duration in its contraction were not produced.

Neurones of the anterior lymph-cardiac spinal center discharged burst spikes synchronized with the contraction in the homolateral LHs and the silent period between two successive bursts was shortened by increasing ASC temperature. Burst spikes were enhanced both in their number and mean frequency, and the Q_{10} value of the latter between 15 and 25°C was 1.75 ± 0.41, but they were decreased in duration. The discharge pattern of burst could be classified into 4 types at room temperature and one pattern was changeable to another one by warming and cooling ASC.

330

COMPARATIVE STUDY OF ARTERIAL CHEMORECEPTOR OF THE TOAD. K. ISHII, K. ISHII, and J. KIMURA. Dept. of Physiol., Fukushima Med. Coll., Fukushima

On pithed toads the carotid labyrinth was perfused with modified Ringer solution at steady pressure. Drops flowed out from the external and the internal carotid arteries were recorded simultaneously with the chemoreceptor impulses induced on a fine strand split from the V_1-root. The effects of some drugs and blood gas tension were tested.

The flow of the carotid labyrinth increased linearly and impulses were in hyperbolic relation with perfusion pressure. Adrenaline, N-adrenaline strongly depressed chemoreceptor activity and increased vascular resistance which was less remarkable in the latter. Dopamine and 5HT also depressed chemoreceptor activity without accompanying any vascular effect. Effects of these drugs were found to be dose response and depression was strong enough to diminish impulses completely in high doses. N-adrenaline was found to provoke the increase of impulses in low dose tested. In a half of preparations atropine brought about slight excitation followed by slight depression with no vascular effect. Increasing in impulses with O_2-lack and low pH was not emphasized by CO_2, decreasing with O_2 was rather intensified by CO_2. These changes in gas tension did not show any effect on vasculature.

331

ANALYSIS OF CARDIAC SYMPATHETIC NERVE ACTIVITY AND HEART RATE IN CONSCIOUS AND FREELY MOVING ANIMALS. NINOMIYA,I., NISHIURA,N., HAYASHI,T., AND OKADA,Y. Dept. of Card. Physiol., Res. Inst., National Cardiovascular Center, Suita, Osaka

With the use of implantable electrode and multichannel telemeter, cardiac sympathetic nerve activity (CSNA) was measured continuously and simultaneously with ECG, heart rate and left ventricular pressure (LVP) in conscious cats for more than one week following electrode implantation surgery. In a given experiment day, CSNA, heart rate and LVP changed with various time courses in response to behavioral stimuli. The magnitude of responses in CSNA was greater than that in heart rate. At resting period, CSNA showed grouped patterns synchronous with cardiac cycle. This grouped CSNA disappeared when heart rate increased to the maximal level during inspiration. Time interval between R spike of ECG and peak CSNA in a cardiac cycle varied amoung the different cycles and it tended to reduce when the heart rate increased. With sitting, standing or walking, an overshoot increase in CSNA was frequently observed prior or simultaneous with an increase in heart rate and LVP. Delay time between peak responses in CSNA and heart rate ranged from one to ten sec. In a range from 130 to 200 cpm, heart rate changed almost linearly with mean value of CSNA at steady state. It is concluded that in conscious cat higher central nervous system was the major determinant of increase in CSNA & heart rate.

332

A STUDY OF OVERALL MODEL FOR BLOOD CIRCULATION UNDER ANOXIC CONDITION, O. OKAI*, A. WATANABE**, M. SAITO**,*Dept. of Physiol., Kyorin Univ. Sch. of Med., Shinkawa 6-20-2, Mitaka, Tokyo 181, **Inst. of Med. Electron., Univ. of Tokyo

An overall model of the blood circulatory system has been analyzed. The model represents the relation of heart rate (H) to mean arterial pressure (P) and mean venous pressure (V): $H = a.\log^2(F) + b.\log(F) + c.P + d.V$ ---(1), where a, b, c and d are constants. By rewriting this equation we get next equation: $x^2 + y^2 = z^2$ ---(2) where $x = \sqrt{a}\{\log(F) + b/2a\}$, $y = \sqrt{H}$, $z = \sqrt{b^2/2a + c.P + d.V}$. Dogs were anesthetized with pentobalbital (25 mg/kg, iv). Various circulatory conditiones were induced by choke or intravenous infusion with noradrenaline (2 μg/kg/min), isoproterenol (0.2 μg/kg/min) and acetylcholine (2 μg/kg/min). In these conditiones hemodynamic variables were measured for determining parameters of equation (1); during drug infusion venous pressure indecated small values of less than 10 mmHg while under choke condition venous pressure showed higher ones, but there was no remarkable difference between heart rates calculated by equation (1) and observed; these parameters x, y and z correspond to each side of a right angled triangle according to equation (2). x was greater during infusion with acetylcholine than control while x was smaller during choke or infusion with noradrenaline and isoproterenol than control.

333

CHANGES OF MYOCARDIAL OXYGEN TENSION AND CONTRACTILE FORCE DURING THE BRAIN ISCHEMIC HYPERTENSION IN RABBITS. T. SHIMIZU, S. HANAI, H. NOMURA. Dept. of Physiol., Fujita-Gakuen Univ. Sch. of Med., Toyoake, Aichi

The acute brain ischemic hypertension elicited by interrupting completely the blood supply to the brain for 30 seconds in rabbits is always accompanied with an apnea and decrease of cardiac output. Left ventricular contractile force was measured by a strain gauge arch sutured directly to the outer surface of the ventricular wall. Tissue oxygen tension was measured by a polarographic technique. Accompanying with the elevation of arterial pressure, the contractile force was increased and estimated to 200% of the control value. The brain ischemia also produced an initial increase in left myocardial as well as femoralis muscular oxygen tension. The increase of the former and the latter averaged 248 and 132% of control levels respectively. During a plateau of the elevated arterial pressure was maintained, femoralis muscular oxygen tension began to return toward the control, and further, it showed a rapid fall less than the control. Myocardial oxygen tension curve also showed the reversion, however it still remained above the control. The difference of oxgen tension response between femoralis and cardiac muscle during the brain ischemia may be a result of redistribution of blood flow from skeletal muscles to myocarduim, which supports the increase of myocardial contractile force strengthened against the severe increase of the afterload.

334

CORRELATION BETWEEN POTENTIAL ENERGY OF VENTRICULAR TIME-VARYING ELASTANCE MODEL AND CARDIAC OXYGEN CONSUMPTION. HIROYUKI SUGA, and TAKAKAZU HAYASHI. Dept. of Cardiac Physiol., National Cardiovascular Center, Suita, Osaka 565

A time-varying elastance model has been proposed as a cardiac ventricle model, which can reasonably simulate instantaneous intraventricular pressure and volume dynamics. A change in potential energy of the time-varying elastance model of the ventricle was theoretically obtained. The increment in the potential energy of the model for a contraction was shown to be equal to the specific pressure volume area (PVA) in the pressure-volume diagram bounded by the end-systolic and end-diastolic pressure-volume relationship lines and the systolic segment of the pressure-volume loop trajectory of the contraction. In experiments on canine left ventricles, we studied correlation between PVA and actually measured cardiac oxygen consumption rate per beat in variously pre- and afterloaded contractions under a given inotropic background. The correlation in each heart was linear with a correlation coefficient of about 0.96. The result indicates that the time-varying elastance model of the ventricle can simulate not only the ventricular pressure-volume dynamics, but also its overall energetics. PVA seems to serve as a reliable predictor of cardiac oxygen consumption rate per beat.

335

INCREASED POST-EXERCISE T WAVE AMPLITUDE IN ELECTROCARDIOGRAPHY

NAKAYAMA, A. SAITO, T. MURAYAMA, H. SUGIYAMA, Y. HINO, Y. MIZUNO, T. TONOOKA, M. MOROOKA, N. HATOGAI, H. KATAGIRI, M. YUMURA, Y. IRIE, S. TAKEDA, K. DEGUCHI, F. INAGAKI, Y. 3rd Dept. Intern. Med., Chiba Univ. Sch. Med., Inohana, Chiba

We studied the mechanism of exercise-induced spatial vectorcardiographic T wave change. The subjects were 19 normal healthy and one pace-maker inplantation woman. Exercise stress testings were performed with a bicycle ergometer in supine position. Vcg was recorded with Frank lead system. As the result, we found the spatial maximal T wave (T max) markedly increased at the immediate post-exercise period. Serum potassium concentration gradually increased in continuation of exercise and recovered gradually at the initial level after exercise. But serum potassium at the immediate post-exercise period remained higher than the initial level. We suggested that the markedly increased Tmax reflected mainly increased serum potassium and abruptly decreased sympathetic drive at the immediate post-exercise period.

336

PULMONARY WATER DISTRIBUTION IN PATIENTS WITH CONGESTIVE HEART FAILURE STUDIED BY COMPUTED TOMOGRAPHY

N. MOROOKA, H. YOSHIDA, S. WATANABE, Y. MASUDA, Y. INAGAKI, Y. KINOSHITA*
The Third Department of Internal Medicine, Chiba University School of Medicine, Chiba
*Department of Health and Health Care, Health Sciences Center, Chiba University, Chiba

Pulmonary congestion and pulmonary water distribution of lung fields were evaluated by computed tomography (CT) in 31 patients with congestive heart failure and 19 normal subjects in the supine position. Significant increase of CT values at both anterior and posterior lung fields was shown in patients with congestive heart failure compared to normal subjects. In congestive heart failure, pulmonary CT values were correlated with various clinical parameters in the order of chest X-ray findings, NYHA functional classification, venous pressure, right heart catheter findings and circulation time. CT values were decreased with the improvement of parameters by medical treatments.

Thus, increase of pulmonary CT values in patients with congestive heart failure indicated increase of pulmonary blood content in a unit volume and of pulmonary perivascular edema.

337

NEW SPHYGMOMANOMETER AND ITS CLINICAL UTILITY

M. TONOOKA, H. TOMIYA, K. TAKEDA, M. SHUKUYA, T. SAITO, Y. MASUDA, Y. INAGAKI,
*A. HIRAI,
**M. TOMITA.
The Third Department of Internal Medicine, Chiba University School of Medicine, Chiba
*The Chiba Municipal Hospital, Chiba
**Parama Industrials, Tokyo

This device consists of a new automatic sphygmomanometer with simultaneous recording of the Korotkoff sounds and the P-K intervals, i, e, the time interval from the upstroke of the brachial arterial puls wave to the onset of the Korotkoff sounds.

The results of recording in about 100 patients revealed that the fourth phase was differentiated from the fifth phase with clear elimination of artifacts.

This instrument, thus, can measure blood pressure precisely and will be very useful for various clinical purposes.

338

APPLICATION OF IMAGE SENSOR TO THE MEASUREMENT OF ARTERIOLAR, VENULAR, OR LYMPHATIC DIAMETER.

M. SAKAGUCHI*, T. OHHASHI, T. AZUMA *Dep. of Elec. Eng., Nagano Tech. College, Nagano, Dep. of Physiol., Shinshu Univ. Sch. Med., Matsumoto

A camera-type diameter gauge was constructed and applied to physiol-logical experiments. The distinctive feature of the gauge is summarized as follows. (1) Installation of an image sensor on the focusing plane of a single-eye reflex camera attached to a stereomicroscope make it possible to measure the diameter of blood and lymph vessels as small as 30 μm in outer diameter. (2) Using the gauge, we can distinguish a diameter change of about 3 μm. (3) The frequency response of the gauge is flat up to 100 Hz. (4) Simultaneous measurements of the diameters of two differ-ent vessels can be done by use of the two "window" signals generated independently at a desired moment for a desired period along the time axis of video signals.

339

MICROCIRCULATORY CHANGES RELATED TO DIETARY INDUCED HYPERCHOLESTEROLEMIA IN RABBITS.(1) ACUTE CHANGES. ASANO, M., SAWANOBORI, K. Dept. of Physiol. Hyg., the Inst. Publ. Health, Minato-ku, Tokyo

Microcirculatory changes in a transparent chamber of male rabbits weighing about 2.5kg were observed vital-microscopically for a period of 15 days during which they were fed cholesterol-supplemented(1.5%, w/w) standard diet. Even in the first day of the cholesterol loading, intravascular blood cell behaviors changed remarkably, although vasomotion and corresponding blood flow were not apprecably influenced throughout the whole experiment period. About 6 hours after the initiation of feeding the cholesterol diet, leukocytes became much more adherent in post-capillary vessels. In the venular area leukocytes adhered in piles to the lumenal wall in places for long periods. The mass of leukocytes looked like a thrombus,but platelets appeared not to participate in forming thrombi. Adhering leukocytes also obstructed capillaries in several places. Following 1 week's cholesterol loading, leukocytes became considerably adherent even in arterioles though not forming large masses, and erythrocytes were apt to make aggregates such as sludges and rouleaus. And, moreover, endothelia of post-capillary vessels protruded into lumens in many places. These changes in behaviors of leukocytes and erythrocytes and shapes of endothelia were observed invariably till the 15th day of the cholesterol loading experiment.

340

THE EFFECT OF AMINO ACIDS ON THE MESENTERIC VASCULAR BED.
M. SHIRATAKA, Y. NARA, T. SATO, N. IKEDA Depts. Physiol., Int Medicine, and Information Sci., School of Medicine, Kitasato Univ., Sagamihara-shi Kanagawa

We have previously reported at this meeting that amino acids infused intravenously or intraportally increase blood flow rate of intra-abdominal organs. In order to clarify the mechanism, we studied the response of the auto-perfused vascular bed of the anesthetized dogs under the various conditions.
The following results were obtained: (1) The oxygen consumption and blood flow rate were significantly correlated — average increase of 13% in blood flow vs. 15% in oxygen consumption. This suggests a close relationship of the blood flow response with the metabolic changes. (2) Shift in pH or osmolarity in the solution may not contribute the mechanism of the response: pH adjustment of the solution did not alter the response. Saline or glucose with the same osmolarity as the amino acid solution did not change the blood flow rate significantly. (3) Vagotomy or pretreatment with prostaglandin synthesis inhibitor did not affect the response.

341

THE CHANGES IN NUCLEIC ACID ACTIVITY IN THE VASCULAR ADAPTIVE RESPONSE TO WALL SHEAR STRESS. A. KAMIYA. Res. Inst. of Appl. Elect., Hokkaido Univ.

In the previous study, we reported a local autoregulatory mechanism of the wall shear stress observed in the adaptive response of arterial lumen to flow load. In this study, we tried to analyse the role of the protein synthesis activity by nucleic acids in this adaptive process. An arteriovenous shunt was constructed between the common carotid artery and the external juglar vein in dogs. One week later, the arterial segment proximal to the shunt as well as that of the contralateral control artery was resected after measuring blood flow rate through each artery. RNA and DNA concentration in the resected segments were assayed by the orcinol and diphenylamine reactions respectively. The results showed close correlation between RNA/DNA ratio and the flow rate(r=0.935). Histchemical examination by methylgreen pyronine stain revealed positive RNA distribution in the intima. The increased messenger RNA due to wall shear stress load was suspected.

342

OSMOLALITY AND K^+ CONCENTRATION OF THE BLOOD FROM THE SKELETAL MUSCLE DURING ARTERIAL OCCLUSION. HIGUCHI, Y.*, FUKUOKA, M.*, ITO, H.*, TAKEMIYA, T.** AND NAGASHIMA, CH.***
* Dept. of Physiol., Kyorin Univ. Sch. Med., Tokyo, **Div. of Physiol., Inst. of Health & Sport Sci., The Univ. of Tsukuba, Ibaraki,***Inst. Microvasc. Res., Shinsei Hosp., Nagano

Hct, total plasma protein(Tp), plasma crystalloid osmolality(Osm_c) and electrolytes (Na^+, K^+ & Cl^-) in the venous blood from the rabbit hindlimb preparation during and after the occlusion of femoral artery were measured simultaneously. It has been previously reported that the Hct and Tp changed in association with the change in the venous flow during and after the 5-min occlusion. Firstly, the previous data were re-confirmed. Osm_c was gradually increased during the occlusion. After the release of occlusion it reached to 101.8%($p<0.05$), and then returned to the control level. K^+ showed similar increase and reached to 103.3%($p<0.02$) immediately after the release of occlusion. Na^+ and Cl^- showed no significant change.

It is suggested from these data that the increase of K^+ and Osm_c are due to ischemia and the accumulation of the metabolites produced by it and result in the dilation of the microvascular vessels and the increment of the transcapillary filtration. Fluid movement from the capillaries may be essentially required for maintaining the *homeostasis* of the ischemic tissues.

343

ESTIMATION OF PERIVASCULAR PRESSURE FROM EFFECTIVE CAPILLARY PRESSURE AND NET FILTRATION PRESSURE DURING HEMORRHAGE IN DOGS. K. MIKI, H. NOSE, S. YAMADA AND T. MORIMOTO.
Dept. of Physiol., Kyoto Pref. Univ. Med., Kamigyo-ku, Kyoto

On splenectomized dogs, 15 % of circulating blood was shed and retransfused. The changes in circulating blood volume, arterial pressure, central venous pressure and plasma colloid osmotic pressure were determined continuously. Based on the results, an attempt was made to estimate the systemic response of effective perivascular pressure from effective capillary pressure and net filtration pressure. The effective capillary pressure was calculated from arterial pressure, central venous pressure and plasma colloid osmotic pressure assuming that post- to pre- capillary resistance ratio as 1/4, 1/5 and 1/9. The net filtration pressure was estimated from rate of fluid movement divided by reported capillary filtration coefficient of 0.1 - 4.0 ml/min·Kg·mmHg.

The effective perivascular pressure showed almost parallel changes with the effective capillary pressure during and after blood shedding or retransfusion. In the equilibrium state, which observed 30 minutes after the end of blood shedding or retransfusion, the effective perivascular pressure showed shifts from control values and decreased after blood shedding and increased after retransfusion.

344

REGULATION OF CEREBRAL BLOOD FLOW : STEAL-LIKE PHENOMENON BETWEEN THE INTERNAL AND EXTERNAL CAROTID ARTERIES.
Y. KAWAI, T. OHHASHI, T. AZUMA Dept. of Physiol., Shinshu Univ. Sch. Med., Matsumoto

Y-shaped canine arterial preparations consisting of the common, internal, and external carotid arteries were suspended in an organ bath and perfused under a constant flow rate with physiological saline or arterial blood led from support dogs. Administration of some vasoactive substances into the perfusate induced redistribution of flow between the internal and external carotid arteries. Epinephrine and norepinephrine increased the rate of flow through the internal carotid artery with corresponding decrease in the rate of external carotid flow. Serotonin, $PGF_{2\alpha}$, and ATP, on the other hand, brought about a change of opposite direction : i.e. a decrease of internal carotid flow and an increase in external carotid flow. Bleeding of the support dogs at the rate of 4ml/kg/min. produced the redistribution similar to that caused by exogenous epinephrine or norepinephrine. These findings suggest that a change in distribution of blood flow between the internal and external carotid arteries may take part in the regulation of cerebral blood flow.

345

THE ACTION OF SYMPATHETIC NERVE ON BLOOD VESSEL OF HEAD AND BRAIN. I. Hatakeyama, Z. Simada and J. Okubo. Dept. of Physiol., Kitasato Univ. School of Medicine, Sagamihara.

The effect of sympathetic stimulation on the blood vessel of head and brain of rabbit was studied by means of electrocapacitography (Hatakeyama: Jap. J. Physiol., 9: 387, 1959), a non-invasive method for recording change in volume. When extracranial circulation was normally maintained, the vascular volume was markedly decreased (vasoconstrictive effect) by ipsilateral sympathetic stimulation at any region of the head although no considerable change in pulsatile component of the head electrocapacitogram (ECPG). When extracranial blood flow was hindered by occlusion of external carotid arteries, pulsatile component of ECPG was markedly suppressed and the effect of ipsilateral sympathetic stimulation was altered as follows: 1) considerable diminution of the vasoconstrictive effect, 2) pronounced diminution of the effect, 3) slight vasodilation followed by considerable vasoconstriction, 4) slight vasodilation and 5) no considerable effect. Vasodilative as well as vasoconstrictive effect was produced by contralateral sympathetic stimulation although it was not remarkable. The effect was not essentially influenced by hindrance of extracranial circulation with occlusion of external carotid artery.

It appears that the sympathetic nerve acts on extracranial blood vessel ipsilaterally constrictive and acts on intracranial blood vessel ipsilaterally as well as contralaterally constrictive and dilative.

346

RESERVOIR FUNCTION OF PERIFERAL VASCULAR BEDS DURING A BLOOD PRESSURE OSCILLATION. T. TAKEUCHI, K. MIYAKAWA, Dept. of Physiol., Shinshu Univ. Sch. Med., Matsumoto

Reservoir function of vascularly isolated organs was studied in rabbits during a arterial blood pressure oscillation with its level elevated in steps. The oscilllation was produced by stepwise elevation of side pressure on the common carotid artery which was surgically prepared as the sole route of blood supply to the brain. Weight changes of the organs caused by neurogenic control of the vessels were measured with force-displacement transducers under varied ciculating blood volume. During hemorrhaging and volume loading of 0.3% of body weight of the animal, the left kidney took charge of 8% of total loss of blood, and of the total loading volume, respectively. At the extreme elevation of systemic pressure, the weight of the left kidney indicated 13.7 • 16.8 • 20.0 • 19.6 • 24.1% decreases in the conditions of -0.6 • -0.3 • 0 • +0.3 • +0.6% blood volume changes, respectively. Under likewise conditions, the jejunum, the spleen and the abdominal skin indicated 1.1 • 1.5 • 2.0 • 2.4 • 2.5%, 13.3 • 18.9 • 21.4 • 22.2 • 18.4% and 0.4 • 0.2 • 0.2 • 0.3 • 0.3% decreases in weight, respectively. Under varied circulating blood volume, the respective vascular beds indicated varied reservoir capacities, which were specific to the vascular beds.

347

MECHANISM OF COLD VASOMOTOR REGULAR OSCILLATIONS G. UEDA, M. TAKEOKA, Y. KOSHIHARA. Inst. of Adapt. Med., Shinshu Univ., Matsumoto

The peripheral one-third of a rabbit's earlobe was immersed in a sub-freeze liquid of -4 ~ -7°C. On the central artery very close to the immersion level, the temperature was recorded continuously. The vasomotor pattern was shown to be a regular oscillation with smaller coefficients of variation in wave parameters. These patterns were activated by administration of sympathomimetic drugs, particularly noradrenaline given intraperitoneally in a dose of 1 mg/body weight, and inversely the α-adrenergic blockers such as phenoxybenzamine, 25 mg, or imidaline, 10 ~ 20 mg (Yamanouchi), abolished the established patterns. Also, β-adrenergic blocker, 7.5 mg of apllobal (Fujisawa), tended to inhibit the pattern. Further, the blocking of cholinergic fibers by atropine given intravenously in a dose of 6 mg was proved to enchance the pattern. The parasympathetic stimulant, vagostigmin in a dose of 0.5 mg (Shionogi), tended to weaken the pattern. Thus it appeared that the vasooscillation was modified by some driving force F which may be a function f (adrenergic fibers / cholinergic fibers). A slight inhibition of the central nervous system by urethane seemed to make patterns rather regular.

348

MECHANISM OF TRANSPOSITION RESPONSE

IRIUCHIJIMA, J., TERANISHI, Y., and EGUCHI, C. Dept. of Physiol., Sch. of Med., Univ. of Hiroshima and Dept. of Anesth., Sch. of Med., Univ. of Kagoshima

Transposition response(TR) is a cardiovascular response complex induced when a rat is transposed to a new box from a habituated one. It consists in increases in heart rate, minute volume, and aortic flow acceleration and a decrease in total peripheral resistance with arterial pressure unchanged. Obviously, an excitation of the cardiac sympathetic nerves is playing an important part in TR but the mechanism of the decrease in total peripheral resistance is not clear: The decrease was present when the rat was immobile. TR was essentially unchanged by atropinization excluding an excitation of the cholinergic sympathetic vasodilator fibers as the cause of the total peripheral resistance decrease. After beta blockade with propranolol, arterial pressure and total peripheral resistance increased in TR with heart rate, minute volume and flow acceleration unchanged. This might suggest that the beta effect of adrenaline secreted from the adrenal medulla were the cause of the peripheral resistance decrease, but the decrease was still present after adrenalectomy or adrenal denervation. After abdominal sympathectomy, arterial pressure was increased in TR before propranolol and remained unchanged after it.

349

THE CO_2 EQUILIBRATION CURVE OF HEMOGLOBIN SOLUTION AND WHOLE BLOOD

UEDA, Y., TYUMA, I. Dept. Physicochem. Physiol., Osaka Univ. Sch. Med., Osaka, Japan.

The CO_2 equilibration curve and in vivo buffer line of hemoglobin solution, plasma, whole blood and etc. were measured by new method which allows continuous determination of pCO_2, pH and total[CO_2]. This apparatus is based on the same principle of DCA which was developed by Duvelleroy. The solubility coefficient(S) of CO_2, the apparent overall dissociation constant($_pK''$) of carbonic acid and the variation of $_pK''$ with $_pH$ were measured by those samples and confirmed in old data.

The curves of oxylabile [CO_2] vs. pCO_2 showed a sigmoidal figure.

350

A COMPARATIVE STUDY ON OXYGEN EQUILIBRIA OF FETAL AND ADULT HEMOGLOBINS., S.Tomita, Y.Enoki, Y.Ohga, M.Kaneko, 2nd Dept.Physiol.,Nara Med.Univ., Kasihara, Nara

The functional property of HbF and A with and without 2,3-DPG were compared over the entire pH. The O_2 affinty for HbF is much lower than HbA at pH from 4.4 to 8.6. This confirms that the low affinity for O_2 is of intrinsic characteristic of HbF.
An addition of 2,3-DPG brings the O_2 affinty for HbF to make relatively higher than for HbA only above pH 7. At pH 5.8 the 2,3-DPG effect is quite identical in both HbF and HbA. With increasing pH, in HbF the 2,3-DPG effect decreases monotonously and disappears completely at pH 8.6. In HbA, on the other hand, it is enhanced first to a maximum at pH 7.2 and then reduced. These results mean that Val 1γ(β) forms primarily a salt bridge with 1st ionized phosphate of 2,3-DPG and then His 143 with 2nd ionized phosphate, The pK of Val 1γ(β) is approximately 7.76, and the pK of His 143 is higher rather than Val 1. Qualitatively, the lower the pH the smaller is the role of His 143 for the 2,3-DPG effect. At higher pH, however, His 143 has a greater role rather than Val 1. 2,3-DPG enhances the alkaline Bohr effect of HbF and A from -0.55 in their stripped forms to -0.9 and revesely reduces the acid Bohr effect from +0.26 in HbF and +0.41 in HbA to +0.2. n which is reduced by lowering pH is recovered by adding 2,3-DPG in HbA but not in HbF.

351

ABNORMAL HEMOGLOBINS WITH AN AMINO ACID SUBSTITUTION AT THE 2,3-DPG BINDING SITE NAGAI, K. AND ENOKI, Y. 2nd Dept. of Physiol, Nara Medical University, Kashihar 634, Nara

The 2,3-DPG (2,3-diphosphoglycerate) binding constants of deoxyhemoglobin have been estimated for abnormal hemoglobins with an amino acid substitution at the 2,3-DPG binding site. The 2,3-DPG binding constant was equally lowered by the replacement of either Valine-1β, Lysine-82β or Histidine-143β by a neutral amino acid which indicates that Valine-1β, Lysine-82β and Histidine-143β contribute equally to the binding of 2,3-DPG. However, the replacement of Lysine-82β by Methionine in Hb Helsinki almost completely abolished the DPG binding which could be attributable to the bulkiness and hydrophobicity of Methionine.

352

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

It has been previously reported that pyridoxal 5'-phosphate (PLP), a substitute for 2,3-diphosphoglycerate, improves the oxygen transport function of ACD-stored erythrocytes effectively. In the present study, the effect of PLP derivatives (attached various amines to aldehyde group of PLP through Schiff base) on the improvement of oxygen affinity of stored erythrocytes was investigated.
(1) Generally, the derivatives with benzene ring were effective as allosteric effector for decreasing oxygen affinity of hemoglobin solution. (2) Only PLP moiety was incorporated into erythrocytes, and the side chain, amine moiety, was not detected in the erythrocytes. However, it seemed that amine moiety altered the permeability of PLP to membrane. (3) PLP incorporated into erythrocytes from various PLP derivatives improved effectively the poor oxygen transport function of stored erythrocytes.
Conclusively, it was assumed that the effectiveness of PLP-Schiff base derivatives on the improvement of oxygen transport function of erythrocytes depended on the chemical characteristics of Schiff base and the chemical properties of amine moiety.

353

THE INFLUENCE OF RED CELL OXYGENATION ON CO_2 TRANSPORT CAPACITY OF PLASMA IN HYPERCAPNIA. MOCHIZUKI, M., NIIZEKI, K. and TAMURA, M. Dept. of Physiology, Yamagata Univ. School of Med. 990-23 Yamagata

The HCO_3^- shift between red blood cells and plasma is accelerated by CO_2 diffusion across the red cell membrane. When $[H^+]$ and $[CO_2]$ are increased by Haldane effect, HCO_3^- ions shift from plasma to red cells in exchange for Cl^-. Even when CO_2 could diffuse from alveolar air into plasma in hypercapnia, $[HCO_3^-]$ in plasma does not increase so much as true plasma does without the inward Cl^- shift into red cells, showing a similar increase to that of separated plasma. During the contact time of red cells in the lung, thus, the veno-arterial CO_2 content difference due to the veno-alveolar Pco_2 difference will be decreased down to the level of separated plasma. In order to give a direct experimental support to the above theoretical evidence, we measured O_2 and CO_2 contents, Po_2, Pco_2 and pH in arterial and venous blood samples obtained during a rebreathing carried out under various alveolar Pco_2 in dogs. The measured veno-arterial Cco_2 differences are distributed along the theoretical curve, suggesting a good agreement between the theoretical and experimental data.

354

STIMULATION OF AMMONIAGENESIS BY ACUTE ACIDOSIS: EVIDENCE FOR A URINARY INHIBITOR. Terao, N., & Tannen, R.,: Dept. of Med., Jichi Med. Sch. & Dept. Med. University of Michigan

By using isolated perfused rat kidney in vitro, ammonia production was investigated in acute metabolic and resipiratory acidosis. In the both conditons, an increase in ammonia production was demonstrated. By contrast, when experiments were carried out under an identical conditon except that urine drained into the perfusate, ammonia production was not enhanced. Thus, acute change in perfusate ph directly stimulates renal ammoniagenesis. This response is inhibited by an unidentified factor excreted in the urine.

355

EFFECT OF EXCESSIVE ACIDEMIA INDUCED BY INTRAVENOUS INFUSION OF HCL UPON THE RESPIRATORY FREQUENCY. C. ADACHI. Dept. of Phisiol., Niigata Univ. Sch. of Med., Niigata

Arterial blood H^+ concentration $[H^+_a]$ was altered by slow intravenous infusion of 0.3N-HCL at controlled level of Pco_2 in artificially ventilated rabbits. Central inspiratory activity was indicated by phrenic motor discharge. In urethane anaesthetized(1g/kg), and vagotomized animals, respiratory frequency(f) was unchanged with alterations in $[H^+_a]$. f decreased with increasing $[H^+_a]$ after conbined section of the vagus and peripheral chemoreceptor fibres. This decrease in f with increasing $[H^+_a]$ was accompanied by an increase in T_E and alittle change in T_I. Under deeper pentobarbital anaesthesia (45mg/kg), f response to $[H^+_a]$ abolished after combined section of vagus and chemoreceptor fibres. This suggest that the periodicity of the bulbopontine inspiratory activity might be little dependent on the $[H^+_a]$ and that a suprapontine acceleratory mechanism might be deppresed by increasing $[H^+_a]$. The peripheral chemoreceptor may play an important part in compensatory mechanism of metabolic acidosis to maintain f at control level.

356

APPEARANCE OF Na^+ AND HCO_3^- IONS IN THE PLASMA OF DOG'S WHOLE BLOOD EXPOSED TO CO_2 GAS

TANASE, K., OGAWA, A., ASAHI, T., SHIMABUKURO, S., HIRAKAWA, S.
2nd Dept. Intern. Med., Gifu Univ. Sch. Med., Gifu

In research for an answer to a question of renal physiology, concerning renal arteriovenous gradient of plasma sodium concentration, We tested whether sodium ions are released from red blood cells under hypercapnia. In most of our experiments, a gas mixture(60 $\%N_2$,25$\%O_2$,15$\%CO_2$) was passed through heparinized whole blood from mongrel dog for 30 minutes. Blood samples were withdrawn at intervals of 5 minutes, and the whole blood was examined for pH, pO_2, pCO_2, while blood plasma was examined for $[Na^+]$, $[Cl^-]$ and $[K^+]$. The plasma concentration of $[Na^+]$, $[HCO_3^-]$ rose with time, while plasma concentration of $[Cl^-]$ fell. If ΔA means an increment of A ion concentration in plasma, We found that $-\Delta Cl^- \fallingdotseq \Delta Na^+$ and $\Delta HCO_3^- \fallingdotseq 2 \cdot Na^+$. This fact was compatible with a model consisting of ① chloride shift, with, say, 4"particles" of HCO_3^- leaving red cells and 4"particles" of Cl^- entering red cells, and ② a "simultaneous" release of 4"particles" of Na^+ and 4"particles" of HCO_3^- from red cells. If chloride shift alone is cut half, one would expect a relation of $-\Delta Cl^- \fallingdotseq \frac{1}{2}\Delta Na^+$ and $\Delta HCO_3^- = \frac{3}{2}\cdot\Delta Na^+$. This relationship was roughly satisfied by an experiment with a carbonic anhydrase inhbitor, acetazolamide(20mg/kg). By contrast, if chloride shift becames the relatively predominant channel, one would expect a relation of $-\Delta Cl^- \fallingdotseq 2\cdot\Delta Na^+$ and $\Delta HCO_3^- \fallingdotseq 3\cdot\Delta Na^+$. This relationship was roughly satisfied by an expemment with gas mixture rich in CO_2(50% N_2,25$\%O_2$,25$\%CO_2$).

357

COMPENSATION FOR THE RESPIRATORY DISTURBANCES OF ACID-BASE BALANCE IN THE CHICK EMBRYO.

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

Diffusivity of O_2 and CO_2 in air is varied by replacing N_2 with other inert gases. It is increased in helium (He) atmosphere and decreased in sulfur hexafluoride (SF_6). The effect of these inert gases on the gas diffusivity changes air cell gas composition of the incubated chicken egg by altering the diffusive conductance of the shell for O_2 and CO_2. When the egg was exposed to He-O_2 gas mixture, the embryo encountered hypocapnia and respiratory alkalosis. The exposure to SF_6-O_2 gas mixture, on the other hand, reduced the embryo to hypercapnia and respiratory acidosis. The acid-base balance disturbance induced by SF_6-O_2 exposure was mimicked by imposing CO_2 on the ambient air.

These respiratory disturbances of acid-base balance were found to be compensated partially in terms of pH or $[HCO_3^-]$. The repetitive sampling and analysis of blood of the embryo revealed that there is a beginning of compensation within 1 hour and the incomplete compensation comes to an end around 3 hours after disturbances. When the egg was replaced again in air after the acid-base balance reached a new compensated state, there appeared first the respiratory changes in the acid-base balance and then the pH and $[HCO_3^-]$ returned to the initial air levels after 3 hours. Resorption of egg shell minerals may not contribute to compensation. The compensation may be attributed to a renal function and/or equilibration by the extraembryonic membranes.

358

CHANGES IN KIDNEY FUNCTIONS AND BLOOD CONSTITUENTS OF DOG WITH A LOAD OF EXOGENOUS CREATININE.

Yasuo TANAKA, Shigeyuki NAKAYA, Ryoko HONJO and Keiko KASHIMA.
Dep't of Physiol. II, Med. Schl. of IWATE Med. Univ., Morioka, JAPAN.

Such an amount of creatinine as to raise the plasma level at maximum up to 10 to 138 mg/dl with little changes in circulatory and respiratory activities, each about 3 to 32 g of Wako's and Nakarai's was intravenously administered to 9 dogs weighing 7 to 21 kg. About 28 to 96 % of the infused were recovered into the urine each at various rates of 0.04 to 4.4 g/h by the volume of about 6 to 180 ml/h and by the concentration of about 0.5 to 7.5 g/dl within the experimental period of 8 hours, after all, each resulting in a rise of the creatinine clearance from the normal of 4 to 23 ml/min to a range of 5 to 60 ml/min. During the period, tissue oxygen tensions pO_2 of various parts of the left kidney taken with the oxygen electrodes were integrated each in figures of mVh every second at a time interval of 60 min, and simultaneously both of blood and urine samples timed to the integration of pO_2 were taken for various determinations.

There were found those tendencies in which, so much as the plasma creatinine increased about 10 times, the kidney levelled up about 2 times greater in the integrated pO_2 - figures of the outer cortex but down about 50 % less in those of the inner medulla, and then the blood became about 10 % higher not only in the hematocrit values but in the plasmin activities.

359

EFFECTS OF FULL SPEED RUNNING ON SODIUM DIURESIS AND CHANGES OF URINARY SUBSTANCES.

OGO, K., *INOMOTO, T.. Dept. Phsiol., Fac. Educ., Kumamoto Univ., Kumamoto, *Dept. Morphol., Inst. Const. Med., Kumamoto Univ.,Kumamoto

Effects of full speed running of the renal fuction were observed using chages of urinary substances, Na^+,K^+, Cl^-,Creatinine,Pyruvate,etc.. After warming up, excretion rate of urine volume , Na^+, Cl^-,K^+, Ca^+ and Creatinine decreased. It seems that decrease of excretion rates of these substances is due to BFR reduced by warming up. In urine of 30 minutes after full speed running, however, excretion of urine volume and Na^+ were considerably increased , especially after running with large oxygen debt (200, 300, 400 m), it was larger than that of the rest time . In contrast with Na^+, Cl^- ,and K^+ decreased after running and excretion rate of Creatinine went up and down inconstantly. These excretion chages were caused by not only the change of GFR. It is suggested that the high excretion rate of Na^+ resulted from the reduction of the active reabsorption in tubule caused by oxygen deficit and that decrease of Cl^- excretion resulted from increase of HCO_3^- excretion in tubule and that decrease of K^+ excretion resulted from competitive secretion with H^+ and exchange secretion with reduced Na^+ reabsorption in distal tubule.

360

AN ATTEMPT TO CLARIFY UREMIC TOXINS IN BLOOD PLASMA OF AN ANEPHRIC RABBIT AND OF UREMIC PATIENTS.

MATSUMOTO, A., YONEMURA, K. and TANAKA, I. Dept. of Physiol., Kumamoto Univ. Med. School, Kumamoto

This study aimed to prove the existence of biologically active substances in the plasma of a nephrectomized rabbit or uremic patients. The plasma collected from the subjects was ultrafiltrated and divided into 2 to 3 samples, each of them containing substances of MW less than 500, 500-10,000 or 10,000-20,000 respectively. Isolated hypogastric nerve-vas deferens preparations of guinea-pigs were used to detect the effects of the plasma on the nerve-mediated contraction. The plasma containing substances of MW less than 500 inhibited the contraction, potency being greater in the anephric rabbit or in the patients than in the healthy controls. The plasma containing substances of MW 500-10,000 obtained from the control rabbit augmented the contraction, whereas the plasma from the anephric rabbit inhibited. In human, such plasma from the controls showed no effect, whereas the plasma from the patients inhibited. The plasma containing substances of MW 10,000-20,000 from the healthy human showed only an inhibition, whereas the plasma from the patients inhibited in a dose-related manner but augmented in low doses.

361

EFFECTS OF PARATHYROID HORMONE AND THYROID HORMONE ON CALCIUM-STIMULATED ATPase ACTIVITY IN THE PLASMA MEMBRANE OF RAT KIDNEY

KUSANO, E., TAKEDA, K., ASANO, Y. Dept. of Cardiol., Jichi Medical School, Minamikawachi, Tochigi

Recently, a calcium-stimulated ATPase(Ca-ATPase) has been described in the plasma membrane from rat kidney cortex. This enzyme was proposed to be involved in the active transtubular calcium transport by the fact that it is located in the basal-lateral plasma membrane as Na-KATPase.(Kinne-Saffran, E., et al. J. Membrane Biol. 17:263, 1974) Parathyroid hormone(PTH) and thyroid hormone(T3) are suspected to play some important roles in calcium handling of the kidney.

In the present study, the effects of PTH and T3 on Ca-ATPase activities were investigated in the plasma membranes of rat kidney cortex and medulla. Parathyroidectomy produced an significant increase in Ca-ATPase activity of medulla. This increase was depressed by the administration of PTH. On the other hand, thyroparathyroidectomy produced a significant increase in Ca-ATPase activity in both cortex and medulla. T3 depressed only the cortical Ca-ATPase activity.

These results suggest that PTH might regulate the medullary and T3 might regulate the cortical Ca-ATPase activity.

362

EFFECT OF GUANINE NUCLEOTIDE ON ADENYLATE CYCLASE ACTIVITY IN THE BULLFROG BLADDER EPITHELIAL CELLS.

T. MISHINA, H. SHIMADA, AND F. MARUMO. Dept. of Medicine, Kitasato University, Kanagawa

We previously reported that GTP and its analogue Gpp(NH)p stimulated the osmotic water flow across the toad bladder in-duced by Pitressin, and further cyclic AMP addition experiments suggested that this was partly pre-cyclic AMP events. To investigate this mechanism, we assayed adenylate cyclase (AC) activity of the bullfrog bladder epithelial cells by the method of Salomon, et al. Crude homogenate of epithelial cells was used as enzyme. Basal AC activity was ~50 pmoles/5 min/mg protein at 30°C, and its apparent Km for ATP was ~0.2 mM. Posterior pituitary peptided homones stimulated the AC activity up to 9 fold of basal level with the following order of affinity which was suggested from Ka: [Arg^8]Vasotocin $\gg$ Oxytosin $\geq$ [Arg^8]Vasopressin (AVP) $\fallingdotseq$ Pitressin. Effect of NaF, Gpp(NH)p, AVP, NaF+AVP, Gpp(NH)p+NaF and Gpp(NH)p+AVP with their saturating concentrations on steady-state kinetical parameters were obtained by Eadie-Scatchard plots: basal (Km ATP 1.8×10^{-4}M, Vmax 239 pmoles/5 min/mg protein), AVP (400 mU/ml)(1.7; 779), Gpp(NH)p (1×10^{-4}M)(2.0; 928), NaF (1×10^{-2}M)(1.8; 742), AVP+Gpp(NH)p (2.6; 1984), AVP+NaF (1.4; 779), and NaF+Gpp(NH)p (2.0; 970). These data suggested that GTP may play important role of modulation in the hormone-receptor-AC system.

363

PLASMA COLLOID OSMOMETRY FOR ASSESSING CAPILLARY WALL PERMEABILITY.

KAKIUCHI, Y., KOYAMA, T., and MIKAMI, T*. Div. of Physiol., and *Div. of Biomedical Controls, Research Institute of Applied Electricity, Hokkaido University, Kita-12, Nishi-6, Kita-ku, Sapporo.

A needle type colloid osmometer equipped with two probes installing each hollow fiber of different retentivity (13,000 Molecular Wt. as the low cutoff, and 50,000 as the high cutoff membranes) was devised to assess permeability of capillary wall to plasma proteins. The difference in colloid osmotic pressure (COP) values between the low and the high cutoff membranes reflected on a profile of protein fractions. Arterial blood from the femoral artery and lymph from the right lymph duct of anesthetized dogs were periodically collected for COP measurement. During the course of pulmonary edema by alloxan administration, blood COP decreased gradually from 19 mmHg to 9 mmHg accompanying decrease in COP difference between the low and the high cutoff membranes from 3 mmHg to 0.8 mmHg. On contrary, the difference increased from 0.3 mmHg to 2.2 mmHg in the lymph. The data gave a vivid description that an increased capillary wall permeability caused transudation of smaller sized proteins from blood to lymph (change in protein concentration from 5.8 g/dl to 4.2 g/dl) and altered the profile of protein fractions (change in A/G ratio from 1.4 to 0.7).

364

EFFECT OF ADMINISTRATION OF ADRENALINE AND PILOCARPINE UPON NEUTROPHILS

K.Goshi S.Okubo Dept.of Physiol, Dental-Clinic House of Representatives Nagata-cho Chiyoda-ku Tokyo.

We made five types of reagent as shown below by diluting with purity water one gramme each of adrenaline and pilocarpine, which idiosyncratically affect a living body: Purity water (-fold) x Adrenaline.Pilocarpine (A) 250 x Iml. (B) 500 x 2ml.(C) 750 x 3ml. (D)I,000 x 4ml. (E) I,500 x 6ml. We administered these reagents of adrenaline and pilocarpine to sub-cutaneous and intravenous. Alteration rate is defined as follows:

$$\text{Aleration rate} = \frac{\text{Post-stimulus value} - \text{Ante-stimulus value}}{\text{Ante-stimulus value}} \times 100\ \%$$

The result is,both adrenaline and pilocarpine decreased in value in case of reagents (C),(D) and (E). Decrease of adrenaline was promoted in case of(A) and (B) much more than in the former case, and pilocarpine increased on the contrary,as we observed. Furthermore, the course time of alteration was on the average 20 or 30 minutes shorter in case of (A)and (B) than in case of (C),(D) and (E), and the course time of recovery was 60 or 90 minutes longer in the former case than in the latter. In terms of sub-cutaneous and intravenous administration, an effect was observed slightly less in the former than in the latter, but we saw that the difference was negligible.

365

THE RED CELL DEFORMABILITY AND OSMOTIC FRAGILITY OF PHENYLHYDRAZINE INJECTED RATS MEASURED BY EKTACYTOMETER AND COIL PLANET CENTRIFUGE

T. NAGASAWA, A. SARASHI, T. KOBAYASHI, E. KIMURA

Wistar strain rats were injected phenylhydrazine hydrochloride (5 mg/ 100 g) two days and were sacrificed three days after last injection. The RBC deformability was measured by the ektacytometer devised by M. BESSIS et al. The osmotic fragility of erythrocyte was measured by the coil planet centrifuge system.

The RBC deformability of PHZ injected rats which contained 68% reticulocyte was less deformable than normal RBC. Three fractions were separated by the ultracentrifugation (12,000 rpm, 10 min). The top (5%), middle (5%) and bottom (5%) fractions contained 95, 71 and 2 % reticulocyte respectively. The RBCs of top and middle fractions showed more deformable than that of bottom fraction. The deformability index was 2.40 (top), 2.25 (middle) and 1.21 (bottom) at 125 dynes/cm^2. The erythrocyte osmotic fragility of PHZ injected rats showed the biphasic curve which consisted of two populations osmotically. The top fraction was less fragile compared to the bottom fraction.

366

HEMATOLOGICAL CHANGES DURING A 14-DAY DRY SATURATION DIVE AT 31 ATA

S. SAGAWA, N. KONDA, K. SHIRAKI, S. K. HONG*, H. NAKAYAMA**, AND M. MATSUDA**, Dept. of Physiol., Sch. of Med., Univ. Occup. & Environm. Hlth., Kitakyushu, *Dept. of Physiol., State Univ. of N.Y. at Buffalo, **Japan Marine Science and Technology Center, Yokosuka

Changes in red cell fragility and blood constituents were studied in 4 male divers during a course of a 14-day dry saturation dive at 31 ATA. The chamber temperature at 31 ATA was maintained at 31.5°C and the PO_2 at 0.4 ATA. The hematological findings were characterized by an increase in red blood cell count, hemoglobin concentration, and hematocrit at the early period of the exposure with a return to the predive control level in one week in the pressure, then after these parameters leveled off. MCV, MCH, and MCHC did not change throughout the experiment. The osmotic fragility of red cells tended toward decrease during 31 ATA. There were no significant changes in the plasma concentration of cholesterol and phospholipids. Red cell content of cholesterol and phospholipids decreased significantly at the early period of 31 ATA. The phosphatidyl choline of red cell membrane was linearly related with the osmotic fragility of red cells ($r=-0.55$, $p<0.01$), but the relation was independent of the changes of dive pressure. From above findings we concluded that the dry saturation dive at 31 ATA had no effect to make the red cells fragile or to change the size of the red cells significantly.

367

COMBINED EFFECTS OF PLASMA PROTEINS AND ELECTROLYTES ON RED CELL DEFORMABILITY

Y.KIKUCHI, M.HORIMOTO, Y.KAKIUCHI, T.KOYAMA. Div.of Physiol., Res.Inst.Appl.Electr., Hokkaido Univ., Sapporo

Red cell deformability (RCD) in fresh human blood was measured by means of an improved nuclepore membrane filter method varying concentrations of electrolytes and proteins in plasma. The method gives an average pore passage time of single red cells as an index of RCD. RCD is reduced with increasing ionic osmolarity above 320 mOsmol when the protein concentration is normal. Meanwhile it remains constant up to 370 and 430 mOsmol when the protein concentration is lowered to 1/3 and 1/6 of normal, respectively. This characteristic RCD change suggests that the reduction in RCD is due to an adsorption of plasma proteins on red cell surfaces. According to DLVO theory concerning interactions between colloid particles suspended in an electrolyte solution, an electric repulsive force between red cells and plasma proteins is weakened by an increased ion concentration. This reduction in the repulsive force will increase an adsorption of proteins on red cell surfaces. The adsorbed proteins will restrict cell membrane flexibility, causing a reduced RCD. When the adsorption of plasma proteins on red cell surfaces occurs, the protein concentration in the plasma decreases by the amount of the adsorbed proteins. Observed changes in the protein concentration supported the above mechanism.

368

THE CORRELATION AMONG BLOOD VISCOSITY, THE SHAPE OF ERYTHROCYTE AND MEMBRANE FLUIDITY.

SUDA,T., KON,K, MAEDA,N. AND SHIGA,T. Dept. of Physiol., School of Medicine, Ehime Univ., Sigenobu-cho, Onsen-gun, Ehime.

We showed the close correlation between membrane fluidity and suspension viscosity last year: i.e. as the cholesterol contents increased in the erythrocyte membrane without changing the cell shape, the membrane fluidity decreased thus the suspension viscosity slightly increased. The membrane fluidity (by spin label method) and the suspension viscosity (by cone-plate viscometer) were examined for the transformed erythrocytes. The anionic drugs induced echinocytic transformation and decreased the membrane fluidity. The suspension viscosity of echinocytes was higher than that of discocytes. In contrast, the cationic drugs, such as chlorpromazine(CPZ) and isoxsupurine(ISO), induced stomatocytic transformation. The suspension viscosity of sphero-stomatocytes became lower. CPZ increased effectively the membrane fluidity but ISO did not. This could be interpreted by the fact that CPZ was more easily incorporated into the erythrocyte membrane than ISO.
Conclusion:(i) The suspension viscosity decreased, when sphero-stomatocytosis occurred. (ii) Concerning suspension viscosity, the shape changes of erythrocytes were main factor, and the membrane fluidity showed minor role. (iii) The transformation depened on the amount of drug incorporated in the membrane.

369

SIGNIFICANCE OF ERYTHROCYTES FRAGMENTATION IN CASES OF DISSEMINATED INTRAVASCULAR COAGULATION (DIC)

MATSUDA,T., YOKOUCHI,M., OGAWARA,M., MIURA,R. and SEKI,T. Dept.Clin. Physiol.(II), Div.Physiol., Tokyo Metropolitan Institute of Gerontology, Itabashi-ku, Tokyo.

Clinical significance of erythrocytes fragmentation in peripheral blood smear in 227 patients with DIC was investigated. Appearance of fragmented red cells in peripheral blood (more than 1-1.5%) was observed in 88 cases (39%) of DIC. Presence of fragmented erythrocytes in patients with DIC was more frequently seen in patients with markedly prolonged euglobulin lysis times (impaired fibrinolysis) and/or with acute renal failure. In some cases of malignant diseases, appearance of fragmented red cells was observed preceding development of DIC. Possibilities that remaining microthrombi due to impaired fibrinolysis in cases of DIC may have mechanically destroyed erythrocytes which passed through fibrin strands in microcirculation and may have caused acute renal failure were discussed.

370

COMPARISON OF PLATELET AGGREGABILITY IN MAN AND CERTAIN ANIMAL SPECIES
TANIMOTO, Y. Dept. of Hematochem., Cent. Inst. Exp. Anim., Takatsu-ku, Kawasaki

Aggregation and release of adenosine triphospate (ATP) of platelet-rich plasma from man, monkey, mini-pig, god, rabbit and rat was studied in response to epinephrine (Epi), norepinephrine (Nor), phentolamine (Ph), isoproterenol (Iso), propranolol (Pro), labetalol (La) and platelets-aggregating agents. In man, Epi led to platelet aggregation in vitro, ATP was also released during the second phase of aggregation. However, platelets from animals did not show the aggregation in response to Epi, but increasing amounts of ATP in ADP or collagen-induced aggregation of monkey, dog and rabbit were released. ADP and collagen-induced aggregation and release of ATP of platelets from man was inhibited by the effect of Ph. ADP and collagen-induced aggregability of human platelets incubated with Iso, Pro, and La was increased, but was lowered in release reaction. Enhance the aggregating potential in platelets from dog was parallel with the release of ATP by these drugs. These results suggest that the mechanism of platelet aggregation and release of ATP might not necessarily parallel.

371

EFFECT OF WHOLE BODY GAMMA RAY IRRADIATION ON RAT PLATELETS
S. OSHIBA, H. IMAI, E. ENDOH, H. SAWAI, T. ARIGA. Dept. of Physiol. Nihon Univ. Sch. of Med., Itabashi-ku, Tokyo

The present report describes the effects of γ-ray irradiation on rat platelets. The whole body was exposed to Co-γ-ray irradiation at a single dose of 700-800 R.

After irradiation, the platelet counts decreased rapidly by the 7th day, and reached a minimal level of about 10,000/mm^3 on the 10th day. ADP-induced platelet aggregation had rapidly decreased by the 3rd day after irradiation, and thereafter gradually returned to normal. Platelet adhesiveness decreased to 40% by the 7th day, reached a minimum level of 28% on the 10th day, and thereafter tended to recover, showing a pattern parallel to that of the platelet count, but differing from the pattern of platelet aggregation. On the 14th day after irradiation, a significant number of giant platelets appeared, probably the result of the reproduction of platelets in the bone marrow.

372

STUDIES ON THE FIBRINOLYTIC ENZYME SYSTEM IN HEPATOBILIARY SYSTEM (XI) —IMMUNOLOGICAL PROPERTIES OF BILOKINASE—
S. OSHIBA, T. ARIGA, H. SAWAI, H. IMAI. Dept. of Physiol., Nihon Univ. Sch. of Med.,Itabashi-ku, Tokyo

This study was undertaken to elucidate the immunological properties of Bilokinase (BK). The BK was divided into 7 fractions according to their reaction with the ionex-changers and gelfiltration used in purification. Each fraction was injected into rats or guinea pigs with complete Freund's adjuvant for two months, and the corresponding antiserum obtained. In three out of 7 antisera, one or two precipitin lines were observed for each antigen-BK at the cathodic side where BK activity was ascertained to exist by zymogram in the same electrophoretic condition.

Anti-bovine UK serum was then obtained by immunizing rabbits with UK purified by Ogawa's method.

The anti-BK showed reactions of both quenching activity and precipitin formation with antigen-BK, but no reactions with UK. Conversely, the anti-UK reacted only with UK itself. This strongly suggests that these two activators are antigenically different proteins.

373

PROPERTIES OF FIBRINOLYTIC PROTEINASE(SPF) OF HUMAN SPLEEN—— COMPARISON WITH ELASTASE.
Y.NAGAMATSU, U.OKAMOTO, J.YAMAMOTO, N.HORIE AND M.ITO. Lab. of Physiology, Fac.of Nutrition, Kobe-Gakuin Univ., Tarumi-ku, Kobe.

Although the literature is abundant which indicates the clearance of fibrin microclots in circulating blood in the RES, little has been known of the fibrin degradation enzyme in the system. To study the degradation mechanism in the RES, the spleen proteinase having high affinity to fibrin and fibrinogen(SPF) was prepared from the human spleen. SPF was found to be a different enzyme from plasmin, trypsin and chymotrypsin in the studies of substrates and inhibitors. SPF had also different properties from pancreatic elastase. Although SPF amidolyzed specific elastase substrates, Suc-$(Ala)_3$-pNA and Suc-Ala-Pro-Ala-pNA, in the same optimal pH range(8.0-9.5), the velocity was lower than that of elastase. Both enzymes were inhibited by $ZnCl_2$, turkey ovomucoid and chicken ovoinhibitor. However, against fibrinogen SPF had higher affinity than elastase had, and elastase had high affinity against elastin, but SPF had not. The remarkable difference was presented in the inhibition study, i.e.SPF was strongly inhibited by STI, but elastase was not. The comparative studies between SPF and spleen elastase recently reported by Sturkey and Barrett(1976) will be required.

374

STUDIES ON INHIBITORS OF UROKINASE PRESENT IN HUMAN PLASMA
YAMAMOTO,H.SAEDA,Y.AND SUGIE,I. 1st.Dept.of Physiol.,Aichi Medical Univ. Nagakute-cho,Aichi

Many authers have posturated that inhibitors of UK occur in human plasma. Most previous investigators have used assays whereby the mesurement of inhibitors of UK was attempted by estimating reductions in the amount of plasmin generated from UK-inhibitor-plasminogen mixture. So we studied inhibitors directed against UK in human plasma using chromogenic peptied substrate S-2444. Human plasma was fractioned by Sephadex G-200 gel filtration or Lysine-Sepharose and Sephadex G-200 combination gel filtration. Four inhibitor peaks were obtained.The first peak was corresponding to α_2M,and the second corresponding C1 INA and IαI. The third and fourth peak eluted from the column agreement with the third protein peak contained α_1AT, α_2PI,ATIII.The third and fourth peak obtained by Lysine-Sepharose and Sephadex G-200 combination gel filtration was higher than obtained by Sephadex G-200. All fractions of these inhibitor peaks inhibited UK progressively not immediately. Judging from these studies there seems to exist many different inhibitors to UK in human plasma and these inhibitors inhibit plasmin also.

375

THE ROLE OF FIBRINOLYSIS IN OVULATION.
MIHARA, H*, KOSUGI, T*, MATSUO, O*, AKAZAWA, K** and MORI, N** *Dept. of Physiology, **Dept. of Obstetrics and Gynecology, Miyazaki Medical College, Miyazaki

The role of fibrinolysis in ovulation was investigated using swine ova collected from a slaughterhouse. Each phase of the ovarian cycle was decided from the size of the follicles. On plasminogen rich fibrin plates, three peaks of plasminogen activator activity were observed with homogenates of the follicular walls. The first peak was observed in the diestrus phase and the second and third peaks before ovulation. These activities were completely inhibited by 10^{-2}M trans-aminomethylcyclohexane carboxylic acid (t-AMCHA), a synthetic plasminogen activator inhibitor. Only the third peak, the activity just before ovulation, was inhibited by aprotinin (20 KIE/ml). Three peaks of fibrinolytic activity were also observed on plasminogen free fibrin plates, in coincidence with the results for plasminogen rich fibrin plates. These activities were completely inhibited by t-AMCHA and aprotinin. The collagenolytic activities of the same homogenates were measured using synthetic substrate for collagenase (DNP-Pro-Gln-Gly-Ile-Ala-Gly-Gln-D-Arg-OH). A high collagenolytic activity was observed to coincide with the second peak on the plasminogen rich fibrin plates. No fibrinolytic activity was observed at any phase in the follicular fluid.

376

Change of FDP and catecholamine under various works

M.IGARASHI, T.ASADA, M.OMOTO*, T.FURUICHI*, T.SHIBA**Dept. of Biochem., Dept. of hygiene*, Dept. of Surg**, School of Med. Toho Univ. Otaku Tokyo, Japan.

This paper were investigated that changes of urinary FDP and catecholamine under various works.

Results of this study were described as follows.

1)a notable amount of FDP were found in spikers of volleyball. In addition, the increase of CPK in plasma was also found in parallel with change of FDP.

2)the 90-min examination increased both FDP and catecholamine the most.

3)the 30-min invader game gave a very little change in FDP but great change in catecholamine.

4)after the 30-min running, FDP and catecholamine were excramed firstly into serum and secondly into urine.

5)the writing work increased both FDP and cathcolamine as it becames longer.

6)sauna both gave less effects in catecholamine than anticipated.

7)the fructuation rate of FDP and catecholamine was not distinctive by different kinds of tasks.

377

SPONTANEOUS PERIODIC FLUCTUATION WITH RESPIRATORY RHYTHMS IN NEOCORTICAL EEG IN CATS. MIYAKAWA, M., NISHIKAWA, Y. and HUKUHARA, T., Jr. Dept. of Pharmacol. II, Jikei Univ. Sch. Med., Minatoku, Tokyo.

Vagotomized and paralyzed cats were maintained with local anesthesia by artificial ventilation under monitoring $F_{E_{O_2}}$ and $F_{E_{CO_2}}$. Neocortical electrocorticogram(ECoG) in the anterior sigmoid gyrus,the efferent nerve activity of the phrenic,renal and sympathetic and splanchnic nerve were simultaneously recorded. A spontaneous periodic fluctuation in ECoG with a shorter period was noted. Autocorrelogram of ECoG and crosscorrelogram between ECoG and the phrenic discharge proved that the periodicity of this rhythmic ECoG fluctuation synchronized with that of the phrenic discharge. Thereby the correlation coefficient of crosscorrelation(C.C.) between ECoG and the phrenic discharge increased during hypoventilation and decreased by hyperventilation. When the sinus nerves were severed,the increase in C.C. induced by hypoventilation was pronounced($p<0.05$),however,the degree of a decrease in C.C. by hyperventilation was not changed significantly. By means of autocorrelation analysis of ECoG and crosscorrelation analysis between ECoG and the sympathetic nerve activity,another spontaneous periodic fluctuation of ECoG showing a period ranging from 30 to 101sec was distinguished. In most cases the period of the periodic fluctuations was synchronized with that of the blood pressure fluctuation in the third order. After cutting the sinus nerves the period of the spontaneous rhythmic fluctuation of ECoG with the longer period shortened showing a range from 23 to 70sec.

378

DIFFERENT STABILITIES OF SPONTANEOUS UNIT ACTIVITY OF RETICULAR RESPIRATORY NEURONS IN THE BRAIN STEM OF THE RABBIT. GOTO, K., HATTANMARU, Y. AND HUKUHARA, T., Jr. Dept. of Pharmacol. II, Jikei Univ. Sch. Med., Minato-ku, Tokyo

The spontaneous burst activity of brain stem respiratory neurons varies considerably in the regularity of volley period. The variation was analyzed quantitatively to determine whether the degree of variation may relate to the discharge type and the localization of respiratory neurons in the brain stem. Experiments were performed in 40 paralyzed rabbits being maintained by artificial ventilation under monitoring end-tidal O_2 and CO_2 levels. In order to obtain a quantitative measure of the stability of respiratory units, the coefficient of variation (CV; the ratio of the standard deviation to the mean) for the period of volley was calculated for 88 respiratory units which exhibited discontinuous patterns having a silent period. The CVs for period of volley varied in a range from 1.3 to 14.4%. All of the inspiratory and expiratory units which were discharging stably with CVs ranging from 1.3 to 2.0% were located in the N. reticularis parvocellularis. Another variable of spontaneous burst activity of respiratory neurons, the correlation coefficient of autocorrelation also varied in a wide range (0.06-0.92, N=131). There was a significant correlation ($r=-0.74$, $p<0.001$, N=85) between the both variables. These results suggest that respiratory neurons showing different degrees of stability may have different functional significances in the bulbar mechanisms of respiratory rhythmogenesis.

379

RESPIRATORY NEURONAL ACTIVITIES IN THE UPPER CERVICAL CORD OF THE CAT. M. AOKI, K. KAWAHARA, S. MORI. Dept. of Physiol., Asahikawa Med. Coll., Asahikawa

Our recent study has demonstrated that spontaneous rhythmic breathing could be resumed in cervical (C1) spinalized cats after spinal shock. This spontaneous spinal respiration was characterized by dominant diaphragmatic activity. We could not, however, induce such spinal respiration in C3 spinalized preparations. These results led us to assume that cervical transection at C1 may leave some medullary type respiratory neurons within the cervical segments, which begin to fire spontaneously after the shock. In the present experiments, we explored C1 to C2 segments with tungsten microelectrodes during spontaneous breathing in lightly anesthetized brain intact cats. A total of 24 neuronal discharges which were associated with respiratory movements was successfully recorded. The burst discharges were all in synchrony with the inspiratory phase of respiratory cycles. The number of spikes within a burst ranged between 21-62 (mean 39.8). The mean frequency ranged between 17.8-35.5 (mean 26.8) imp/sec and the peak frequency reached 27.6-66.7 (mean 46.2) imp/sec. In this series of experiments, no expiratory type cells were recorded. Most of the recording sites were histologically located in the intermediate zone of the spinal gray matter of the C1-C2 cervical cord.

380

H^+-SENSITIVITY AND PHASIC ACTIVITY OF NEURONS IN THE RESPIRATORY CHEMOSENSITIVE AREA OF THE RAT VENTRAL MEDULLA OBLONGATA IN VITRO

FUKUDA, Y. and HONDA, Y., Dept. of Physiol., Chiba Univ. Sch. Med., Inohana, Chiba

Brain slices taken from the ventral surface layer of the rat medulla oblongata were used to analyze the central respiratory chemosensitivity. Phasic activity of neurons was recorded in the rostro-lateral part of the hypoglossal nerve root (superficial part of the lateral reticular nucleus) (area II). Rostral and medial to it, a population of 'chemo- or H^+-sensitive' tonic neurons was found previously (area I). H^+ increased the activity of area I neurons. 64 of 126 neurons in area II fired in an irregular phasic fashion at pH 7.4. The duration of burst or silent period was not constant and varied from 100 ms to 2 min. Another 62 neurons fired tonically. The phasic activity was either excited or inhibited by H^+. Some tonic neurons in area II started to show phasic burst under low pH conditions. After cutting the slice between area I and II, the number of neurons firing phasically in area II was reduced, and their response to H^+ became largely inhibitory. Excitatory action of H^+ on area I neurons was maintained intact even after sectioning. Therefore a connection of H^+-sensitive neurons in area I with neurons in area II seemed to influence the phasic discharge and the excitatory response to H^+ of the latter.

381

CHANGES OF PHRENIC DISCHARGE PATTERN INDUCED WITH STRYCHNINE.

SHIMADA, K., IKUNO, H. AND KITADA, Y. Dept. of Oral Physiol., Niigata Univ. Sch. of Dent., Niigata.

Effects of strychnine of the vagal inhibition and the respiratory rhythm were investigated. Rabbits were anesthetized with urethane and paralysed with gallamine and artificially ventilated. Phrenic activity was recorded. Strychnine (1×10^{-4} - 1×10^{-5}) was applied in the medulla oblongata with microinfusion pump. Nucl. tractus solitalii and Nucl. ambiguus were functionally identified with field potential evoked by stimulation of the vagus. Application of strychnine in the lateral reticular formation gave rise impulse discharge during expiratory phase. The impulse discharge may due to disinhibition of input from the expiratory neurons. Vagal reflex was blocked with strychnine application in ventro-lateral region of Nucl. tractus solitalii. Minimum dose of strychnine (1×10^{-5}) to block the vagal reflex was 4 µl. The respiratory rhythm disappeared and tonic discharge of the phrenic nerve continued when strychnine was applied in dorso-median region of Nucl. ambiguus. Minimum dose of strychnine (1×10^{-5}) to lose the respiratory rhythm was 10 µl. Strychnine applications in both cranial and caudal regions out of the vagal nuclei did not show noteworthy effect on the respiratory rhythm.

382

THE EFFECT OF DOXAPRAM ON RESPIRATORY CHEMOREFLEXES

T. NISHINO, *S. LAHIRI. DEPT. OF PHYSIOLOGY SCHOOL OF MEDICINE CHIBA UNIV. AND *DEPT. OF PHYSIOLOGY SCHOOL OF MEDICINE UNIV. OF PENN.

The effects of doxapram hydrochloride on carotid chemoreceptors and ventilation at various levels of Pao_2 and $Paco_2$ were investigated in 14 cats anesthetized with α-chloralose. Ventilation, carotid chemoreceptors activity, $P_{ET}co_2$, $P_{ET}o_2$ and arterial blood pressure were recorded contineously before and during administration of doxapram. We found that the ventilatory effect of doxapram was greater with increased intensity of hypoxia and increased $Paco_2$ level. Carotid chemoreceptors activity, on the other hand, increased by a similar magnitude at any level of $Paco_2$ and Pao_2. These findings show that the effect of doxapram on ventilation is dependent on Pao_2 and $Paco_2$ but that the effect of doxapram on the carotid chemoreceptors activity is independent of Pao_2 and $Paco_2$. We concluded that the augmented ventilatory effect of doxapram during increased chemical drive is not peripheral but it is central effect.

383

AN ON-LINE COMPUTER SYSTEM FOR ASSESSING CARDIORESPIRATORY FUNCTION DURING EXERCISE.
Y.MIYAMOTO AND T.MIKAMI. Dept.Biomedical Control, Res. Inst. Appl. Elect. Hokkaido Univ., 060 Sapporo.

A noninvasive and loadless system was developed for the purpose to assess cardiorespiratory function during exercise. An impedance plethysmograph measured ventilation of a human subject, which was sampled at a rate of 50 times/sec and was fed into a microcomputer system of 32k bytes together with PO_2 and PCO_2 of expired air. The computer calculated tidal volume, breath frequency, minute ventilation, end-tidal PO_2 and PCO_2, O_2 input, CO_2 output and respiratory quotient. These were displayed simultaneously at end of each breath. The second plethysmograph with a different frequency measured the impedance change of the thorax caused by the systolic ejection from the heart. The impedance signal was sampled at a rate of 200 times/sec and was fed into the computer. In order to cancel the respiratory artifact, the impedance signal was averaged for several cardiac cycles utilizing R wave of ECG as a trigger. Then, the computer calculated stroke volume, heart rate, cardiac output and ventricular ejection time which were displayed together with respiratory parameters. Reliability of the present system was confirmed through comparisons with other techniques so far used. For respiratory parameters, the comparison was made with a pneumotachograph-integrator system, and for cardiac parameters with the direct measurement of aortic flow by an electromagnetic flow meter. The correlations between these were found to be excellent.

384

PNEUMOGRAM PATTERNS ASSOCIATED WITH KARATE ACTIONS
G.UEDA, Y.YANAGIDAIRA, T.INABA*, S.TANGE*, M.TAKEOKA, Y.KOSHIHARA, I.YONEMURA**. Inst. of Adapt. Med., Dept. of Legal Med.**, Shinshu Univ., Matsumoto, The Branch of Japan Karate Assoc., Nagano*

Subjects and Methods. Healthy adult subjects were examined. The respiratory changes were recorded by a thermistor in front of the nostril or from the termini attached on the upper, lower, medial chest and abdominal walls by means of the impedance pneumography (Nihon Kohden AI-600). Also, the abdominal belt indicated the abdominal respiration (Fukuda TPE-A1060). The movement was checked by a vibration pickup (Nihon Kohden MT-3T) and the ECG (Fukuda FD-16) was obtained by chest leads.

Results. The load for the repetition of simple reverse punches, one action/sec, for 1 min varied around 100 Watt. As for the respiratory patterns, the fluctuation of durations in respiratory cycles was greater in untrained states than in trained states. The amplitudes became smaller even when the subject posed for the next actions and the starting point was usually at the deeply inspirated phase. The ratio of chest to abdominal respiration was greater in women than in men. The values RQ tended to increase after 2 min of repetitive reverse punches.

385

DIAPHRAGMATIC EMG ACTIVITY IN MAN.
HOMMA,I.,KOBATASHI,K.,KOBAYASHI,Y., NAGAI,T.,SAKAI,T. Dept.Physiol. The Jikei Univ.Sch.of Med. Tokyo

Many studies have suggested that the diaphragmatic activity may represent the neural output from the central pattern generator. In this study diaphragm EMG instead of volume was recorded in man and the relationship between'integrated'diaphramg EMG and insp. duration was obtained. Surface electrode with a flexible cable was passed through the nose into the lower part of oesophagus to record diaphragm EMG. The signals were processed using a 'leaky integrator' to obtain what is here referred to as'integrated'EMG. Successive five breaths were added to be averaged to wipe out the noise. The amplitudes of'integrated'EMG referred to as tidal diaphragm activities ($Int.D_T$) increased due to accumulation of CO_2 during rebreathing. Insp. duaration referred to as $T_{I.D}$ was the period from the onset of the rapid increase of'integrated'EMG to its peak. During the rebreathing $Int.D_T$ increased 7 to 8 times of eucapnic $Int.D_T$. On the other hand, $T_{I.D}$ showed little changes until $Int.D_T$ reached values of 2 to 3 times of eucapnic $Int.D_T$, but shortened at higher levels of $Int.D_T$. The relationship obtained from diaphragm EMG records showed a similar pattern as the relationship obtained in volume records.

386

EFFECTS OF REGIONALLY APPLIED HYPOXIA AND HYPERCAPNIA ON PULMONARY MICROCIRCULATION OF BULLFROG.

M. HORIMOTO, T. KOYAMA, Div. of Physiol., Res. Inst. Appl. Electr., Hokkaido University, Sapporo

There was no direct measurement of the effects of hypoxia and hypercapnia on pulmonary microcirculation in vivo. We examined the effects of those gases on blood flow velocity and diameter of microvessels on the lung surface of anesthetized bullfrogs. The unilateral lung exposed by a unilateral thoracotomy was inflated by introducing 20 ml of hyperoxic gas (38% O_2) and the intrapulmonary pressure was maintained at 2 cmH_2O. For a localized administration of gases a small plastic ring (O.D.: 12 mm) with a glass window was placed on the exposed lung surface. The blood flow velocity in microvessels was measured through the glass window by means of a laser Doppler microscope. Hypoxic gas (0 to 5.7% O_2) or hypercapnic gas was introduced into the ring with the glass window, after the hyperoxic gas had been initially applied. Under each condition, ventricular pressure (monitored by an intraventricular catheter), heart rate, blood flow velocity and the diameter of the aimed vessel were measured. Although ventricular pressure and heart rate showed no detectable changes, the flow velocity decreased by 4.5% in hypoxia and 9.5 % in hypercapnia of 34.2% CO_2 on an average. 47.7% CO_2 caused a stronger decrement in flow velocity than 34.2% CO_2 did. The decrement of vessel diameter was 7.5 % in hypoxia and 9.5% in hypercapnia.

387

VENTILATORY RESPONSES TO HYPOXIA AND HYPERCAPNIA IN MOUNTAINEERS.

MIYAMURA,M., SHIMAOKA,K., HARA,M., AND MATSUI,H.
Lab. work Physiol., Res. Cent. Hlth. Phys. Fit. Sports,
Nagoya University, Chikusa-ku, Nagoya

Ventilatory responses to hypoxic and hypercapnic stimulation in the mountaineer was determined at sea level before and after mountaineering to the Mt. Huascaran (6,770 m).
Maximum ventilation was measured using the Douglas bag during maximal treadmill exercise with incremental loading. Hypoxic drive was expressed as the difference of ventilation (ΔV_E) when subject breathed with ambient air and low oxygen (about 9.7 %) during submaximal bicycle work for 7 min. furthermore, hypercapnic ventilatory resqonse line was determined by the rebreathing method.
It was found in this study that ventilatory responses to exercise and hypoxia have a tendency to increase after returning from high altitude, though hypercapnic drive is almost the same before and after mountaineering.

388

ANALYSIS OF ALVEOLAR P_{CO_2} CONTROL DURING THE MENSTRUAL CYCLE.

NARIKO TAKANO. Dept. of School Health, Fac. of Education, Kanazawa Univ., Marunouchi 1-1, Kanazawa 920

We attempted to analyze how P_{ACO_2} is regulated during progesterone-induced hyperventilation in the luteal phase. A CO_2 control loop model was constructed, in which function of the CO_2 exchange system was described as $P_{ACO_2}=0.863\dot{V}_{CO_2}/\dot{V}_A$ (the gain $H=dP_{ACO_2}/d\dot{V}_A$) and that of the CO_2 sensing system, as $\dot{V}_A=S(P_{ACO_2}-B)$. Using this model, we estimated (1) primary increase in $\dot{V}_A$ ($\Delta\dot{V}_A(op)$) produced by progesterone stimulation and (2) effectiveness (E) of the closed loop defined as $\Delta P_{ACO_2}(op)/\Delta P_{ACO_2}$ (cl), where op signifies open loop and cl, closed loop. On 8 healthy women, the above respiratory variables were investigated throughout the menstrual cycle. $\Delta\dot{V}_A(op)$ increased with days of the luteal phase while E remained unchanged at the value of 7.9. This means that the CO_2 control loop operated to reduce the primary deviations of $\dot{V}_A$ and P_{ACO_2} due to progesterone stimulation to one-eighths, which resulted in finally small deviations of $\dot{V}_A$ (+9.4%) and P_{ACO_2} (-2.5 mmHg) during the luteal phase. In addition, the decrease in B by 3.5 mmHg during the luteal phase was found to be dependent on $\Delta\dot{V}_A(op)$.

389

RHYTHMIC PATTERNS OF DISCHARGE IN HYPOTHALAMIC NEUROSECRETORY NEURONS OF CATS AND DOGS.
H. YAMASHITA AND K. INENAGA. Dept. of Physiology, Univ. of Occupational and Environmental Health, Japan, School of Medicine, Kitakyushu.

Recent Studies in rats suggest that vasopressin- and oxytocin- secreting neurons in supraoptic (SON) and paraventricular nuclei (PVN) of the hypothalamus show two different patterns of activity; one "bursting" or "rhythmic" pattern and the other, irregular continuous discharges. This possibility was investigated in cats and dogs anesthetized with chloralose or nembutal by recording electrical activity of single SON and PVN neurons. Only some of the "identified" neurosecretory cells showed rhythmic, intermittent discharges ("bursting" cells in rats) while the majority showed an irregular continuous firing pattern. Furthermore, the pattern of discharge sometimes changed from one to the other during long periods of observation. This occurred without apparent stimulus in certain instances; in others the rhythmic firing was associated with fluctuation in blood pressure and heart rate and was likely to be caused by changes in baroreceptor activity. Possible origins of rhythmic discharges and the physiological importance of such patterns in terms of hormone secretion were discussed.

390

ELECTROPHYSIOLOGICAL CHANGES IN THE LIMBIC-PREOPTIC-ARCUATE PROJECTIONS ACCOMPANIED WITH THE LOSS AND REINITIATION OF ESTROUS CYCLES IN RATS.
T. AKEMA, M. KAWAKAMI Dept. of Physiol., Yokohama City Univ. Sch. of Med., Urafune-cho, Minami-ku, Yokohama.

Percentages of the hypothalamic arcuate neurons responding to single pulse stimulation of the medial preoptic area were statistically higher in female rats than in males, and they were almost similar in young and aged rats in each sex. Responses of preoptic neurons to stimulation of the medial amygdala were not different between sexes but decreased in the senile animals in each sex. Preoptic unit responses to the dorsal hippocampal stimulation were more frequently observed in proestrous females than in young males, and were decreased significantly in aged constant estrous females. In aged females whose vaginal cyclicity was induced by daily treatment with progesterone, the reponses of preoptic neurons to the amygdaloid or hippocampal stimulation were increased to as high as those in young animals. Stimulus thresholds for inducing unit responses were almost equivalent among different groups of the rat. These results indicate the sex difference in the function of the hippocampal-preoptic and preoptic-arcuate connections in the rat. The results also suggest the functional modification of the amygdalo-preoptic and hippocampal-preoptic neural connections in aged rats, the modification being possibly related to the loss of the ability to produce estrous cycles in aged rats.

391

A ROLE OF THE ARCUATE NUCLEUS MEDIAN EMINENCE-DOPAMINE SYSTEM IN MORPHINE-INDUCED PROLACTIN RISE OF THE RAT.
IEIRI,T., SUZUKI,H. AND SHIMODA, S. Dept of Endocrinology, Dokkyo University, Mibu, Tochigi.

Participation of the arcuate nucleus in morphine-induced prolactin (PRL) rise of the rat was studied using male adult rats treated with monosodium glutamate(MSG) neonatally, which resulted in a reduction of dopamine(DA) content in hypothalamus. A single intraperitoneal injection of 10mg/kg BW of morphine sulfate(MS) resulted in elevations of PRL levels in both control and MSG groups. The PRL level of MSG group was lower than that of control. Naloxone in a dose of 0.2mg/kg BW decreased PRL levels in both groups. The PRL level of MSG group was higher than that of controls. In saline(SAL) treated rats, there was no significant difference in PRL levels between 2 groups. These results suggest that the arcuate nucleus-DA system has a role in morphine and endogenous opioid peptides induced PRL rise of the rat. MSG treatment also has been reported to induce some changes in cholinergic activity or β-endorphine content in the same region. It is difficult to mention, at present, which neurotransmitter mainly causes the present results. In conclusion, the present study demonstrates a direct evidence for participation of the arcuate nucleus in morphine induced PRL rise in the rat.

392

NEUROENDOCRINOLOGICAL SIGNIFICANCE OF OPIOID ACTION ON MEDIAL SEPTO-PREOPTIC NEURONES IN FEMALE RATS. K. KUBO. Dept. Physiol., Kumamoto Univ., Inst. Const. Med., Kumamoto 862

Endogenous opiate is suggested to act to inhibit ovulatory gonadotropin secretion. An electrophysiological investigation was made into the mechanisms of the action of opioids on the medial septo-preoptic neurones in female rats.

The majority of the neurones were responsible to microiontophoretically applied β-endorphin, and displayed either inhibitory or excitatory responses. These effects appeared to be specific, since they could be antagonized by naloxone, as it was tested. β-endorphin-induced changes in spontaneous activity were usually paralleled by similar changes in the activity evoked by the dorsal hippocampal stimulation. Indeed, β-endorphin prolonged an inhibitory period induced by the stimulation. None of the facilitatory responding neurones to β-endorphin could be affected by iontophoretically applied LRH and LH. Either sensitive neurones to LRH or LH were inhibited or unaffected by β-endorphin. Although neuronal changes responded to iontophoretically applied estradiol were not corresponded with the action of β-endorphin, facilitatory effect of estradiol was diminished by iontophoretically or intraventricularly administered β-endorphin.

In conclusion, action of β-endorphin appeares to be closely linked with hippocampal neural input, and to modulate the responsiveness of the neurones to the feedback action of estrogen, as well as LRH and LH.

393

LATERAL HYPOTHALAMIC AND GASTRIC SECRETORY RESPONSES TO VARIOUS NEUROPEPTIDES IN THE RAT. SHIRAISHI, T., A. INOUE* AND N. YANAIHARA* Dept. of Physiol. Tokai Univ. Sch. of Med. Isehara 259-11 and *Bioorganic-chem. Lab. Shizuoka Pharm. Coll. Shizuoka 422.

Discovery of new neuropeptides in the brain has been increasing at an accelerating rate. Their functional effects in the brain are important, but many have yet to be determined. Several neuropeptides were applied electro-osmotically to neurons in the lateral hypothalamus (LHA), while unit activity and gastric acid secretion were simultaneously monitored. Somatostatin and substance-P inhibited non-glucose sensitive neurons and had no effect on gastric acid secretion. TRH and met-enkephalin suppressed both gastric acid secretion and unit activity of glucose sensitive neurons in the LHA, but had no effect on non-glucose sensitive neurons. Neurotensin and bombesin had unique effects in the LHA. Neither had any effect on any LHA neurons when used alone. When used with 2-DG, bombesin enhanced 2-DG elicitation of LHA glucose sensitive neuron activity and gastric acid secretion. Neurotensin inhibited the effects of 2-DG on both LHA activity and gastric acid secretion.

The results suggest that neurotensin and bombesin, while not having direct effects when used alone, are effective modulators of other factors which do affect chemosensitive neurons; at least in the LHA.

394

ROLE OF CATECHOLAMINES TURNOVER RATES IN THE RAT BRAIN IN LH, FSH OR PROLACTIN RELEASE. KEN-ICHI HONMA and WOLFGANG WUTTKE. Dept. of Physiol., Hokkaido Univ. Sch. of Med., Sapporo 060., Max-Planck Inst. for Biophy. Chemistry., 3400 Göttingen, West Germany.

Norepinephrine (NE) and dopamine (DA) turnover rates were measured in the medial preoptic area (MPO), anterior and posterior mediobasal hypothalamus (A-MBH & P-MBH) in groups of rats subjected to various endocrinological manipulations. The NE turnover in the MPO was high in proestrous (P), ovariectomized (OVX), ovariectomized-estrogen primed (OVX+E) and ovariectomized estrogen-primed progesterone treated (OVX+E+P) rats when the experiments were carried out during afternoon hours, whereas diestrous (D) rats had low NE turnover rate in the MPO. In OVX+E animals the NE turnover was also low when measured in animals decapitated in the morning. These turnover rates correlated good with serum LH levels. The NE turnover in the A-MBH and P-MBH was low in D and OVX rats during afternoon hours. High NE turnover rates in these structures were observed in P, OVX+E and OVX+E+P rats and correlated best with serum prolactin levels. No obvious relation between DA turnover in the MPO, A-MBH or P-MBH and serum hormone levels could be established. It is suggested that NE stimulates LH-RH release by acting in the MPO. Furthermore NE acts in the MBH either to stimulate the release of a PRF or to inhibit release of a PIF.

395

AGONIST-INDUCED DESENSITIZATION OF β-ADRENERGIC RECEPTOR IN RAT PAROTID SLICES.
YOSHIMURA, K., NEZU, E., and CHIBA, A. Dept. of Physiol., Hokkaido Univ. School of Dent., North 13, West 7, Kitaku, Sapporo

The exposure of rat parotid slices to norepinephrine(NE) resulted in a progressive loss of cyclic AMP response to NE (desensitization(DS)). The degree of DS depended on the concentration of agonists and their order of potency correlated well with their activities as β-stimulants. The induction of DS was stereospecific as well as β-adrenergic specific. β-adrenergic blocking agents such as atenolol and alprenolol, while having no effects of its own, effectively blocked the DS caused by NE. The degree of DS was markedly decreased by a lowering of the temperature of the medium, while the amount of ^{3}H-dihydroalprenolol(^{3}H-DHA) binding was only slightly affected. No significant change in the amount and affinity of ^{3}H-DHA binding was found in the membrane fraction prepared from the slices incubated with NE. These results suggest that induction of DS was mediated by modulating the coupling process between receptor and adenylate cyclase.

396

VAGAL MODULATION OF INSULIN SECRETION IN THE RAT
SAKAGUCHI, T., HIRANO, T., YAMAGUCHI, K., FUKUDA, A. AND NIIJIMA, A. Dept. of Physiol., Niigata Univ. Sch. Med., Niigata

To evaluate the physiologically possible role of the vagus nerve in the secretion of insulin in the rat, changes in plasma levels of insulin and sugar were examined after vagotomy with and without adrenalectomy. Male rats, fasted for 22 hr, weighing about 300 g and anaesthetized with pentobarbitone were used. Thirty minutes after various adrenalectomy, the first blood sampling was made just before pancreatic vagotomy and a second sampling was done 15 min after vagotomy. Pancreatic vagotomy significantly lowered levels of plasma insulin in bilaterally adrenalectomized animals. It was also noticed that electrical stimulation of the pancreatic vagus nerve elicited an increase in levels of insulin associated with a reduction of carbohydrates in the blood. These observations support the hypothesis that there is a vagal mechanism modulating the secretion of insulin and suggest that the vagal mechanism is a potent factor although such a mechanism may be masked by the activity of the adrenal gland.

397

ROLE OF GABA(γ-aminobutyric acid) IN THE RAT PANCREATIC ISLETS (II).
Y. OKADA, H, TANIGUCHI Dept. Neurochemistry, Tokyo Metropolitan Institute for Neurosciences, Musashidai, Fuchu-shi, Tokyo and 2nd Dept. Internal Medicine, Kobe Univ. School of Medicine, Ikutaku, Kobe.

Amino acid analysis revealed high concentration of GABA(18.2mmol/kg prot) in the pancreatic islets. GABA is localized in the β-cells in the islets, because high amount of GABA is found in the central part of the islets, and streptozotocin, a β-cell attacker, decreased the GABA level in the islets, and because human insulinoma(β-cell tumor) contained high amount of GABA. Uptake study of ^{3}H-GABA to the isolated pancreatic islets and to the brain tissue(substantia nigra-SN) showed low uptake of the ^{3}H-GABA to the islets whereas high affinity uptake was found in the SN, indicating that the role of GABA in the islets is different from that of the nervous system. Exogenous GABA application and endogenous GABA increase in the isolated islets had nothing to do with the release of the insulin from the islets. Increase of endogenous GABA(by γ-vinyl GABA) raised the incorporation of ^{3}H-leucine to the insulin in the islets, suggesting that GABA may be related to the insulin synthesis in the pancreatic islets.

398

PROPERTIES OF HAMSTER INSULINOMA CELL(In-111 R). Y. OKADA, T. ANDO. Dept. Neurochemistry and Microbiology, Tokyo Metropolitan Institute for Neurosciences, Musashidai, Fuchu-shi, Tokyo 183.

It is often required to use large quantities of homogenenous tissue for the biochemical study of the pancreatic islets. The cell line In-111 R (Uchida et al 1976) derived from hamster pancreatic tumor may serve for this purpose, although its properties have not been studied in detail. Inoculation of the cell to the young golden hamster caused hypoglycemia with the increase of blood insulin level. In-111 R cell contained insulin (21.7± 1.0ng/2x10^6 cells, equivalent to the rat insulin, measured by the radioimmuinoassay). Electronmicroscopic study revealed that the cell contained secretory granule. The cultured cell has been studied for its capacity to respond to known stimuli of insulin release. During 1h incubation, insulin release was increased 2.5 fold by 50mM potassium in the presence of calcium and three fold by the application of veratridine(100 uM). Arginine(20mM) increased the insulin release by 40%. High concentration of glucose(17.7, 27.8mM), however, did not raise the insulin secretion of the cell. The absence of the glucose sensitivity for insulin secretion of this cell is differed from the normal islets.

399

THE TESTICULAR ACTIVITY AND POLYAMINES IN THE JAPANESE NEWT
MATSUZAKI, S. AND K. YAMAMOTO. Dept. Physiol., Inst. Endocrinol., Gunma Univ., Maebashi

Testes of Japanese newts were analyzed for their contents of diamines and polyamines throughout the year. The testicular concentration of cadaverine was very high in winter (about 3 μmoles per g wet weight), while it was very low in summer. Spermidine and spermine levels which were rather low during winter months increased in spring and remained elevated in summer when spermatogenesis was very active. The levels began to decrease in September to reach their nadir in winter. There was a significant negative correlation between the cadaverine level and the spermidine or spermine level. The testicular concentration of putrescine that was much higher than that of spermidine or spermine, was a little lower in winter than in summer. The *sym*-homospermidine level showed only a little change throughout the year. Ovine gonadotropins administered *i.p.* decreased the cadaverine level and increased the putrescine or polyamine levels. The cadaverine level was much higher in the immature lobe of the testis harvested in winter than in the mature lobe, while polyamine levels were higher in the immature lobe. These results suggest that intratesticular cadaverine suppresses the biosynthesis of polyamines, especially spermidine and spermine which are closely associated with spermatogenesis.

400

CHANGES IN PITUITARY-ADRENAL FUNCTION IN RATS INTOXICATED WITH METHYLMERCURIC CHLORIDE. *ABE, K. AND **TANAKA, I. Dept. of Physiol., Kumamoto Univ., *Coll. Med. Sci., **Med. School, Kumamoto

Male Wistar rats received twice a week methylmercuric chloride (MMC) by subcutaneous injection at a dose of 5 mg/kg body weight. Plasma corticosterone levels and adrenal weights were examined during the treatment with MMC up to the total doses of 100 mg/kg. Crossing phenomenon in the hindlimbs appeared at 100 mg/kg. Adrenal weights gradually increased to 2.5-fold of the controls at 100 mg/kg. Corticosterone levels transiently increased up to 4-fold of the control levels at 60 mg/kg, and thereafter decreased to control levels at 100 mg/kg. In those rats at 100 mg/kg, administration of ACTH caused secretion of corticosterone in larger amounts than in the controls. These results suggest that the decrease in corticosterone levels at 100 mg/kg was due to the damage of hypothalamus-pituitary function by MMC. When MMC dosing was discontinued at 60 mg/kg, adrenal weights and corticosterone levels recovered to control levels within 2.5 months, whereas they decreased to the levels less than controls with elaspe of 5 months after discontinuance at 100 mg/kg.

401

EFFECTS OF CORTISOL, PROGESTERONE AND TRANSCORTIN ON ^{3}H-THYMIDINE INCORPORATION INTO PHA-STIMULATED HUMAN LYMPHOCYTE AND THEIR INTERACTION. OGAWA,K., SUEDA,K. and MATSUI,N. IInd Division of The Research Institute of Environmental Medicine, Nagoya University, Chikusa-ku, Nagoya

We investigated the effects of cortisol(F), progesterone(P), dexamethasone(D) and transcortin(Tr) on ^{3}H-thymidine incorporation into PHA-stimulated human lymphocyte. Suppressive effect was demonstrated within the range of 10^{-7}- 10^{-6}M, 10^{-6}- 10^{-5}M and 10^{-8}- 10^{-7}M for F, P and D, respectively, in a dose dependent manner. The addition of P to F or D decreased the effect of F or D, which suggested that P competed with F or D at the intracellular glucocorticoid receptor site. Tr itself had no effect, but when added with F, it decreased the suppressive effect of F in proportion to the decrease of unbound F concentration, suggesting that in this system the effective fraction may be unbound F, of which concentration is modified by the presence of P. From these data, we speculated that the increase of F and P during pregnancy might be suppressing immunological interaction between mother and fetus, especially, P participates in the local immunosuppression, and also speculated that the biological effects might be modulated at their two competing sites; one is intracellular glucocorticoid receptor site, and the other is transcortin binding site.

402

THE EFFECT OF HISTAMINE LIBERATION ON THE ADRENAL SECRETION OF ALDOSTERONE IN HYPOPHYSECTOMIZED-NEPHRECTOMIZED DOGS. T. AIKAWA, T. HIROSE, I. MATSUMOTO, T. SUZUKI. Dept. of Physiol., Nagasaki Univ. Sch. Med., Nagasaki

The adrenal secretion of aldosterone in hypophysectomized-nephrectomized (hx-nx) dogs in response to histamine liberation induced by compound 48/80 was examined under pentobarbital anesthesia. After i.v. injection of compound 48/80 (75 μg/kg), blood pressure decreased profoundly in 7 hx-nx dogs; the adrenal secretion of aldosterone increased from 0.12 ± 0.03 (mean ± SEM) to 1.10 ± 0.23 ng/kg/min and those of cortisol and corticosterone increased slightly; plasma concentrations of potassium and sodium changed slightly from 4.3 ± 0.2 to 4.6 ± 0.2 mEq/l and from 134.6 ± 1.7 to 137.5 ± 2.1 mEq/l. In 2 hx-nx dogs, the adrenal secretion of aldosterone and blood pressure did not change after injection of compound 48/80. The result suggests that endogenous histamine liberated into blood stream may have a direct stimulatory effect on the secretion of aldosterone by the adrenal gland.

403

MICROELECTROPHORETIC STUDY ON THE OSMOTIC CONTROL OF THE NEUROSECRETORY NEURONE IN THE PARAVENTRICULAR NUCLEUS(PVN). AKAISHI,T and H.NEGORO. Dept. Physiol., Niigata Univ. Sch. Med., Niigata

Extracellular recordings were made from antidromically identified cells in the PVN of urethane-anesthetized rats. Fifty-seven neurones were examined for their responsiveness to acetylcholine(ACh) applied iontophoretically and 69 % of them were excited, 12 % inhibited and 19 % unaffected by ACh. In 58 % and 42 % of the neurones excited by ACh, the excitation were blocked by hexamethonium and atropine, respectively. In these cells, iontophoretic application of hexamethonium and atropine also blocked significantly($P<0.05$) the activation induced by the intracarotid injection of hypertonic saline(0.6 M NaCl). Thirty-nine neurones were examined for their responsiveness to angiotensin II(A II) and 46 % of them excited. The excitation was blocked by the iontophoretic application of (Sar^{1},Ala^{8})-A II. However its application did not block the response of these cells to osmotic stimuli significantly. These data indicate that the nicotinic and muscarinic ACh receptors are involved in the osmotic control of the PVN neurones.

404

ADRENAL MEDULLARY SECRETORY RESPONSE TO PONTINE AND MESENCEPHALIC STIMULATION IN THE RAT

HIDEO MATSUI. Dept. of Physiol., Nagasaki Univ. Sch. of Med., Nagasaki

Adrenal medullary secretion in response to electrical stimulation of the pons and the mesencephalon was investigated in sodium pentobarbital (50 mg/kg i.p.) anesthetized rats. Adrenal venous blood samples were collected and analyzed for adrenaline and noradrenaline by the fluorometric method. Stimulation of the dorso-lateral areas of the pons and mesencephalon resulted in a significant increase in adrenaline secretion with or without significant increase in noradrenaline secretion. A significant decrease in noradrenaline secretion was observed in one rat following pontine stimulation. In no case, however, was observed a selective increase in noradrenaline secretion. Most of the responsive areas were located near the sensory nucleus and the motor nucleus of the trigeminal nerve.

It may be suggested that in the pons and mesencephalon of the rat there exists the central nervous system mechanism for the regulation of the adrenal medullary secretion.

405

INCREASE OF CYCLIC AMP LEVELS BY ADENOSINE IN RAT PHEOCHROMOCYTOMA CELLS (PC 12).

K. KOBAYASHI & Y. KURODA, Dept.of Neurochem.,Tokyo Metropolitan Inst.for Neurosciences, Fuchu-shi, Tokyo 183.

The activation of tyrosine hydroxylase (TH) in catecholamine secreting cells after stimulation has been explained by phosphorylation of the enzyme by cyclic AMP-dependent protein kinase. However, the mechanism to increase intracellular cyclic AMP has not yet been known. We have reported that adenosine derivatives increase levels of cyclic AMP and activate TH in nerve endings from mammalian brain (Proc.Japan Acad.54, 243; ibid. 640,1978). Adrenal chromaffin cell systems were tested using clonal pheochromocytoma (PC 12). The cells were incubated with Krebs-Ringer solution. Addition of adenosine (0.1-100 μM) increased the level of cyclic AMP to 400% of the control. AMP,ADP and ATP caused less increase, while acetylcholine, dopamine, noradrenaline and adrenaline did not increase. ATP is released from chromaffin cells together with catecholamines and degraded to adenosine in extracellular space. Our results suggest that the increased exogenous adenosine after stimulation causes the elevation of intracellular cyclic AMP levels, possibly resultings in the activation of TH in a feed-back manner.

406

SUPPRESSION OF THE LUTEINIZING HORMONE RELEASING EFFECT OF LUTEINIZING HORMONE RELEASING HORMONE BY ARGININE-VASOTOCIN IN IMMATURE MALE DOGS.

M.MIENO, ER. YAMASHITA AND K. YAMASHITA. Dept. of Pathophysiol., Atom. Dis. Inst., Nagasaki Univ. Sch. Med., Nagasaki 852

Arginine-vasotocin(0.1 or 10 ng/kg body wt) was administered into the carotid artery of anesthetized immature male dogs 3 h before the administration of a standard dose of luteinizing hormone releasing hormone (LH-RH, 5 ug/kg body wt) into the same vessel. The rate of secretion of 17-oxosteroids by the testes in vivo served as an index of luteinizing hormone(LH) secretion. The administration of LH-RH into the carotid artery of control dogs which had been injected with isotonic saline caused a slight but definite increase in the secretion of testicular 17-oxosteroids. This effect of LH-RH on the testicular secretion of steroids was markedly reduced by pretreatment with arginine-vasotocin. However, the testicular response to the i.v. administration of human chorionic gonadotrophin(5 i.u./kg body wt) was unaffected by pretreatment with arginine-vasotocin(10 ng/kg body wt). These results indicate that in immature male dogs, arginine-vasotocin is able to inhibit the action of LH-RH by acting directly on the anterior pituitary gland.

407

EFFECTS OF VERAPAMIL ON Ca ACTION POTENTIALS AND HORMONE RELEASE IN RAT ANTERIOR PITUITARY CELLS.

S. OZAWA and N. KIMURA* (Dep. of Physiol., Jichi Med. Sch., Tochigi, and Dep. of Med. Chem., Tokyo Metropolitan Institute for Neurosciences*.)

The anterior pituitary cell generates action potentials with a Ca component. To understand a functional role of this Ca component of action potentials, effects of verapamil on the Ca spike and hormone release were studied using the clonal cell line GH_3. Verapamil reversibly suppressed the occurrence of Ca spike in Na-free saline. The stimulatory effects of high K^+ and Ba^{2+} on the release of prolactin from GH_3 cells were suppressed by verapamil (10^{-6}-10^{-4} M). The effect of thyrotropin-releasing hormone (TRH) on prolactin release was similarly affected by verapamil. It has been suggested that TRH stimulates hormone release by increasing voltage-sensitive Ca influx, since TRH enhances the generation of action potentials in the GH_3 cell. The present results are compatible with this suggestion. The stimulatory effects of TRH on the release of both thyrotropin and prolactin from primary cultures of rat anterior pituitary cells were also suppressed by verapamil.

408

THE MODE OF ACTION OF THYROTROPIN-RELEASING HORMONE ON THE SMOOTH MUSCLE OF RAT DUODENUM.

K. FURUKAWA, T. NOMOTO and T. TONOUE. (Dept . Pharmacol. Tokyo Women's Med. Coll. Shijuku-ku, Tokyo, 162)

Thyrotropin-releasing hormone (TRH) added in vitro prduced a transient relaxation of the isolated segment of rat duodenum even in the presence of tetrodotoxin. This response was not abolished in the K^+free, Na^+free or Cl^-free medium but abolished when Ca^{++} concentration in the medium was reduced to 0.27 mM. The simultaneous recording of electromyogram and mechanical activity demonstrated that spike discharge was inhibited along with the TRH-induced relaxation. We also found that [met]-enkephalon (ENK) produced a similar transient relaxation in the rat duodenum in the presence of tetrodotoxin. However, the spike discharge was not inhibited in this response. On the other hand, tetraethylammonium (TEA, 30 mM) blocked completely the response to ENK whereas the response to TRH was not abolished in the presence of TEA. In the presence of caffeine (8 mM) the responses to either TRH or ENK was not produced. These results suggest the differential mode of action of these neuropeptides in the smooth muscle of rat duodenum. TRH may inhibit calcium influx while ENK semms to affect potassium channel to reduce the intracellular calcium concentration. Later might be through the sequestration by sarcoplasmic reticulum.

409

THE EFFECT OF THE THYROID ON NEURAL CONTROL OF RAT GROWTH HORMONE SECRETION.

M. SUZUKI, T. KAKEGAWA, S. MIYAHARA AND Y. OOMURA. Dept. of Physiol., Inst. of Endocrinol., Gunma Univ., Maebashi, and Dept. of Physiol., Fac. of Med., Kyushu Univ., Fukuoka.

In previous studies, we reported that thyroidectomy abolished the "ultradian" GH burst secretion which was a characteristic in rat pituitary hormone secretions. T_4-supplement restored the GH burst. There are two possible mechanisms in thyroid hormone action on the GH burst, viz. the first is a neural mechanism and the second is a change in the responsiveness of pituitary somatotrophs to hypothalamic hormones. To analyze those, we measured plasma GH response to electrical stimulation of the ventromedial hypothalamic nuclei which formed an excitatory pathway for GH secretion. The animals were pretreated with α-MT 8 hr before the stimulation to suppress the spontaneous GH burst through catecholamine depletion. The response of GH secretion of control animals was greater than that of thyroidectomized animals although the difference was not statistically significant. To evaluate the responsiveness of pituitary somatotrophs of the two groups to a GH secretagogue, dibutyryl-cyclic AMP was injected. In contrast to the electrical stimulation, plasma GH response of thyroidectomized rats was slightly enhanced more than that of the control. These results suggest that neural mechanism for rat GH secretion is maintained by thyroid hormone as well as GH biosynthesis in the pituitary.

410

INDUCTION OF ANDROGEN-DEPENDENT ESTEROPROTEASES BY T_3 IN THE SUBMANDIBULAR GLAND OF ANDROGEN INSENSITIVE (Tfm) MICE HOSOI, K. and UEHA, T., Dept. of Oral Physiol., Josai Dental University, Sakado-shi, Saitama.

Various esteroprotease isozymes (BAEE hydrolytic activities) of the mouse submandibular gland were separated by isoelectric focusing. In normal female mice, pI-4.6, -5.8, -7.1 and -9.9 hydrolytic activities were found, whereas in mice with testicular feminization (Tfm), only pI-4.6 hydrolytic activity was found. In female mice, both 5α-dihydrotestosterone (5α-DHT) and tri-iodothyronine (T_3) significantly increased all these isozymes except the pI-4.6 hydrolytic activity. In Tfm mice, 5α-DHT had no effect on any enzymes but T_3 increased all these isozymes except the pI-4.6 hydrolytic activity. Therefore, the pI-4.6 activity is independent of the two hormones. Histochemical and electron microscopic studies also demonstrated that T_3 stimulated protein synthesis in the submandibular gland. These findings suggest that the esteroprotease gene(s) in Tfm mice is normal and that androgen is not involved in the induction of hormone-dependent esteroproteases by T_3.

411

EFFECT OF BOVINE GROWTH HORMONE ON THE RETARDED MYELINOGENESIS OF PITUITARY DWARF MICE. T.SUGISAKI, T.NOGUCHI AND Y.TSUKADA. Dept. of Physiol., Sch. of Med., Keio Univ. Tokyo

The effect of bovine GH on the myelinogenesis was investigated using the Snell dwarf mice (dw), in whose anterior hypophyses normal acidophilic cells are absent and thyrotropes are scarce. At 40 days of age, three parts of the brain from the dwarf, the pallium cerebri, cerebellum and brain stem, were reduced in weight. The activity of CNPase and both the contents of S-100 protein and Thy-1 antigen were found to be reduced only in the pallium cerebri. By the daily joint-administration of 10 μg /g of bovine GH and 0.25 μg of T_4 to the dwarfs during the first 40 days of postnatal life, the reduced weight and the activity of CNPase in the pallium cerebri were completely restored, although by the single-administration of bovine GH they were restored in some extent. On the contrary, by the single-administration of TSH they still remained at the same reduced-levels of the untreated dwarfs. These results indicate that dysmyelination occurs selectively in the pallium cerebri of the Snell dwarf mice and the myelination is accelerated by the administration of bovine GH with the synergistic effect of T_4.

412

EFFECT OF DENERVATION ON POSTNATAL RAT SKELETAL MUSCLE

NARUSAWA,M.,NAGAMI,K.,YOSHIOKA,T. and NAKANO,S. Dept. of Physiol. Tokai Univ. Sch. of Med., Isehara, Kanagawa, 259-11.Japan.

Each immature muscle fiber is supplied by two or more motor axons which converge on to a single end-plate and innervated by one single axon in future. A while, undifferentiated cells frequently occured in the interspaces between neighboring muscle fibers at the early stage after birth. Investigation of the effect of denervation upon process of muscle development is presented in this study.

The siatic nerve was cut on right side of the rat (another side is as control) at the period of 1, 7, 14 and 21 days, 2 and 13 months after birth. Soleus muscle were used after 2 and 4 weeks denervation for light and electron microscopical observation.

Muscle weight and cross-sectional area reduced at denervated younger period than that of adult. However, the number of muscle fiber increased at denervated adult rat and decreased younger one. It might be considered that a few muscle fiber is splitting by denervated adult rat and also immature fiber is degenerating at younger period. Developing umscle fiber might be influenced by innervating process at the postnatal period.

413

THE CHANGES OF THE VASCULARIZATION OF MUSCLE AND FAT TISSUES DUE TO LONG-TERMED ENDURANCE EXERCISE.

S. YUSA, M. SATOYOSHI, F. TANISHIMA and Y. OGAWA. Inst. of Sports Med., Yokohama City Univ. Kanazawa-ku, Yokohama

The experiment was conducted in order to ascertain the changes between muscle fibers or fat cells and the vascular arrangements. Albino rats were used and divided in to running group, swimming group and non-exercised group. Exercised started two months after birth and lasted 60 days and 60 minutes per day. The specimens, gastrocnemius, tibialis anterior, soleus and epididymal fat tissue, were perfused with Indian ink Ringer's solution. Photomicroscopic observation was made on the cross section preparations. The number of capillaries per fiber or per cell was higher in exercised group than in non-exercised group except soleus. The highest number of capillaries per mm^2 among the specimens was soleus and tibialis anterior. These facts indicate that the changes of the vascularization of tonic muscle due to long-term endurance exercise differ from that of phasic muscle.

414

EFFECTS OF VOLUME CHANGE ON THE CARDIAC FUNCTION AT REST, ON EXERTION IN THE NORMAL SUBJECTS.

KATSUYA KOBAYASHI, KENJIRO ISHIDA, EICHI TAJIRI, ZAITETSU KAN, TSUNENORI TODA, HISASHI FUKUZAKI, Dept. of Internal Med. Div. I, Kobe Univ. Sch. of Med. Ikuta-Ku, Kobe.

The cardiac function with various postures, with sequential evaluation at the standing exercise was studied in the normal subjects with systolic time intervals(STI) using ear densitography under volume changes with dextran(D), tourniquet(T), and nitroglycerin(NTG). Effects of (D), and (NTG) were mainly reflected at the standing with increased heart rate, stroke volume(SV), and ejection fraction with (D), while the opposite results were obtained with (NTG). Effects of (T) were revealed at the supine and leg elevation with similar effects to (NTG). (D) showed increased SV, while effects of both (T) and (NTG) were cancelled out during exercise. The effects of (NTG) became apparrent only during recovery, while (D) always affected, especially at late recovery. Loading dynamic STI by changing postures with the above interventions were concluded as the useful methods to assess the left ventricular function at the dynamic exercise testing.

415

EFFECTS OF FALL SPEEDS ON THE 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.

The muscle discharges of M.Gast. and M.Tibia. are appeared within 100 msec after onset of falls. In previous study,we have reported that appearance times of M.Tibia. delayed with slowing fall speed although the times of M.Gast. were in about 100 msec with speed range of 65-150 cm/sec. This study was designed to investigate the effects of speeds on the muscle activities of extensor and flexor. The parachute falls were performed throughout the experiments. Fall speeds were controlled by two ways:1) method of loading in opposite to fall,2) using the rubbing resistor instead of load. The former,accelerated motion,resulted the same tendency as previous study. By the latter,linear motions were realized less than 90 cm/sec. In these cases,appearance times of M.Gast. and M.Tibia distributed in the range of 50-300 msec. Discharge amplitudes were decreased gradually in common. The results suggested that different activities of both muscles related to accelerated motion during falls, although further analysis more than 90 cm.sec speed linear motion falls might be needed.

416

RELATION BETWEEN EXCERCISE DIURESIS AND RUNNING LOAD.
INOMOTO, T.,*OGO, K. Dept. Morp., Inst. Const. Med., Kumamoto Univ., Kumamoto, *Dept. Physiol. Educ., Fac. Educ., Kumamoto Univ., Kumamoto

Relation between renal function and energy metabolism was investigated observing fluctuation of urine diuresis and change of urinary substances after running. Five sprinters, aged from 18 to 26 years, were made to run at full speed, covering various distances, 60, 100, 200, 300, 400, 800,1500m. Urines were collected at the rest time before running, at the time right after warming up, and, after running, every thirty minutes, from 30 minutes past till 150 minutes past. Passing diuresis known by urine of 30 minutes after running is remarkable in case of short distance, 200,300,400m. As in these three short distances excretion rate of creatinine wasn't found changed remarkably, this diuresis can't be due to increase of GFR. At the same time concentration and excretion rate of uric acid showed a tendency to decrease, and besides, dependence of Urea-N upon urine volume could be hardly perceived.

It is suggested, therefore, increase of anaerobic energy metabolism caused by running is reflected upon functional fluctuation of urine concentration.

417

URIC ACID METABOLISM AT EXERCISE IN HYPERURICEMIA MEN
ITO,A., HORIUCHI,T., SUGIURA,T., FUJITA,S., YAMADA,T., SUMIDA,S. and IKAWA,Y* Institute of Health and Sport Science, Tsukuba University, Sakura-mura, Ibaraki. Clinical Laboratories, Jikei University Hospital, Minato-ku, Tokyo*

6 hyperuricemia men(8.6±0.8 mg/dl) aged 23 to 58 participated in this study. The work load was 30%,40%,60% and 100%$\dot{V}O_2$max with bicycle ergometer. In 100%$\dot{V}O_2$max their serum uric acid(S U A) did not increase at Rec.3 min.. But it showed increase(+29%) at Rec.120 min. and remained high level at Rec.180 min.. In 60%$\dot{V}O_2$max it showed increase at Rec.120 min.. In 40% or 30%$\dot{V}O_2$max there were some cases that their S U A showed decrease after exercise and their uric acid clearance was found higher. Our result showed that the hyperuricemia may be able to be cured by exercise.

418

EFFECT OF LONG-TERM PHYSICAL TRAINING IN ADULT MEN ON THE CHANGES IN BLOOD CONSTITUENTS DUE TO EXERCISE.

H.SHIBAYAMA & H.EBASHI. Dept. Physiol., Physical Fitness Research Institute. Minato-ku, Tokyo.

The present authors made observations of the changes in substrate contents of the blood as response to exercise in 3 healthy men of age 30-38 years who underwent long-term physical training. They were trained by 20 minute treadmill running once a day of the speed corresponding to work intensity of 2/3 VO max for each subject, on a treadmill of 3° of inclination, 5 times a week and the training continued for 7 years. The determinations of sugar-and lactate-contents of the blood were performed just after exhaustive exercise in every 20-25 weeks of the training and it was ascertained that the increment of lactate due to exercise was reduced by training. The change of blood sugar level due to training was also slight. Before starting the training, even the exercise of 2/3 VO max caused a rise of blood sugar level just after exercise, but, after 220-300 weeks of training, only the exercise of intensity as high as 3/4 VO max could cause such a rise. Above-mentioned findings seemed to suggest that long-term physical training would augment the utilization of lactate by oxydation in active muscles and reduce the sugar metabolism to suppress the sugar consumption, and, besides, the training would augment the aerobic metabolism by improving the capacity of oxygen supply and accelerate the fat mobilization and oxydation.

419

ON THE MODIFICATION OF ORTHOSTATIC TOLERANCE BY ATHLETIC TRAINING AND ITS MECHANISM.

H. SAIKI, M. NAKAYA, M. SUDOH, M. ABE. Space Medicine Laboratory, The Jikei University School of Medicine, Minato-ku, Tokyo

Related to a study on decreased orthostatic tolerance of athletes, using scores of non-athlete subjects, fluctuations of their physical fitness through 2 weeks of athletic training were measured in many parameters. On some of the subjects, the effects of 6 hours' water immersion before training were compared with those after training.

Results:1) As an influence of training many functions of non-athletes showed an increase of the physical fitness capacity. And no decrease of orthostatic ability was observed. 2) Following the physical training orthostatic tolerance of better physical fitness subjects of non-athletes or quasi-athletes have a tendency to rather decrease. 3) The urinary excretion of noradrenalin during water immersion was decreased. And before training the decreasing rate of better physical fitness subjects was slighter than lower physical fitness subjects. But after training the decrease rates of all subjects became larger and tend to reach the same lower values, that means the training influences on the modification of the conditions of sympathetic nervous activity during the hypodynamics exposure. These results seem to suggest that during the process of training a state of body condition where there is an increase in physical fitness capacity including orthostatic tolerance is attained.

420

PHYSIOLOGICAL EFFECTS ON ADULT WOMEN OF CIRCUIT WEIGHT TRAINING

Y. KIMURA, H. ITOW. Lab. of Physical Physiol., Pedago. Facul., Waseda Univ., Shinjuku-ku, Tokyo. and S. YAMAZAKI.Dept. of Hygiene, Natl. Defence Med. College,Tokorozawa-shi, Saitama.

Circuit Weight Training(CWT) was evaluated relative to its efficiency to elicit alterations in endurance, strength, body composition and physical fitness test. 6 collegeaged females completed a 8-week program of CWT, 3 circuit(-24min)/day, 3 days/week. The subjects exercised at 40% of 1-RM, executing with 15 to 20 repetitions in 45 sec, followed by a 15 sec rest as the subjects moved to next station. Measurements of physical resouce, performance, anthropometry and muscular endurance were assessed twice, both at the beginning and the conclusion of the training period. After a 8-week of CWT, significant increases in H.R.max, FVC 1.0, all-out time, 12-min run, step test score,muscular endurance, virtical jump and side step point.

It was concluded that CWT was a good general conditioning activity, which had a significant aerobic components.

421

THE RELATIONSHIP BETWEEN DEEP BODY TEMPARATURE AND i-EMG DURING EXERCISE.

K.KIKUCHI, T.KAWAMURA, Y.OKADA, M.WADA Dept.of Health and Physical Edu., Fac.of Integrated arts and Sci., Hiroshima Univ., Hiroshima-city, Hiroshima

The purpose of this study was to pursuit the relationship between deep body temparature and i-EMG during the exhaustive exercise on bicycle ergometer. Five healthy male subjects aged 28 to 43 years were seved in this experiment. The work load of bicycle ergometer was 3kp. During experiment i-EMG,deep body temparature and HR was continuously recorded. The experiment was performed twice for each subject with the room temparature 10°C and 20°C. The following results were obtained;

1) The deep body temparature and HR increased gradually during exercise. The integrated EMG,however,increased in the first stage and decreased at the end of exercise.
2) The deep body temparature was found not to be related with i-EMG but with HR.

422

CHARACTERISTICS OF VOLUNTARY SINGLE HUMAN MOTOR UNITS

KURATA, H. and OGAWA, Y., Lab. of Sports Med., Jikei Univ. Sch. Med., Chofu, Tokyo
MASUDA, M. and MORIMOTO, S., Dept. of Physiol., Jikei Univ. Sch. Med., Minatoku, Tokyo

To study the characteristics of voluntary human motor units (MUs), action potentials of single human MUs were recorded in the medial vastus muscle during rapid, ramp and sustained isometric contractions. The subjects were two male adults. For the detection of action potentials of single MUs stably, an electrode which we devised was used. This electrode was coiled with copper wire (50μm φ). In rapid, small muscle contractions, a MU with a 5.8 kg threshold force (F_0) measured at the ankle joint at 1 kg/s of force development was recruited while no MU firing was observed with 3.6, 5.5 and 5.6 kg of F_0. The subjects sustained various isometric forces above the F_0 of each MU for 10 s. The firing frequency (f) of each MU was measured at each force level (F). The experimental relationship between f and F was found to fit the following equation; $f - f_0 = K \log F/F_0$. Where f_0 is f at the F_0 of each MU and K is a constant value for each MU. In deep MUs, K values were lower at a given F_0 value. The subjects also exerted ramp forces of various gradients from 0.1 to 8.0 kg/s. An increment in the firing frequencies of MUs with low F_0 was observed compared to those at sustained forces with an increasing gradient in force development, while a decrement, in MUs firing frequency was observed with high F_0.

423

This study was made to clarify the dynamics in PRA, Angiotensin(Ang.), Aldosterone (Ald.)and β_2-microglobulin before and after exercise.

The subjects were 6 healthy males(26.3±5 years). Four kinds of work loads(38, 53, 86,100%$\dot{V}O_2$max.)for 20 minutes on the treadmill were given to each subjects. Blood and urine samples for estimation of PRA, Ang., Ald., β_2-micro. and the other biochemical constituents were taken at rest, and at 3, 30, 120 min. of recovery. The results were as follows,: 1) The peak in plasma Ang.II was found at 3 min. after exercise and returned to initial levels after 2 hours. 2) After the exhaustive exercise, the peak increase in Ald. was found at 30 min. and at 3 min. after the below submaximal exercise. 3) PRA increased by 10 ng/ml/hr. at 3 min. after 53 % $\dot{V}O_2$max. and 4 ng/ml/hr. after 38 % $\dot{V}O_2$max. and returned to initial levels at 2 hours recovery. 4) Serum β_2-micro. increased only slightly after all kinds of exercise. In urine obtained at 30 min. after max. exercise, β_2-micro. output increased by 2.15μg/ml/min. and only slightly after the below submaximal exercise.

424

PHYSIOLOGICAL RESPONSES OF DISTANCE RUNNERS AND THROWER DURING IMMERSION OF BOTH LEGS IN HOT WATER BATH. TSUJITA, J., TANAKA, N., MAYUZUMI, M., *ARAKI, T., WATANUKI, M., AND HORI, S. Dept. of Physiol., Hyogo Coll. of Med., Nishinomiya, *Dept. of Hygiene, Kobe University, School of Med., Ikutaku, Kobe.

Observations of physiological responses during hot foot bath were made on ten distance runners and ten throwers in winter. The subjects immersed both legs just up to knees into a water bath of 42 °C for 60 min after staying for 60 min in a room of 30 °C and 70 % R.H.

Distance runners showed higher skin temperature, lower rectal temperature and lower heart rate at 30 °C before heat load. Distance runners showed smaller metabolic rates per body surface area before and during heat exposure than thrower. Distance runners showed smaller increase in heart rate, greater increase in sweat volume per body weight and higher rise in rectal temperature. The higher skin temperature before heat load and lower heart rate before and during heat exposure for distance runner might be due to a better cardiovascular function of distance runners. Greater sweat volume per body weight and higher rise in rectal temperature during heat exposure for distance runners might be a result of lighter body weight when compared with that of throwers.

425

GASTRIC FACTOR MODIFYING THE CUTANOGENIC REFLEXIBLE CHANGE OF HUMAN THENAR MINOR TREMOR (MT) K. NODA, H. SOEDA, K. YAMAMOTO, C. SAMEJIMA AND K. WATANABE Dept. of Physiol., Fukuoka Dental College, Nishi-ku, Fukuoka

MT was presumed as myogenic. Afferent modifiers of human thenar MT were investigated. Alpha fibre activation following digital flexion caused a transient increase in α share. About 30° inclination of the spine to the right or left side resulted in α increase; the increase was moderate and undulating in the ipsilateral bending and intense but vanishing in the contralateral bending. Taking a meal (stomach expansion) decreased α share by ca. 25 %. Reflex increase of α component after spinal inclination was compared pre- and postprandially; ipsilateral response increase was almost suppressed and contralateral increase was transiently suppressed but thereafter promoted. The results were explained by vago-reticulospinal desynchronizing disorder of the spinal γ motoneurons which were simultaneously elicited only by cutaneosomatic afferents. This was an example of visceral interference in somato-somatic (skin-MT) reflex.

426

RESPONSES OF ENDOCRINE SYSTEMS IN MEN EXPOSED TO 16-21 AND 26-31 ATA HELIOX ENVIRONMENTS.
MATSUI,N., TAMURA,Y., OKAZAKI,S., SUEDA,K., OGAWA,K., YAMAMOTO,M. 2nd Div., Res. Inst. Environ. Med., Nagoya Univ., Nagoya; NAKAYAMA,H., TAKEUCHI,H. Marine Sci, & Technol. Center, Yokosuka; OISO,Y. 1st Dep. Int. Med., Nagoya Univ. Sch. Med., Nagoya.

We investigated roles of endocrine systems in the adaptation to heliox hyperbaric environment. Four men were exposed to 16-21 ATA (11 days) and 3 men to 26-31 ATA (14 days). Environmental parameters were; PO_2: 0.4 atm, PN_2: 0.8 atm, temperature (temp) at high pressure (HP): 32°C and humidity: 60%.Urine volume increased following each compression (comp) and decreased during or after decompression (decomp). Hematocrit (Ht) rose following the 1st comp and lowered during decomp. Plasma ADH declined after comp from 1 to 26 and from 26 to 31 ATA and rose during maintenance of HP and decomp, suggesting that ADH may involve in the initial comp diuresis and responds to high Ht to prevent further decrease of plasma volume. Elevated serum K, which may be caused by respiratory acidosis, and elevated plasma renin activity, which may be resulted from decreased plasma volume, may explain increased urinary aldosterone. Lowered skin temp (Ts) and elevated serum TSH, T_4 and rT_3 were followed by elevated rectal temp (Tr) at 21 ATA. At 26 and 31 ATA, lowered Ts and elevated TSH, T_4, T_3, rT_3 and increased urinary catecholamine were followed by elevated Tr. These results indicate that pressure higher than 21 ATA at 32°C increased heat producing hormones, resulting in elevated Tr.

427

ENERGY AND BODY FLUID BALANCE DURING A 14-DAY DRY SATURATION DIVE AT 31 ATA
K. SHIRAKI, N. KONDA, S. SAGAWA, SUK KI HONG* AND M. MATSUDA**, Dept. of Physiol., Sch. of Med., Univ. Occup. & Environm. Hlth., Kitakyushu, * Dept. of Physiol., Sch. of Med. & Dent., State Univ. of New York at Buffalo, Buffalo, ** Japan Marine Science and Technology Center, Yokosuka

Energy and body fluid balance of 4 divers was studied during the course of a 14-day dry saturation dive at 31 ATA. The chamber temperature at 31 ATA was maintained at about 31.5°C and the P_{O2} at 0.4 ATA. The daily calorie intake amounted to 2,800 to 2,900 kcal throughout the dive; the body weight decreased by 700 gm over a 14-day period at 31 ATA, and gradually returned to the predive level during 12 days of decompression. The daily urine flow increased 1,420 ml predive to 1,800-1,900 ml throughout the 31 ATA period ("hyperbaric diuresis"), and then gradually decreased to the predive level during decompression. Although the above increase in urine flow was accompanied by a reduction of urine osmolality (from 770 to 650 mOsm/kg), the osmolal clearance was consistently high (10%) at 31 ATA. GFR decreased by 10-20% at 31 ATA. Thus it is evident that the observed hyperbaric diuresis is primarily due to an inhibition of tubular reabsorption of both solute and water. The pattern of diurnal variation in urine flow changed significantly; the maximum urine flow of the day shifted from 15:00-16:00 hr at predive period to 24:00 hr at 31 ATA.

428

MAINTENANCE OF HIGHER BLOOD FLOW TO CALORIGENIC ORGANS IN COLD ACCLIMATED RATS.
HIRATA, K., SUGANO, Y., SHIBATA, H. and NAGASAKA, T. Dept. of Physiol., Kanazawa Univ. Sch. of Med., Takara-machi, Kanazawa 920

Control (CT) and cold-acclimated (CA) rats were fitted with polyethylene catheters (left ventricular, aortic and jugular catheters) to measure arterial blood pressure (BP), cardiac output (CO) and the fractional distribution of CO to the calorigenic organs during infusion of norepinephrine (NE). Under urethan-chloralose anesthesia, NE produced a dose-dependent increase in BP, heart rate (HR), oxygen consumption ($\dot{V}_{O2}$) and colonic temperature (T_{col}) in both groups. The increases in HR, $\dot{V}_{O2}$ and T_{col} were significantly higher in CA than in CT rats. The increase in BP was less in CA rats. CO increased significantly in both groups. The fraction of CO to the calorigenic organs except the skeletal muscles increased significantly in both CT and CA rats. In unanesthetized rats, however, the effects of NE were different. NE (2 μg/kg·min) produced a bradycardia particularly in CT rats, of which CO and the fraction of CO to the calorigenic organs did not increase significantly. With NE, $\dot{V}_{O2}$ and T_{col} did not increase in CT rats, while those in CA rats increased. These results suggest that the negative chronotropic effect of the heart are necessary important cardiovascular the lowered pressor response to NE and the negative chronotropic effect of the heart are necessary important cardiovascular changes occurred in cold acclimation.

429

CORRELATION BETWEEN SWEAT VOLUME AND RISE IN RECTAL TEMPERATURE DURING EXERCISE AND MAXIMAL OXYGEN INTAKE. HORI, S., AND IHZUKA, H. Dept. of Physiol., Hyogo Coll. of Med., Nishinomiya.

Observation of the physiological responses during exercise in a hot environment and measurement of maximal oxygen intake were made on 8 young male subjects. Exercise was performed on a bicycle ergometer at a constant work load of 450 kg·m/min at the cycling rate of 50 rpm for 30 min in a climatic chamber at 30 °C with 70 % relative humidity. The maximal oxygen intake was measured by a bicycle ergometer exercise. Heat load during exercise was calculated using metabolic rates at rest and during exercise, assuming heat loss through respiratory tract to be 10 percent of metabolic rate.

Fairy good correlations were found between the ratio of work done to maximal oxygen intake and rise in rectal temperature and the ratio of sweat volume to body weight. Close correlations were found between relative heat load during exercise and rise in rectal temperature and relative body weight loss. The magnitude of physiological strain expressed by the combination of relative rise in rectal temperature, relative water loss and relative salt loss during exercise at 30 °C was inversely proportional to maximal oxygen intake.

430

EFFECT OF LIGHT-DARK CYCLE ON RUNNING ACTIVITY IN RATS. Y. ISOBE, Y. HASEGAWA*, and S. TAKABA 2nd Dept., 1st Dept.* of physiol. Nagoya City Univ. Sch. Med., Nagoya 467

To examine the circadian rhythm of running activity, rats were exposed to a light-dark(LD) cycle. Activity was measured in terms of the number of a wheel's revolution under a short LD cycle(L,D=0.5hr,0.5hr) and a normal LD cycle(L,D=12hr,12hr) on the same rats throughout 3 days. In the short LD cycle, activity in L phase was significantly higher than in the D phase. Rectal temperature recorded continuously under the short LD cycle, revealed that the peak temperature was higher in L phase than in D phase. Fluctuations of rectal temperature between each short photoperiod was not differed in the lower period and higher period of rectal temperature. Circadian rhythm of activity under the short LD cycle expressed as a sum activity of L and D phase in 1 cycle through out 3 days showed similar pattern with that under the normal LD cycle. Administration of p-Chlorophenylalanine, subcutaneously injected to the same rats, resulted that activity in L phase of the short LD cycle decreased when measured at the L phase corresponding to the normal LD cycle. In short LD cycle, activity ratio L vs. D phase was not changed after the p-Chlorophenylalanine. Thus, in these short LD cycle rats were more active in L phase than in D phase. In other short LD cycles of L,D=8hr,8hr, L,D=6hr,6hr, L,D=4hr,4hr, L,D=3hr,3hr, and L,D=0.25hr,0.25hr, the activity in the D phase was higher than in the L phase.

431

LEVELS OF GLYCOGENOLYTIC AND GLYCOLYTIC ENZYMES, LACTATE AND ATP IN DIFFERENT PARTS OF RABBIT AORTA DURING CONTRACTION. S. MASUMURA, M. HASHIMOTO, Y. HASHIMOTO and T. SATŌ. Dept. of Physiol., Shimane Medical Univ. Izumo

After removal of the adventitia from rabbit aorta, the prepararions were cut into spiral strips and mounted in a bath medium at 37°C, aerated with 5 % CO_2 and 95 % O_2 under a load of 1 gm of tension. When adrenaline was added to the bath medium to contract these strips, we estimated levels of glycogenolytic and glycolytic enzymes in different parts of the contracting aorta and simultaneously checked the lactate and ATP contents in order to study whether the contraction is dependent on glycolysis and on ATP degradation. In the experiments, most of the enzymatic activities were significantly augmented in comparison with those of the controls. Such a rise in the glycogenolytic activity was 42 % in the aortic arch, 56-76 % in the thoracic aorta and 40-46 % in the abdominal aorta. On the glycolytic activities, hexokinase and phosphofructokinase in the aortic arch and in the distal part of abdominal aorta increased by 20-50 %. Lactate and ATP production was stimulated during contraction. In this case, net increase in lactate was 0.5 - 1.3 μmole/g/min, while such a rise in ATP was 0.005-0.06 μmole/g/min. This finding suggests that under aerobic conditions, ATP synthesis in the contracting strips would be more predominant than the nucleotide degradation.

432

The influence of repeated stress on glucose metabolism in liver slices of rabbit with lesioned stria terminalis. Fujita M.,Ushikoshi A.,Kaba H.,Saito H.,Seto K.,Meed J.F., Akama T.,Arita J. and Kawakami M. Dept. of Physiol.,Kochi Med. Sch. and Dept.of Physiol.,Yokohama City Univ. Sch. of Med.

^{14}C transfer from ^{14}C-glucose into CO_2,ketone bodies(KB),cholesterol ester(CE),triglyceride(TG),free cholesterol(FC),free fatty acid(FFA) and phospholipid in liver slices of rabbit with lesioned stria terminalis on repeated cold exposure,heat exposure and immobilization stress(IM) were measured. 1)On cold exposure,^{14}C transfer into CO_2,CE,TG ,FFA and PL increased,into KB and FC decreased in intact animals on the 1st day of exposure. In stria terminalis(ST) lesioned animals,^{14}C transfer into $CO_2$and PL also increased,into CE,TG and FFA reversed to decrease,into KB reversed to increase,then,into FC was not changed on the 1st day of exposure. 2)On heat exposure,^{14}C transfer into KB, FC and FFA increased,into CO_2,CE,TG and PLdecreased in intact animals on the 1st day of exposure. In ST lesioned animals,^{14}C transfer into FC also increased,into TG also decreased,into KB and FFA reversed to decrease,into CO_2reversed toincrease,then,into CE and PL were not changed on the 1st day of exposure. 3)On IM,^{14}C transfer into KB and FFA increased,into CO_2,CE,FC and PL decreased,then,into TG was not changed in intact animals on the 1st day of IM. In ST lesioned animals,into KB,CO_2,PL,TG decreased,FC increased,FFA and CE were not changed on the 1st and 7th day of IM.

433

EFFECT OF PENTOBARBITAL ON STIMULATED RESPIRATION IN RAT'S SUBMANDIBULAR GLANDS. ENDOH, S., TSUBOI, M*, KOMABAYASHI, T* AND SAKAMOTO, S** Dept. of Physiol., Keihin Women's Coll., Kamakura-shi, Kanagawa * Dept. of Physiol., Tokyo Coll. Pharm., Hachioji-shi, Tokyo ** Dept. of Physiol., Showa Univ., Sch. of Med., Shinagawa-ku, Tokyo

The aim of the present study was to investigate the effects of procaine or pentobarbital on the oxygen uptake caused by K^+ or norepinephrine.

1. Procaine inhibited the oxygen uptake caused by K^+, but made no effect on the oxygen uptake caused by norepinephrine.
2. Pentobarbital inhibited apparently the oxygen uptake caused by K^+ or norepinephrine.

434

THE EFFECT OF PROTEIN QUALITIES ON PROTEIN INTAKE IN RATS. K. KISHI, G. INOUE. Dept. of Nutr., Sch. of Med., Tokushima Univ., Kuramotocho, Tokushima.

Dietary protein has been considered as a possible component of food intake regulation from the observation that feeding of very low or high protein diets depressed food intakes. Thus, we studied the effect of dietary protein on food intake in rats using egg protein, lactalbumin, casein, soy protein and wheat gluten. In expt. 1, protein intake as well as total food intake was measured in growing rats fed a self-selection diet ad libitum. Rats were allowed to choose freely from a combination of protein free diet and high protein diet. Great differences were observed in protein intakes depending upon the protein quality ranging from 1.6 g/day in egg protein diet to 6.4 g/day in wheat gluten diet. However, total food intakes were similar in all groups. In expt. 2, the effects of protein or non-protein energy restriction on food intakes were investigated. When the intakes of various proteins were restricted to 200mgN/day, rats given egg protein consumed normal amounts of food, whereas food intakes were depressed in rats fed proteins of poor quality. In contrast, protein intakes increased similarly regardless of protein qualities in case of non-protein energy restriction to 20 kcal/day. These results suggest that protein intake may be regulated separately from energy intake and that protein intake may be a primary factor in the maintenance of normal food intake.

435

EFFECT OF HISTAMINE ON THE BLOOD LIPIDS IN DOGS. TSUBOI, M., KOMABAYASHI, T., ENDOH, S. AND SAKAMOTO, S* Dept. of Physiol., Tokyo Coll. Pharm., Hachioji-shi, Tokyo *Dept. of Physiol. Showa Univ., Sch. of Med., Shinagawa-ku, Tokyo

Effect of histamine on the blood lipids in dogs and rats was investigated. In dogs, histamine increased the level of free fatty acids, glycerol and triglycerides in the blood, while did not in rats. Histamine stimulated the lipolysis of dog omental adipose tissues, but did not in epididymal adipose tissues of rat. The mobilization of blood lipids caused by histamine was not inhibited by diphenhydramine and propranolol, but was remarkably blocked by H_2-receptor antagonist, cimetidine. Also histamine increased the plasma adrenaline level in dogs. The lipolytic response to histamine was considerably blocked by cimetidine, but did not by propranolol. On the other hand, the lipolytic response to adrenaline was strongly blocked by propranolol, but did not by cimetidine. From these results, we suggest that the mobilization of blood lipids caused by histamine take place mainly through the stimulation of H_2-receptors.

436

NITROGEN BALANCE AND ENERGY AVAILABILITY ON LITTLE CHILDREN T.KITANO, H.KOISHI. Fac.of the Sci.of Living, Osaka City Univ., Sumiyoshi-ku, Osaka

We studied N-balance and energy availability on healthy little children(3-6yr.) whose average age, body weight and height were 5.0±0.1, 16.7±0.3 kg and 102.2±0.9 cm, respectively. One group(n=31) was given routine diets and the other(n=14) was given diets containing about 10 g of protein less than routine. The body status and food intake were almost same in both sexes. There were no difference of energy intake between both levels of protein intake. Average of energy intake and fecal output per day for all subjects were 75.1±1.1 kcal/kg and 2.9± 0.1 kcal/kg. Then energy availability was 96.2%. Urinary energy output was measured with 21 subjects of all and was 1.71±0.11 kcal/kg in average. In this case, net availability of energy was 93.9%. Average N intake, fecal and urinary N output at the routine diets were 403±9 mg/kg, 30±1 mg/kg and 303±6 mg/kg, respectively. Percent of absorption and retention of N were 92.3 and 16.9. The regression line between N intake(Xmg/kg) and N retention(Y mg/kg) including subjects given low protein diets was Y=-84.9+0.395X, r=+0.62, p 0.01, n=45. Urinary energy in 1 g of urinary Nx6.25 was 0.88 ±0.05 kcal in routine diets(n=15) and 1.25±0.07 kcal in low protein(n=6).

437

MEASUREMENT OF THE INSENSIBLE WEIGHT LOSS IN MAN.
HIGUTI, K. and INOUE, M. Div. of Food and Nutrition, Nakamura Gakuen Coll., Fukuoka

The insensible weight loss under basal conditions in thirty-six female college students was recorded using a sensitive scale. This scale has a capacity of 70kg, and a resolution of about 5g. The insensible weight loss was found to be about 0.6g per minute (range:0.3-1.0g) at rest. The close relationship between the insensible weight loss and the work load was seen. It is convenient to consider the "ratio of weight loss" $\Delta w/w$, where Δw is the insensible weight loss measured in grams per minute and w is body weight in grams. The ratio of weight loss at rest was found to be approximately 1×10^{-3} for any subject. The subjects were grouped by somatotyping devised by Sheldon(1940). The relationship between the basal metabolic rate and the insensible weight loss was studied. For convenience, the basal metabolic rate (kcal/m^2/h) was plotted against the insensible weight loss (g/m^2/min), and the relationship between the two variables can be seen to be linear. Higher values of the insensible weight loss were seen for the lowest values of the basal metabolic rate for the endomorph (r=-0.775) and for the ectomorph (r=-0.756). Higher values of the insensible weight loss were seen for the highest values of the basal metabolic rate for the mesomorph(r=0.510).

438

Pyretic response and thermoregulatory behavior in the rat

Murakami,N., Sakata,Y. and Morimoto,A.
Dept. of Physiol., Yamaguchi Univ. School of Med., Kogushi, Ube

It has been recognized that intraperitoneal or intravenous administration of Lipopolysaccharide (LPS) fails to produce a fever in the rodents. However, following a microinjection of LPS into the preoptic/anterior hypothalamic region the production of fever appeared in the rat with latency of 40 to 60 min. Intrahypothalamic injection of leucocyte pyrogen which, was prepared from the whole blood of the rabbit, also produced a fever without latency. When allowed to press a bar to turn off a heat lamp (250 w) suspended 37 cm high from the floor against exposure to heat, rats are able to keep constanly their rectal and tail-skin temperatures by appropriate pressing a bar. During fever with the intrahypothalamic injection the number of bar press to avoid the heat reduced significantly and the thermopreferendum changed to keep a high temperature of both the skin and the ambience. This behavioral response seemed to be part of the cordinated drive to increase heat storage.

439

TEMPERATURE CHANGES OF CUTANEOUS SUPERFICIAL VEIN BLOOD DURING EXTERNAL COOLING.

K.UCHINO, H.HASEGAWA, M.MASUDA. Dept. of Physiol., Jikei Univ. Sch. of Med., Minato-ku, Tokyo

The aim of this work was to examine cutaneous superficial vein blood temperature responses concerning with the peripheral body temperature regulation.

The experiments were done on five healthy male subjects. The blood temperatures of V. cubiti (Tvecu) and V. cephalica (Tvece) were recorded simultaneously during external cooling. Tvecu increased rapidly at the beginning of preshivering and decreased at the beginning of shivering in spite of no increase in Tvece. Tvecu showed the clear fluctuation in preshivering stage and its amplitude and frequency were variable. The blood of V. cubiti showed a decrease in Pvo_2, pH and base excess and an increase in $Pvco_2$ during preshivering and shivering. The contrary results of these items were obtained in V.cephalica.

It was concluded that the increase in Tvecu would be produced by an inflow of deep warm vein blood to the superficial vein via the perforating vein and the perforating vein would be closed by the increase of muscle tonus in shivering.

440

SALIVARY COOLING IN VARIOUS STRAINS OF RATS.

* FURUYAMA, F., TAKABA, S., and *OHARA, K. Cent. Clin. Lab., and Dept. of Physiol.*, Nagoya City Univ. Med. Sch., Mizuho-ku, Nagoya

Male rats of 17 strains and females of 4 strains were exposed to 42.5°C, 40%RH. Rats had been kept at 24±1°C before heat exposure. Age was 13 weeks old. Survival time and body weight loss were compared among these strains. Salivary cooling was graded by scores of wet body surface at 42.5°C, 40%RH and 86-87%RH. Sprague-Dawley($P < 0.01$) and Fisher($P < 0.05$) survived heat for a longer time than the other strains. Female SD rats tolerated heat for longer time than males($P < 0.05$), but any sex difference of survival time was not observed in the other 3 strains. In Wistar strains, strain difference of survival time was observed. HOS: Wistar tolerated heat for a longer time than some of Wistar strains. Body weight loss of Sprague-Dawley and Fisher was 5-7%, but it was 3-5% in most strains. Saliva spreading of Sprague-Dawley was more rapid and wider than of Donryu. Saliva spreading of Sprague-Dawley in heat and humidity had a tendency to a slightly earier start ($0.1 > P > 0.05$) and showed higher scores ($P < 0.001$). However, their survial time was short and sex difference was not observed. It was confirmed that the more a rat strain tolerate heat, the more and rapidly saliva was spreaded.

441

RELATIONSHIP BETWEEN INCREASE OF TAIL SKIN TEMPERATURE AND CHANGE OF BLOOD PRESSURE DURING SCROTAL HEATING IN ANESTHETIZED RATS. K. TSUCHIYA (Dept. of Environment. Physiol. and Epidemiol., Inst. for Tropical Medicine, Nagasaki Univ., Sakamoto-machi, Nagasaki)

In anesthetized rats with sodium pentobarbital (50mg/kg I.P.), tail skin temperature, rectal temperature and blood pressure of common caroted artery were recorded simultaneously. Scrotal skin was heated selectively by means of a water-perfused thermode. In 5 immobilized rats with gallamine triethiodide under artificial ventilation, scrotal skin temperature was changed from 30.8 ± 0.5C to 41.3 ± 0.4C. During heating the scrotum tail skin temperature was changed from 25.9 ± 3.2C to 30.1 ± 1.1C. Blood pressure also changed from 114 ± 15mmHg to 137 ± 9mmHg. In these cases, an onset of increase of blood pressure preceded those of increase of tail skin temperature. Scrotal skin temperature was stepwise increased in anesthetized rat which breathed spontaneously through the trachea cannula. Results obtained from 7 rats were analyzed as following; in 4 animals out of 7, an increase of tail skin temperature was accompanid with an increase of blood pressure, while in the rest 3 animls increase of tail skin temperature was observed without change of blood pressure. Critical temperature of sctotal skin for increase of tail skin temperature were 37.2 ± 0.4C and for abrupt increase of blood pressure, 36.4 ± 0.7C. From these results, it is concluded that an increase of blood pressure and vasodilation of the tail are incuced by scrotal heating, but these responses occur indepenently.

442

EFFECTS OF TRACHEAL BYPASS BREATHING ON HEAT BALANCE IN RABBITS.
SUGANO, Y., SHIBATA, H., HAYASHI, M. and NAGASAKA, T. Dept. of Physiol. Kanazawa Univ. Sch. of Med., Kanazawa 920

The effects of alternating the respiratory pattern from nose to tracheal bypass breathing on colonic (T_{col}) and hypothalamic (T_{hy}) temperatures and heat balance were studied in rabbits by using a direct calorimeter, of which temperature (T_a) was maintained at 17, 22, 26 and 28°C. The difference between T_{col} and T_{hy} (ΔT) was approximately 0.3°C in both nose and bypass breathing rabbits at T_a 17°C. As T_a was increased, the difference increased in nose breathing rabbits, but not in bypass breathing animals. The ΔT in nose breathing rabbits at T_a 28°C was 0.45°C, which was significantly higher than that in bypass breathing ones ($p<0.01$). As T_a was increased, non-evaporative heat loss ($H_{L\ dry}$) decreased in both rabbits. At T_a 28°C, $H_{L\ dry}$ decreased to greater extent in nose breathing rabbits than in bypass breathing ones. Evaporative heat loss ($H_{L\ wet}$) was nearly same at T_a 17 - 28°C in both groups. Respiratory rate increased insignificantly after alternating the respiratory pattern from nose to bypass breathing. Neither heat production nor $H_{L\ wet}$ changed greatly after alternating the respiratory pattern. These indicate that the hypothalamus can be cooled when the rabbit breathes through the nose. The selective brain cooling may be produced by an enhanced direct heat transfer from the hypothalamus to the cooled cavernous sinuses.

443

THERMAL SENSATION AND CHANGES IN SKIN TEMPERATURE DURING A LIGHT EXERCISE IN WOMEN.
Y.OSADA, S.OGAWA and K.YOSHIDA*. Dpt.Physiol.Hyg.,Inst.Publ.Health, Minato-ku, Tokyo and Dpt.Publ.Health,Sch.Med.,Showa Univ.,Shinagawa-ku, Tokyo.

Six female students were exposed to ET* 20, 22, 24, 26 and 28°C for one and a half hrs on the separate days in nude. Relative humidity was 50% and air velocity was less than 20 cm/s. Subjects sat on a bicycle ergometer and kept rest for one hr and then took an exercise at 60 r.p.m. for 30 min. Work load was 40 watt. Neutral thermal sensation,i.e. neither cool nor warm sensation, was obtained at ET* 26-28°C at the end of rest period and at ET* 22°C at the end of exercise. Mean skin temperature was 33°C at rest and 30.5°C at work under the neutral thermal sensation. Heat loss and gain of the body, calculated by the heat balance equation, showed a positive relation with the thermal sensation at rest but had no relation at work. Increased skin temperature at shoulder, trunk, thigh and leg, resulted by the muscular activity, might produce the growth of whole body warm sensation at work. Such situations were same as in the previous experiment using male subjects(**) and the only difference was a higher metabolic rate with a lower sweat rate during the work in female subjects. (**)Osada,Y., Ogawa,S. and Yoshida,K.: Skin temperature and thermal sensation during a light exercise--Study on the optimal thermal conditions. J.Physiol.Soc.Japan,41:446,1979.

444

CIRCADIAN VARIATION OF THERMOREGULATORY RESPONSES IN WOMAN

K . NIWA , T . TSURUTANI AND T . NAKAYAMA . Department of physiology , Osaka University School of Medicine , Nakanoshima , Kita-ku , 530 Osaka

Changes in body temperature , heart rate , metabolic rate , evaporative water loss and shivering were measured on 6 healthy female students during 1 h heat (40°C , 60 % r.h.) and cold exposure (10°C , 60 % r.h.) in the morning (9:00-12:00) and in the evening (21:00-24:00) . The metabolic rate during cold exposure was higher in the morning than in the evening due to increased shivering . Inthe hot environment , the rate of evaporative heat loss was more increased in the evening than in the morning . During heat and cold exposures , however , the mean body temperature changed to a similar extent in the morning and in the evening when the circadian variations of body temperature are balanced. The analysis of these results implies that the increased sweating in the evening and the increased metabolism in the morning are brought about by changes in the threshold and not by changes in the sensitivity of thermoregulatory responses .

445

EFFECTS OF ONE HAND IMMERSION IN COLD WATER ON THE FINGER TIP TEMPERATURE, ESPECIALLY IN VIBRATION EXPOSED.

MURAKAMI, N., TAKASHIMA, S., SATO, S., AZUMA, T., FUNAHASHI, A. Dept. Physiol. Mie Univ. Sch. Med. Edobashi, Tsu, 514

Fingertip skin temperature (FST) was monitored on 185 vibration exposed (VE), 40 control subjects (C), 70 students in winter (SW) and 74 students in summer (SS) during hand immersion for 10 minutes in water at 5°C. All subjects were males. Ages of subjects and the months carried out the tests. VE, 29-66, Dec. C, 30-57, Jan. and Feb. SW, 18-28, Dec. and Jan. SS, 18-31, Jul. Mean ages were comparable among VE and C. Some of the special features of FST from VE are as follows. 1) preimmersion FST; VE<C<Students. 2) the time taken to gain the lowest FST during immersion; VE>C>SW>SS. 3) the appearance of CIVD (a temperature increase≧0.5°C), VE, 33%, C, 75%, SW, 88.6%, SS, 97.3%. 4) the amplitude of CIVD; VE<C<SW<SS. 5) recovery rate (FST at the 10th minute recovery); VE<C≦SW<SS. Above results show that the special features from VE, all outdoor workers, were not caused only by the vibration exposture, but also by both age and seasonal variation. Seventy-two of VE (39%) displayed vibration white finger (VWF) in the past. Above special features from VE with VWF were similar to C. FST at the 10th minute recovery and the cooling rate (VCR) or rewarming rate (VWR) of venous blood temperature on wrist of the immersed hand during and after immersion showed a good correlation. Both VCT and VWR were VE without VWF<VE with VWF<C.

446

NEURAL CONNECTIONS BETWEEN PREOPTIC THERMO-SENSITIVE NEURONS AND THE MEDIAL FOREBRAIN BUNDLE IN THE RAT.

T. KIYOHARA, T. HORI, M. SHIBATA, T. NAKASHIMA. Dept. Physiol., Saga Medical College, Saga.

Single-unit responses of preoptic neurons to hypothalamic thermal stimulation and electrical stimulation of the medial forebrain bundle (MFB) were studied in urethan-anesthetized male rats. Out of 129 units studied, 54 units responded to a rise in hypothalamic temperature with an increase in firing rate (warm-units) and 17 units with a decrease in firing rate (cold-units). The cells activated orthodromically by MFB stimulation corresponded to 50% of warm-units, 29% of cold-units and 28% of insensitive-units. This suggests that preoptic warm-sensitive cells receive ascending input through MFB more than cold- and insensitive-cells. Poststimulus time histograms of orthodromic activation showed the different response patterns; inhibition, facilitation, inhibition followed by facilitation and facilitation followed by inhibition. Inhibitory responses were observed in 60% of orthodromically activated units. Activities of some warm-units were inhibited both by MFB stimulation and by iontophoretic application of noradrenaline. Iontophoretic application of dichloroisoproterenol to these cells reversibly blocked both noradrenaline-induced inhibition and MFB-induced inhibition. A small proportion of cells (3.8%, 5 of 129) were antidromically activated by MFB stimulation and the estimated conduction velocity were in the range between 0.5 and 2.0 m/sec.

447

EFFECT OF CALCIUM REMOVAL ON THERMOSENSITIVITY OF PREOPTIC NEURONS IN VITRO.
T. HORI, T. NAKASHIMA, N. HORI, T. KIYOHARA, M. SHIBATA. Dept. Physiol., Saga Medical College, Saga and (N.H.) Dept. Pharmacol., Kyushu Univ. Sch. of Dentistry, Fukuoka.

Single-unit activities were recorded from 300-400um thick slices in vitro of preoptic area (POA) in the rat. Two hundred and four POA units from 81 preoptic slices perfused with oxygenated (95% O_2/5% CO_2) Krebs-Ringer's solution were studied for their responses to changes in neuronal temperature between 33 and 42°C. Of these, 57 units (27.9%) increased the firing rates in response to a rise in temperature (warm-units) and 13 units showed the opposite type of response to temperature (cold-units). The thermal coefficients of warm-units were in the range between 0.5 and 5.1 impulses/sec.°C and their Q_{10} was greater than 2.5. Thermal coefficients of cold-units varied from -0.1 to -5.0 imp./sec.°C. These features of POA thermo-sensitive neurons in slices, in terms of population and thermosensitivity, are quite similar to those of in vivo POA thermo-sensitive neurons. The effect of calcium ion removal from extracellular fluid was studied on 18 warm-units. Of these, 13 warm-units did not lose local thermosensitivity during perfusion with calcium-free (substituted by magnesium) solution. This indicates that some POA warm-sensitive neurons have the inherent thermosensitivity.

448

BLOOD FLOW CHANGES IN THE HYPOTHALAMUS, RETICULAR FORMATION AND SPINAL CORD DURING PYROGEN INDUCED FEVER IN HEAT ACCLIMATED RABBITS.
M. KOSAKA, N. OHWATARI, T. INOMOTO. Dept. of Environment. Physiol. and Epidemiol., Inst. for Tropical Medicine, Nagasaki Univ., Sakamoto-machi, Nagasaki

Local brain temperature has three physical factors, i.e., metabolic heat production in local cerebral tissue, local blood flow. and the temperature of inflowing blood. From the thermoregulatory point of view, it is particularly important to determine how these three factors regulate the temperatures in the central nervous tissues. The present study was designed to evaluate changes in hypothalamic, reticular formation as well as in spinal cord blood flow during pyrogen-induced fever in non-heat-and heat-acclimated rabbits. A hydrogen clearance method was used to measure cerebral blood flow with conscious animals restrained stereotaxically. Blood flows were calculated from the initial slope of hydrogen clearance curves. Difference of blood flows between the hypothalamus, reticular formation and spinal cord was statistically not significant in non-heat-acclimated rabbits. After intravenous injection of LPS-pyrogen (from E.coli), the blood flow was increased or decreased with similar shifts of biphasic character in hypothalamic temperature in non-heat-acclimated rabbits, although almost no changes in blood flow in the central nervous tissues were obseverd during pyrogen-induced fever in heat-acclimated rabbits. The result suggests that blood flow changes in the hypothalamus may play an important role in fluctuations of hypothalamic temperature during pyrogen-fever.

449

Mode of action of endogenous pyrogen in the rabbits brain.
Sakata,Y. and Murakami,N.
Dept. of Physiol., Yamaguchi Univ. School of Med., Kogushi, Ube

Effects of an endogenous pyrogen (E.P.) released from leucocytes on the activity of the temperature-responsive (TR) neurons were extracellularly observed. The activity of warm neurons was inhibited and that of cold neurons was augmented with the focal administration of the E.P. These behaviors of the neurons were also obtained by an iontophoretical application of the E.P. (20-60 nA). When increased a dose of administration, there was observed a sigmoidal relation between the activity and the dose of the E.P. From the results it may be suggested that the pyrogen receptor resids on the membrane of the TR neurons.

After focal administration of neuraminidase, which eliminates a sialic acid from gluco-residue on the cell membrane, the responses of the TR neurons to the E.P. were reduced remarkably. This indicates that a sialic acid must play an important role for binding of the E.P. with the pyrogen receptor of the neurons.

450

ACTIVITIES OF PREOPTIC-HYPOTHALAMIC THERMOSENSITIVE NEURONS AND TAIL VASOMOTOR RESPONSE TO THERMAL STIMULATION OF THE SCROTAL SKIN IN RATS.
ISHIKAWA, Y., NAKAYAMA, T. AND TSURUTANI, T. Dept. of Physiol., Osaka Univ. Sch. Med., Kitaku, Osaka, 530

At room temperature(T) of 25-27°C, skin T of the tail was measured in urethanized rats. The scrotum was thermally stimulated while preoptic(PO) T was kept constant between 36-41°C. Local heating and cooling of the PO was performed at scrotal T of 25-40°C. Scrotal heating above 33°C caused a proportional rise in tail T but only when PO T was above 37°C. Cooling the scrotum from 30°C to 25°C did not reduce tail T even at PO T of above 40°C. At the scrotal T of 40°C, the tail T began to rise at PO T of 38°C. The threshold T of the PO for tail vasodilation was about 39.3°C at the scrotal T of 25-33°C. According to our previous observation, 3/4 of preoptic-hypothalamic warm-sensitive neurons were facilitated by warming of the scrotum above 30°C. The operating ranges of most warm-sensitive neurons were in scrotal T of above 36°C. These findings indicate that the blood flow of the tail during thermoregulatory responses is controlled by warm-sensitive neurons, the activity of which is influenced by afferents from scrotal warm receptors, but not cold receptors.(abbrev,T:temperature)

451

ESTIMATION OF FOREARM BLOOD FLOW CHANGE BY THERMAL MEASUREMENT DURING AND AFTER LEG EXERCISE.
T. TAMURA*, T. TOGAWA*, M. TANAKA**, K. YOSHIDA **. * Inst.for Med.& Dent. Eng., Tokyo Med. & Dent. U., ** Dept. of Public Health., Showa U.

Subjects exercised 10 min on a bicycle ergometer at 50, 75 and 100 W, and 20 min recovery in ambient temperatures of 15,25 and 35 °C. Rectal temperature (Tr) was measured with a thermistor and forearm tissue temperature (Tf) was measured with deep body thermometer. Heat flow (H) from the skin was measured with heat flow meter. Forearm blood flow(BF) was measured with electro-plethysmography. Forearm blood flow by thermal measurement was accounted for by the equation of the form $BF=(C_fT_f+H-M_o)/\rho c(T_r-T_f)$, where C_f is thermal capacitance of forearm compartment, M_o is estimated metabolism of the forearm tissue, and ρc is the product of density and specific heat of blood. The change of inactive (forearm) blood flow was significant at high ambient temperature during leg exercise. Blood flow and tissue temperature was higher during 100 W exercise than recovery. Our results showed that obtained forearm blood flow by thermal measurement was well followed one by plethysmography during and after leg exercise.

452

SWEAT EXPULSION WAVES AS THE INDICATOR OF THE SWEAT CENTER ACTIVITY
OHARA,K., OKUDA,N. AND SATO,H. 2nd Dept. Physiol. Nagoya City Univ. Med. Sch. Mizuhoku, Nagoya 467

Sudorific impulses from the sweat center evoked by heat exposure of the body was found to be detected sensitively at the initial stage of the exposure by early appearance of enlarged synchronized sweat expulsion waves in skin areas where sweat glands activities were elevated by means of combination of local skin heating and local administration of sudorific agents such as pilocarpine. The threshold mean skin temperature and core temperature for activation of the sweat center were measured at the time when sweat expulsion waves appeared. In the case of heat exposures by room temperature rise of about 0.3 °C/min, the time of appearance of sweat expulsion waves was observed in 5 subjects 31.4 minutes earlier in the average in the treated skin areas as compared with that in the untreated skin. The threshold mean skin temperature and core temperature were measured correspondingly different between treated and untreated skin area, the difference amounting 2.20 and 0.31 °C, respectively. It was concluded that elevation of sweat glands responsiveness upon central impulses by means of local treatment mentioned above can indicate more closely the excitability of the sweat center.

453

ON THE CHARACTERISTICS OF AXILLARY SWEATING J. SUGENOYA, T. OGAWA, M. ITO, T. MIYAGAWA, M. ASAYAMA. Dep. of Physiol., Aichi Med. Univ., Nagakute, Aichi

Local sweat rates at axilla, palm, forearm and sole were simultaneously recorded by resistance hygrometry, and the pattern of sweating at the axilla was compared with those in other areas.

Some experiments were performed where the room temperature (Ta) was gradually raised at a rate of 1°C per ten minutes; axillary sweating appeared at a Ta of a few degrees lower than forearm sweating. Mean sweat rate at the axilla was highly correlated with that at any area of the general body surface, the ratio being considerable low. In some subjects, mental arithmetic caused depression of forearm sweating unlike palmar one. In those, the axillary sweating showed a pattern of response similar to the forearm one.

These observations indicate that axillary sweating involves the central mechanism similar to the sweating on the general body surface, and that the threshold temperature for thermal sweating is lower while the sensitivity to thermal load is less at the axilla than in the general body surface.

454

DYNAMIC PROPERTIES OF SWEATING ACTIVITY. M. ASAYAMA, T. OGAWA, M. ITO, T. MIYAGAWA, J.SUGENOYA. Dep. of Physiol., Aichi Med. Univ., Nagakute, Aichi.

The relationship between fluctuations in sweat rate(Sw) and body temperature in thermal equilibrium and to periodic changes in heat load was examined by calculating power spectral density, correlation coefficient and coefficient of variance. Significant negative correlation between fluctuations in Sw and skin temperature(Ts) were observed on 15 subjects. In contrast, significant positive correlation between fluctuations in Sw and core temperature(Tcore) was observed in most cases. Correlation between Sw and Tcore was especially high as for slower components of fluctuations. These results suggest that shorter sweat waves occur as feedback responce to changes in Ts, while longer waves are largely dependent upon changes in Tcore. The mode of power spectral density of Sw was highly reprosucible within an indivisual. The pattern of sweat responses to periodic changes in heat load was also reproducible within an individual within a certin range of frequencies. Considerable individual differences was noted. These results indicate the possibility of the exsistence of sponteneous frequency in the fluctuations of sweat rate.

455

TEMPERATURE ACCLIMATION AND CHANGES IN β-ADRENERGIC RECEPTOR
M. KURAHASHI, A. KUROSHIMA. Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa.

Effect of temperature acclimation on β-adrenergic receptor in rat white adipocyte was investigated by the use of β-adrenergic antagonist (-)-[^{3}H]dihydroalprenolol(DHA).

Either cold(5°C) or heat (33°C) exposure for 24 hr did not affect the number and affinity of β-adrenergic receptor.

Cold acclimation (5°C, 4 weeks) significantly decreased the number of β-adrenergic receptor sites, while heat acclimation (33°C, 4 weeks) significantly increased it.

Equilibrium dissociation constant (K_D) for the interaction of receptor with DHA was not affected by either cold or heat acclimation, indicating no changes in the affinity of β-adrenergic receptor in cold- and heat-acclimated adipocytes.

Affinity of β-adrenergic receptor binding sites for noradrenaline was not significantly different among the control, cold- and heat-acclimated animals.

The changes in β-adrenergic receptor due to temperature acclimation observed here are deemed to be adaptive ones, compensating the response of target cells for the increased or decreased secretion of noradrenaline, although these changes could not explain the altered metabolic responsiveness to noradrenaline.

456

ROLE OF POLYAMINES IN TEMPERATURE ACCLIMATION. T. OHNO*, A. KUROSHIMA, T. YAHATA. Division of Nutrition Physiolology, Hokkaido Educational Coll.*, Hokumoncho 9, Asahikawa and Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa.

In order to ascertain possible involvement of polyamines (PA) in temperature acclimation, effect of temperature acclimation on PA content of brown fat, a major site of nonshivering thermogenesis, and effect of PA on noradrenaline-induced thermogenesis of isolated brown adipocytes were investigated in rats.

Daily urinary excretion of PA measured for combined spermidine and spermine per body weight was decreased in heat-acclimated rats and increased in cold-acclimated ones. PA concentrations per fresh weight of brown fat were located in the low extreme among those of other tissues. Putrescine and spermidine content per fat free dry matter of brown fat was decreased in cold-acclimated rats, while it was not affected in heat-acclimated ones. Spermidine as well as spermine inhibited noradrenaline-induced thermogenesis in the isolated brown adipocytes in relation to dosage between 0.1 to 10 mM.

These results suggest that PA regulates heat production of brown fat in an inhibitory way and cold acclimation potentiates thermogenic capacity of this tissue by means of reducing PA content, although mechanism involved remains to be solved.

457

IMPROVED COLD TOLERANCE AND ITS MECHANISM IN GLUCAGON-TREATED RATS.
YAHATA, T., KUROSHIMA, A. and OHNO, T.* Dept. of Physiol., Asahikawa Med. Coll., Nishikagura, Asahikawa, 078-11 and Div. of Nutr. Physiol., Hokkaido Educat. Coll., Hokumoncho 9, Asahikawa, 070*.

In an attempt to clarify the role of glucagon in cold acclimation, effect of prolonged administration of glucagon (50 μg/100 g, 2 times/day, 4 weeks, sc. injection) on cold torelance was investigated in rats. In glucagon-injected rats (G), the weights of liver and interscapular brown adipose tissue (BAT) were increased and mitochondria of BAT were developed well in size and cristae. Plasma glucagon level was higher in G than in vehicle-injected controls (C). Cold tolerance as asessed by rate of fall in colonic temperature at -5°C after 18 hr of fasting was improved and elevations of colonic and BAT temperature by noradrenaline (40 μg/100 g, im.) were significantly enhanced in G. After acute cold exposure, blood free fatty acid (FFA) and plasma glucagon levels increased in C, while both blood FFA and β-hydroxy butyrate levels increased and blood glucose level decreased in G. Plasma glucagon level was not affected in G. These results suggest that glucagon is one of the members of hormonal team involved in cold acclimation and that it enhanced nonshivering thermogenesis, possibly due to increased production and utilization of ketone bodies.

458

CHANGES IN SECRETORY RESPONSES OF THE EXOCRINE AND ENDOCRINE PANCREAS IN THE COURSE OF COLD ACCLIMATION OF RAT. HARADA, E., HABARA, Y., YONEZAWA, H., SHIBUYA, I. & KANNO, T. Dept. Physiol., Hokkaido Univ. Fac. Vet. Med. Kita-ku, Sapporo, 060

Rats were allowed to be in cold acclimation at 2.0 ± 0.3 °C for several weeks in a climatic laboratory during the early autumn (August 30 - October 6, 1979). The control group of the rats were kept in the other room without temperature control during the experiments. Secretory responses of the exocrine and endocrine pancreas induced by proper secretagogues were observed in the anaesthetized rats in the course of cold acclimation. The secretory responses of the pancreatic acinar cell induced by acetylcholine were reduced temporarily during the course of cold acclimation, recovered to the control level after 3 weeks of cold exposure and rather enhanced after 6 weeks of cold exposure. The secretory responses of the endocrine B cell induced by acetylcholine or glucose were also reduced temporarily during the course of cold acclimation, recovered to the control level after 3 weeks of cold exposure, and significantly enhanced after 6 weeks of cold exposure.

It is thus concluded that the secretory responses of the exocrine and endocrine pancreas are both enhanced after establishement of cold acclimation in several weeks of cold exposure.

459

A CIRCADIAN RHYTHM OF THE LATERAL GENICULATE SYNAPTIC TRANSMISSIONS IN THE RAT.
HANADA, Y. and KAWAMURA, H. Dept. Psychol., Univ. of Tokyo, Bunkyo-ku, Tokyo and Lab. of Neurophysiol., Mitsubishi-Kasei Institute of Life Sciences, Machida, Tokyo.

Wistar strain male albino rats with electrodes (in the lateral geniculate body and optic tract) were placed in a sound-attenuated chamber. Food and water were available *ad libitum*. Evoked responses from the LGB with single OT stimulation were recorded every 5 or 10 min. Twelve responses were averaged and the amplitude of each component was continuously measured. ECoG and EMG from neck muscles were recorded simultaneously and in some rats movement artifacts were recorded. Successive measurements revealed circadian rhythms which continued under DD condition. Postsynaptic components which disappeared at high frequency stimulation showed larger amplitude in night time than in day time. Presynaptic components antidromically recorded also showed a similar rhythmicity. Averaged responses taken only during rat's movement or each sleep-wakefulness stage respectively showed circadian rhythms. However, the effect of sleep-wakefulness changes was different from component to component (less in the third component and larger in the fourth component). After bilateral SCN lesions, the circadian rhythms completely disappeared. These results strongly suggest a circadian variation in information transmission in the primary sensory pathway.

460

CIRCADIAN RHYTHM IN NEURAL ACTIVITY OF THE SUPRACHIASMATIC NUCLEUS.
INOUYE, S.T., and KAWAMURA, H. Neurophysiol. Lab. Mitsubishi-Kasei Inst. Life Sciences, Machida-shi, Tokyo

Daily rhythm in neural activity of the suprachiasmatic nucleus (SCN) in the rat was observed for longer than 1 month. It was characterized by its large difference between day and night and by its unique phase. It alone among all brain sites tested has a daytime maximum.

The rhythm persisted even in a hypothalamic island made with a Halasz knife. This rhythm of the SCN in an isolated island was free-running, namely the period of the rhythm was a little different from 24 hours. When the retino-hypothalamic pathway was left uncut, external light and dark conditions affected the rhythm. Under a constant light condition, it revealed free-running rhythm, whose period was longer than that in constant darkness. It could re-entrain to an external light and dark cycle. The phase of the rhythm shifted in response to a light pulse, although phase advance were difficult to be recognized. Neural activity of the SCN satifies the requirements of the circadian rhythm. These results imply that the circadian pacemaker in the rat is localized in the SCN.

461

TWO DAILY SURGES OF PROLACTIN SECRETION IN THE IMMATURE FEMALE RAT
Fukuko KIMURA and Masazumi KAWAKAMI. Dept. of Physiol., Yokohama City Univ. Sch. of Med., 2-33 Urafune-cho, Minami-ku, Yokohama

Serum concentrations of prolactin (PRL) were determined at 3 or 4 h intervals during a 24 h period in the 27-43 day old female rats maintained on a 14 h light and 10 h dark schedule. Blood samples for analysis by RIA were obtained either by decapitation or from intraatrial cannulae implanted 1-2 days previous to the experiment.

Two peaks of PRL levels were observed in the 27-33 day old rats. In the animals in which blood sampling was done through decapitation, the one peak occurred at 1800 h and the other occurred at 0600 h, and the ovariectomy performed 7 days previous to the sampling did not abolish the occurrence of two PRL peaks. In the animals in which blood sampling was done through intraatrial cannulae one peak was at 1400-1700 h and the other was at 0200-0500 h. Those surges were constantly separated from each other by 9-12 h. The 42-43 old rats which were at a few days before puberty showed a diurnal peak at 1800 h but no nocturnal one in the cannulation experiment. The data demonstrated that in the immature rat, there are two daily surges of PRL secretion, whose regulatory mechanims is operative in the absence of ovarian hormones.

462

SEX STEROIDS MODIFICATION OF SLEEP CIRCADIAN RHYTHM IN THE FEMALE RATS; STRAIN DIFFERENCES. S. YAMAOKA. Dept. of Physiol., Saitama Med. Sch., Moroyama, Saitama, 350-04

Sleep circadian rhythm were studied in female albino rats(Sprague-Dawley,SD) and hooded rats(Long-Evans,LE and Wistar Wild,WW). The frontal and hippocampal EEGs and dorsal neck EMG were used to monitor slow wave sleep(SWS), paradoxical sleep(PS) and alertness. PS rhythm in SD and WW rats showed the sexual cycle dependent changes characterized by the decrease of night PS appearance on proestrus. While in LE rats, this change was not clear. The long term exposure of constant illumination(LL) caused persistent estrus(PE) and ultradian sleep rhythm in SD rats. The LL exposure in LE and WW rats also caused PE and ultradian sleep rhythm, but delayed more 30 days than SD rats. Furthermore, the electrodes implantation for PE-LE rats recovered the sexual cycle and maintained over 50 days, and 4 to 5 months LL exposure for LE and WW rats still indicated circadian free-running component in ultradian sleep rhythm. The estradiol(EB) injection to ovariectomized rats indicated the decrease of night PS appearance in SD and LE rats, but not in WW rats. Progesteron injection 72h after EB indicated the further decrease of night PS appearance in LE and WW rats, but did not affect SD rats. From these results, it is suggested that among these three strains, SD rats are most sensitive to both LL exposure and EB injection, LE rats are most resistant to LL exposure and WW rats are most resistant to EB effect.

463

CRITICAL PERIOD FOR SETTING THE PHASE ANGLE OF CIRCADIAN RHYTHM OF PLASMA CORTICOSTERONE IN PERINATAL PUPS. WATANABE, K., HONMA, K., ENDO, M. and HIROSHIGE, T.
Dept. of Physiol., Hokkaido Univ. Sch. of Med., Kita-ku, Sapporo 060

The free-running rhythm of plasma corticosterone in the rat is shown to develop during maturation, but the time for setting the phase angle of pup's hormone rhythm is not known. In this study, individual time course of free-running rhythm of plasma corticosterone was followed at the 4th, 8th and 12th week postnatally under various lighting conditions. All the pups were enucleated within 24 h after birth. Blood samples are taken every 4 h from the cut end of tail vein over a 24-44 h period. Plasma corticosterone was determined by a competitive protein binding method. Most of the blinded pups showed a free-running circadian rhythm of plasma corticosterone in the 4th postnatal week. Thus eyes are not essential for the development of free-running rhythm. The phase angle of hormone rhythm in pups born from mothers under LD was not essentially affected by different lighting regimen used (DD only, DD2W + LD thereafter) during early postnatal period. The results suggested that the phase angle was set earlier than the end of two weeks of postnatal life. From the results of cross-pairing experiment it is suggested that there is a critical period in the perinatal maturation during which the phase angle of the pup's hormone rhythm is set either by original mother or by foster mother.

464

IS FEEDING-INDUCIBLE PLASMA CORTICOSTERONE PEAK ASSOCIATED WITH AN INDEPENDENT OSCILLATOR IN RATS? HIROSHIGE, T., K. WATANABE, and M. ENDO. Dept. of Physiol., Hokkaido Univ. Sch. of Med., Kita-ku, Sapporo 060

Possibility of the existence of an independent oscillator associated with feeding cycle was examined by imposing restricted feeding (RF) of 2 h duration with 22, 24, and 26 h cycle on blinded rats. Wistar male adult rats were bilaterally enucleated and divided into 4 groups: G1 (4 rats) with free access to water and diet (control). G2 (4 rats) was subjected to RF of 24 h cycle, G3 (6 rats) to RF of 22 h cycle and G4 (6 rats) to RF of 26 h cycle, respectively. Blood was collected from cut end of the tail vein every 2 h intervals over a 24 h period and plasma corticosterone was determined by a competitive protein binding assay. We found that all regimens of RF used were effective as a zeitgeber. An LD-dependent peak of plasma corticosterone tended to diminish during the RF regimen (masking effect), still it continues to free-run with a phase angle unaffected by RF. When freed from RF, an RF-induced peak of plasma corticosterone persists and free-runs in parallel with an LD-dependent hormone peak. We conclude that either free-running of RF-inducible peak is controlled by an LD-dependent oscillator, or an RF-dependent oscillator has a free-running period similar to that of the LD oscillator. Supported in part by Grant-in-Aids from the Ministry of Education, Science and Culture of Japan and from the Naito Foundation.

465

A CIRCADIAN RHYTHM IN THE LOCOMOTOR BEHAVIOR OF A AFRICAN GIANT SNAIL, ACHATINA FULICA.
OGASAWARA, T. and TASAKI, K. Dept. of Physiol., Tohoku Univ. Sch. of Med., Sendai.

The locomotor activity rhythms of individual African giant snails was studied by running wheel method under a constant temperature (25 ± 0.5°C) and a constant humidity (90 ± 5 %). When the rhythms were entrained to LD 12:12 cycles, the bulk of activity occurred in the dark and the peak of activity appeared in the most cases within 2 hours after the light-dark transition. The locomotor rhythms could be re-entrained within a few days after 3 hour phase delay of the LD cycle and freeran in constant light with a period of about 24 hours. Eyeless animals also showed similar rhythms. Thus the presence of extraocular photoreceptors was suggested.

466

ROLE OF RNERGY METABOLISM AND MEMBRANE FUNCTION IN THE CIRCADIAN RHYTHM IN PARAMECIUM.
HASEGAWA, K., KATAKURA, T., TANAKADATE, A. and ISHIKAWA, H. Dept. of Physiol., Kitasato Univ., Sch. of Med. Sagamihara, Kanagawa 228, Japan

1) The circadian rhythms of motility in two species of paramecia were compared. With a video monitor system, the motility was measured by the number of cells which passed across a spot in a culture dish per an hour. Obligate heterotrophic ciliate, P. multimicronucleatum showed high motility at night and free-running rhythm with period close to 24 h. Mixotrophic ciliate, P. bursaria which contains chlorella, a green alga, in its cytoplasm, exhibited sharp maximun of motility at midday and free-running rhythm with period longer than 24 h (about 26 h in DD and about 29 h in LL). 2) Effect of K^+-ion in culture medium upon the motility rhythm in P. multimicronucleatum was tested. According to the increase of K^+ concentration in the medium, rhythmicity of the motility tended to be eliminated. The motility increased temporarily immediately after onset of light and decreased transiently immediately after light-off in high K^+ medium.

It was suggested that energy metabolism and membrane function may play very important role in the decision of the phase of the motility rhythm of Paramecium.

467

RESETTING OF BIOLOGICAL CLOCKS AND BOWEL MOVEMENTS
T.SASAKI, R.KOGA and S.TSUZUKI Dept. Physiol., Inst. Constitutional Med., Kumamoto Univ., Kumamoto 862

Although the time of defecation may be subject to intentional control, the bowel movement itself is of involuntary action. Accordingly with due consideration to data, it may disclose autonomic aspects of biological clock resetting. Effects of trans-meridian flight on the time of bowel movement and sleep-wakefulness routine were observed in 9 cases of individual travelers (6 cases to Europe and 3 to North America) and 6-hour delay cases of 293 athletes traveling in a group.

Events used for analysis were:(A) first day of defecation matching with new local time, (B) SD of the time of morning defecation, (C) final day of defecation matching with preflight local time, (D) final day of multiple movements in a day, (E) final day of evacuation during sleep hours, (F) final day of untimely awakening during sleep hours, and (G) number of defecations per day.

Outstanding differences were observed between eastbound and westbound flights in most items observed, while the SD of the time of morning evacuation was significantly related to the stage of outgoing or homecoming, rather than the direction of flight.

468

EFFECTS OF SLEEP-PROMOTING SUBSTANCE ON SLEEP-WAKING RHYTHMS OF NORMAL MALE RATS. HONDA, K., KOMODA, Y. and INOUÉ, S. Inst. for Med. Dent. Engineering, Tokyo Med. Dent. Univ., 2-3-10 Kanda-Surugadai, Chiyoda-ku, Tokyo 101

Seventeen normal male rats of the Sprague-Dawley strain, 70-80 days old, weighing 300-350 g and kept under LD 12:12 in an air-conditioned sound-proof room, were implanted with cerebrocortical EEG and neck EMG electrodes and a cannula into the third ventricle, through which saline solution was steadily infused (20 µl/h). From one-week recovery period on, they regularly exhibited 464±13 min slow wave sleep (SWS), 68±7 min paradoxical sleep (PS) and 182±15 min waking (W) in the light phase (0800-2000), while 188±18 min SWS, 36±8 min PS and 460±37 min W in the dark phase (2000-0800). Infusion of active fractions containing the sleep-promoting substance, extracted from brainstems of 24 h sleep-deprived rats, for 10 h (1800-0400), brought above a 50-100 % increase of SWS (347±16 min) and a ca. 40 % decrease of PS (20±2 min) in the dark phase.

469

THE EFFECTS OF ELECTROCONVULSIVE SHOCK ON SLEEP OF RATS
NAGATA, K., ISHIKAWA, N., *DAINOSON, K., MATSUMOTO, J.
Dept. of Physiology, Sch. of Medicine, University of Tokushima, Tokushima
*Dept. of Neuropsychiatry, Sch. of Medicine, University of Kurume, Kurume

The effects of electroconvulsive shock(ECS) on sleep of rats have been studied. Wistar rats, weighing 250-300g were treated with ECS. When single ECS was given to the animal, its PS time for 6 hrs was reduced by 50% in comparison with control level. Slow wave sleep showed no remarkable changes. When ECS was given to the animal 4 times every 6 hrs, there was no reduction in PS time for 6 hrs following the 4th treatment of ECS. After the animal was deprived of total sleep for 12 hrs, its PS time was dramatically increased. When ECS was given to the animal following sleep deprivation, the rebound increase in PS time was suppressed. When ECS was given to the one parabiont using parabiotic rats, its PS time was reduced for 6 hrs as in the case of single rats, but the partner did not show any changes of sleep.

In conclusion, ECS resulted in a marked suppression of PS, but its suppression was antagonized by enhanced demand of PS.

470

SLEEP AND INHIBITION OF PROTEIN AND RNA SYNTHESIS. E. UEZU, A. SANO AND J. MATSUMOTO. Dept. of Physiol., Sch. Med. Tokushima Univ., Kuramoto, Tokushima, 770

Following our previous report (J. Physiol. Soc. Japan 40, 1978, p 268), effects of cycloheximide, inhibitor of protein synthesis, on sleep were examined in the four groups intraventricularly administered at 0:00, 6.00, 12:00 and 18:00 respectively. Paradoxical sleep (PS) was remarkably suppressed in all four groups. With intraventricular administration of actinomycin S_5, inhibitor of RNA synthesis, PS was not suppressed. The amount of slow wave sleep (SS) during 24 hrs was unaffected by cycloheximide. When SS was divided into light sleep((LS) and deep sleep (DS), DS showed a clear diurnal variation: the amount of DS was larger in the light (L) period (6:00-18:00) than in the dark period (18:00-6:00), in contrast to uniform distribution of LS in both periods under the normal condition. And DS was suppressed in the L-period but slightly increased during 18:00-0:00 under the cycloheximide-treated condition. LS was significantly increased in both periods. And the normal decrease of SS, especially in DS, during D-period was inhibited by actinomycin S_5.

471

THE ANTAGONISTIC EFFECT OF THE SLEEP PROMOTING SUBSTANCE ON CHLORAMPHENICOL INDUCED PS SUPPRESSION. NAGASAKI, H. and IRIKI, M. Department Physiology, Tokyo Metropolitan Institute Gerontology

The present experiment demonstrated the effect of the SPS on the PS duration to promote from about 70-80 min (genetically determined quantity in C57BL/6) to 100-110 min (40 % increase) during 24 hours following intraperitoneal administration at the dose of 0.2 u when injected at light period (at 9:00). The degree of PS duration promoted during 24 hours was equal to the degree when injected at prior to dark period (18:30-18:50), but the latency of the PS promotion was quite different among two different injection time, those were 1 hour in morning injection and 10 hours in night injection. The different latency of PS promotion was observed also in antagonism between the PS promotion of the SPS and the PS suppression of the chloramphenicol. The PS specific suppression following administration of 100 mg/kg chloramphenicol was canceled by the simultaneous injection of the 0.2 u SPS to the genetical level of PS duration, therefore the latency of the PS promotion was 1 hour as the same latency as the morning injection of the SPS. However the total sleep suppression following administration of 200 mg/kg chloramphenicol was not canceled by the simultaneous injection of the 0.2 u SPS, although there were 10 hours latency prior to the onset of PS promotion as the same delay as the night injection.

472

SEX EDUCATION FOR NEW BORN BABIES

MAKOTO TAKAHASHI. Bio., Chiba-Juni., Konodai Ichikawa.

While there are varied theories advanced when the sex education should be first given, it is considered rational to start at an early age of the child by the mother as the principal party with all the requisites essential for rearing the new born child. Mental conditions of the child should be taken into account throughout its life.

It may be exercised with the Christian spirit which can be understood through love and the spirit of service.

The love and the service spirit received semi-unconsciously would in the process become the basis of his mental attitude.

This will later turn into a new spiritual awakening.

This spiritual awakening will form his new personality.

Such a mental/spiritual experience would be a result from the love and service spirit which he received in his early childhood days.

Therefore it is especially desirable that all the methers impart the love and service spirit to their children.

473

THE EVALUATION OF THE MECHANISM OF BILE PRODUCTION BY ORGANIC ANIONS IN THE RATS.

K.Kitani, First Laboratory of Clinical Physiology, Tokyo Metropolitan Institute of Gerontology, Tokyo

The mechanism of choleresis induced by organic anions was reevaluated in the rat in terms of water and electrolytes transports into the bile using three different organic anions, taurocholate(Ta), dehydrocholate(Dh) and bucolome(Bc) as test agents. The linear regression obtained from the relation between the biliary excretion rates of anions and bile flow rate gave the water volume (ul) generated by the excretion of one umole of anions or their metabolites, 6.4,17.7 and 27.0 for Ta,Dh and Bc respectively. After subtracting the Na^+ transport rate as counter cation for these anions, remaining Na^+ and Cl^- and K^+ transport increments induced by the anion excretion and bile volume values enabled the calculation of the concentrations of these electrolytes in the assumed bulk water induced by the active transport of anions and accompanying counter cation (Na^+), which indicated that the concentrations of Na^+ and Cl^- of bulk flow ranges from 60 to 90 mEq for all three anion experiments.In the separate experiments with rats depleted of bile salts pool, the slope of the regression line for bile salt excretion rate and bile flow was shown to change from 23 (ul/umol) to 9 as the bile salt concentration in the bile increased. The results suggest the paracellular pathway for the assumed bulk flow, the importance of the reevaluation for the mechanism of Na^+ transport in cholereis.

474

Eight-week-old chickens administered Salinomycin (80ppm, 160ppm, 320 ppm) were sacrificed by exsanguination from the carotid artery and were examined at autopsy.

Organs weights, ratio of body weight vs organ weights and histopathological findings were recorded. The results obtained were as follows:

1. Congestion was generally seen in the heart, lung, surrounding the bronchus and in the liver. However, there werw no histopathological findings attributable to the administration of Salinomycin in any organs.
2. The organ weight was in accordance with the body weight.
3. Almost no change was seen in the ratio of body weight vs organ weight in the 320ppm group and 160ppm group.
4. The highest mortality rate was found in the 320ppm group, with decreased body weight and organ weight and the dose of 320ppm was beyond the safety limits from the standpoint of blood and serum biochemistry. 160ppm is adose allowable to be administered and 80ppm is equal to the control group in every findings, so 80ppm is judged to be favorable dose.

AUTHOR'S INDEX

A

ABDELMOUMENE, M. 111
ABE, K. 400
ABE, M. 34
ABE, M. 419
ADACHI, C. 355
ADACHI-USAMI, E. 189
ADANIYA, H. 299
AI, N. 243
AIKAWA, S. 4
AIKAWA, S. 136
AIKAWA, T. 402
AIZAWA, K. 37
AIZAWA, K. 38
AIZAWA, K. 39
AKAIKE, N. 62
AKAISHI, T. 403
AKAMA, T. 432
AKASU, T. 91
AKAZAWA, K. 5
AKAZAWA, K. 114
AKAZAWA, K. 375
AKAZAWA, K. 293
AKEMA, T. 390
AKITA, H. 4
AKITA, H. 136
ALLISON, T. 159
AMAGAI, Y. 256
AMAGAI, Y. 17
AMANO, N. 247
ANDO, K. 326
ANDO, M. 33
ANDO, M. 51
ANDO, T. 398
ANRAKU, M. 87
ANRAKU, M. 64
AOKI, K. 4
AOKI, K. 136
AOKI, M. 379
AOKI, M. 175
AOKI, S. 55
AOKI, T. 58
AOU, S. 323
AOU, S. 141
ARAIE, N. 320
ARAKI, T. 424
ARAKI, T. 321
ARAKI, T. 131
ARIGA, T. 371
ARIGA, T. 372
ARIMA, T. 272
ARIMA, T. 270
ARITA, A. 63
ARITA, J 432
ASABA, H. 474
ASADA, T. 376
ASAHARA, T. 124
ASAHI, T. 356
ASAMI, K. 18
ASAMI, K. 40
ASANO, M. 339
ASANO, Y. 361
ASANUMA, A. 223
ASANUMA, N. 233
ASATO, R. 11
ASATO, R 32
ASATO, R. 75
ASAYAMA, M. 453
ASAYAMA, M. 454
ASHIDA, H. 156
ASHIDA, H. 81
ASHIDA, H. 16
ASO, H. 65
ASO, H. 178
AZUMA, M. 180
AZUMA, T. 445
AZUMA, T. 338
AZUMA, T. 277
AZUMA, T. 344

B

BABA, H. 160
BAN, M. 104
BANDO, T. 123
BENNETT, G. J. 111
BRINK, E. 129

C

CHIBA, A. 395
CHIBA, J. 189
CHICHIBU, S. 1
CHUJO, T. 224
CHUJO, T. 225

D

DAINOSON, K. 469
DAUTH, G. W. 145
DEGUCHI, F. 335
DOI, A. 177
DUBNER, R. 111

E

EBASHI, H. 418
EBE, M. 110
EBE, M. 161
EBE, M. 162
EGUCHI, C. 348
EHARA, T. 297
ENDO, H. 112
ENDO, K. 131
ENDO, M. 464
ENDO, M. 463
ENDOH, E. 371
ENDOH, S. 433
ENDOH, S. 435
ENOKI, Y. 350
ENOKI, Y. 351
ENOMOTO, K. 97
ENOMOTO, S. 137
ENOMOTO, T. 20

ERA, S. 15
ERA, S. 16

F

FUJII, K. 5
FUJII, K. 114
FUJII, K. 313
FUJII, S. 285
FUJIMOTO, M. 46
FUJIMOTO, M. 55
FUJIMOTO, M. 202
FUJIMURA, H. 36
FUJINO, M. 270
FUJINO, M. 272
FUJINO, T. 302
FUJISHITA, S. 195
FUJITA, M. 138
FUJITA, M. 432
FUJITA, S. 417
FUJITA, Y. 153
FUJITA, Y. 231
FUJITANI, Y. 159
FUJITSUKA, N. 72
FUJIWARA, T. 324
FUKAI, K. 318
FUKUDA, A. 396
FUKUDA, J. 71
FUKUDA, M. 140
FUKUDA, Y. 380
FUKUI, M. 474
FUKUOKA, M. 342
FUKUSHIMA, K. 125
FUKUSHIMA, M. 30
FUKUSHIMA, T. 277
FUKUZAKI, H. 414
FUNAHASHI, A. 445
FUNAHASHI, S. 149
FUNAI, H. 227
FUNAKOSHI, M. 249
FURUICHI, H. 65
FURUICHI, H. 66
FURUICHI, T. 376
FURUKAWA, K. 408
FURUKAWA, T. 229
FURUYA, K. 67
FURUYAMA, F. 440
FURUYAMA, S. 34

G

GEMBA, H. 151
GILMAN, S. 145
GOFF, W. R. 159
GOMI, S. 262
GORIS, R. C. 261
GOSHI, K. 364
GOTO, K. 301
GOTO, K. 378
GOTO, M. 288
GOTO, M. 302
GOTOW, T. 64

H

HABARA, Y. 59
HABARA, Y. 458
HACHISU, M. 251
HADA, J. 216
HADA, R. 180
HAMADA, I. 148
HAMADA, T. 190
HAMADA, T. 217
HANADA, Y. 459
HANAI, S. 3
HANAI, S. 333
HANAMORI, T. 122
HANAWA, I. 196
HARA, M. 387
HARADA, E. 458
HARADA, S. 234
HARRINGTON, T. L. 184
HASEGAWA, H. 439
HASEGAWA, K. 22
HASEGAWA, K. 466
HASEGAWA, Y. 430
HASHIBA, M. 155
HASHIGUCHI, T. 93
HASHIMOTO, I. 161
HASHIMOTO, I. 162
HASHIMOTO, M. 172
HASHIMOTO, M. 174
HASHIMOTO, M. 431
HASHIMOTO, S. 151
HASHIMOTO, T. 226
HASHIMOTO, Y. 207
HASHIMOTO, Y. 431
HASIMOTO, M. 7
HASHIMURA, S. 64
HASHIMURA, S. 87
HASUO, H. 88
HATADA, K. 146
HATAKEYAMA, I. 345
HATASE, O. 21
HATOGAI, F. 335
HATTANMARU, Y. 378
HATTORI, H. 165
HAYAMA, T. 240
HAYASHI, H. 43
HAYASHI, H. 45
HAYASHI, H. 63
HAYASHI, H. 111
HAYASHI, K. 116
HAYASHI, K. 253
HAYASHI, M. 442
HAYASHI, R. 173
HAYASHI, T. 334
HAYASHI, T. 331
HAYASHI, Y. 214
HAYASHI, Y. 216
HIGASHI, H. 105
HIGASHIDA, H. 107
HIGASI, T. 7
HIGUCHI, T. 95
HIGUCHI, Y. 342
HIGUTI, K. 437
HIJI, Y. 82
HIKOSAKA, O. 254
HIMUKAI, M. 44
HINO, N. 300
HINO, Y. 335
HIRAI, A. 337
HIRAI, K. 99
HIRAI, N. 128
HIRAI, N. 129

HIRAI, T. 113
HIRAKAWA, S. 356
HIRAMURA, K. 243
HIRANO, S. 65
HIRANO, S. 178
HIRANO, T. 396
HIRAO, H. 265
HIRAO, T. 166
HIRAOKA, M. 295
HIRATA, K. 428
HIROSE, T. 402
HIROSHIGE, T. 463
HIROSHIGE, T. 464
HIROTA, A. 285
HISADA, M. 133
HISAMITSU, T. 250
HOMMA, I. 110
HOMMA, I. 385
HOMMA, S. 116
HOMMA, S. 117
HONDA, K. 468
HONDA, M. 46
HONDA, Y. 380
HONG, S. K. 366
HONG, S. K. 427
HONGO, T. 128
HONJO, R. 358
HONMA, I. 161
HONMA, I. 162
HONMA, K. 394
HONMA, K. 463
HORI, H. 31
HORI, H. 69
HORI, N. 447
HORI, S. 424
HORI, S. 429
HORI, T. 290
HORI, T. 446
HORI, T. 447
HORI, Y. 21
HORIE, H. 31
HORIE, H. 69
HORIE, N. 373
HORIIKE, K. 12
HORIIKE, K. 13
HORIKAWA, J. 227
HORIMOTO, M. 367
HORIMOTO, M. 386
HORIUCHI, T. 417
HOSHI, T. 42
HOSHI, T. 44
HOSHINA, Y. 163
HOSOI, K. 410
HOTTA, K. 271
HUKUHARA, T., Jr. 367
HUKUHARA, T., Jr. 378

I

IBUKI, C. 30
ICHIKAWA, O. 82
ICHIKAWA, S. 280
ICHIKAWA, T. 192
ICHINOSE, M. 97
ICHIOKA, M. 135
ICHIOKA, M. 158
IEIRI, T. 391
IGARASHI, K. 164
IGARASHI, M. 376
IHZUKA, H. 429
IIJIMA, M. 256
IIZUKA, M. 242
IKAWA, S. 423
IKAWA, Y. 417
IKEDA, N. 340
IKEDA, Y. 295
IKEGAMI, S. 245
IKEHARA, T. 49
IKUNO, H. 319
IKUNO, H. 381
IMAI, H. 371
IMAI, H. 372
IMAI, I. 57
IMAI, S. 113
IMAI, Y. 27
IMAI, Y. 80
IMANAGA, I. 279
IMOTO, T. 240
INABA, T. 384
INAGAKI, Y. 336
INAGAKI, Y. 337
INAGAKI, Y. 335
INAZAWA, M. 297
INENAGA, K. 389
INOKUCHI, H. 105
INOKUCHI, M. 207
INOMATA, H. 278
INOMATA, K. 2
INOMOTO, T. 359
INOMOTO, T. 448
INOMOTO, T. 416
INOUE, A. 393
INOUE, G. 434
INOUE, M. 437
INOUE, S. 468
INOUYE, H. 134
INOUYE, H. 15
INOUYE, H. 16
INOUYE, S. T. 460
IRIE, S. 335
IRIKI, A. 135
IRIKI, A. 158
IRIKI, M. 471
IRIMAJIRI, A. 18
IRIMAJIRI, A. 40
IRISAWA, H. 294
IRISAWA, H. 298
IRIUCHIJIMA, J. 348
ISHIDA, A. 415
ISHIDA, K. 414
ISHII, K. 330
ISHII, K. 330
ISHIKAWA, H. 466
ISHIKAWA, N. 469
ISHIKAWA, T. 324
ISHIKAWA, T. 18
ISHIKAWA, Y. 450
ISHIKO, N. 239
ISHIKO, N. 122
ISHIYAMA, Y. 110
ISHIYAMA, Y. 161
ISHIYAMA, Y. 162
ISHIZAWA, M. 276

ISHIZUKA, K. 139
ISHIZUKA, K. 141
ISHIZUKA, S. 323
ISOBE, Y. 430
ITO, A. 417
ITO, H. 342
ITO, F. 72
ITO, J. 93
ITO, K. 2
ITO, M. 454
ITO, M. 453
ITO, M. 373
ITO, S. 187
ITOH, Y. 312
ITOW, H. 231
ITOW, H. 420
IWAI, E. 168
IWAI, E. 186
IWAMA, K. 212
IWAMA, K. 215
IWAMOTO, J. 311
IWAMOTO, J. 308
IWAMURA, Y. 254
IWASE, Y. 172
IWASE, Y. 174
IWATA, T. 65
IWATSUKI, N. 26
IZUMI, H. 58

J

JIJIWA, H. 154
JIJIWA, H. 173

K

KABA, H. 432
KABASAWA, K. 293
KADOYA, T. 474
KAJI, S. 190
KAJINO, K. 55
KAKEGAWA, T. 409
KAKIUCHI, Y. 363
KAKIUCHI, Y. 367
KAKUDO, Y. 120
KAMADA, T. 230
KAMEDA, K. 230
KAMEYAMA, M. 71
KAMINO, K. 285
KAMIYA, A. 341
KAMIYAMA, A. 265
KAMIYAMA, K. 291
KAMOGAWA, H. 119
KAN, Z. 414
KANAI, K. 325
KANAMATUE, T. 178
KANDA, K. 101
KANEDA, T. 301
KANEKO, A. 208
KANEKO, M. 350
KANEKO, N. 72
KANIIKE, K. 50
KANNO, T. 59
KANNO, T. 458
KANNO, Y. 19
KANNO, Y. 20
KANNO, Y. 283
KANO, A. 42
KANO, M. 79
KANOSUE, K. 5
KANOSUE, K. 114
KANO-TANAKA, K. 107
KANUMA, A. 241
KARITA, K. 241
KASAGI, T. 82
KASAHARA, K. 238
KASAHARA, Y. 234
KASAI, S. 17
KASEDA, M. 287
KASHIMA, K. 358
KASHIWAGURA, T. 48
KASUGA, N. 268
KATADA, A. 157
KATAGIRI, M. 335
KATAGIRI, Y. 207
KATAKURA, T. 466
KATAYAMA, Y. 309
KATO, E. 94
KATO, H. 187
KATO, I. 143
KATO, M. 125
KATO, M. 126
KATO, M. 137
KATO, S. 281
KATOH, K. 28
KAWAGOE, R. 100
KAWAGUCHI, S. 152
KAWAGUCHI, T. 14
KAWAHARA, K. 44
KAWAHARA, K. 175
KAWAHARA, K. 379
KAWAI, N. 103
KAWAI, Y. 344
KAWAKAMI, M. 138
KAWAKAMI, M. 390
KAWAKAMI, M. 432
KAWAKAMI, M. 461
KAWAKITA, K. 249
KAWAMURA, H. 245
KAWAMURA, H. 459
KAWAMURA, H. 460
KAWAMURA, T. 186
KAWAMURA, T. 421
KAWAMURA, Y. 320
KAWANO, K. 30
KAWANO, K. 181
KAWANO, K. 184
KAWASAKI, T. 143
KAWATA, H. 290
KIKUCHI, K. 421
KIKUCHI, R. 168
KIKUCHI, Y. 367
KIM, K. 322
KIMURA, E. 24
KIMURA, E. 365
KIMURA, F. 461
KIMURA, J. 330
KIMURA, M. 121
KIMURA, N. 407
KIMURA, S. 24
KIMURA, Y. 326
KIMURA, Y. 420
KINOSHITA, K. 288
KINOSHITA, Y. 24

KINOSHITA, Y. 336
KISHI, K. 434
KISHI, M. 290
KISHIDA, A. 177
KITA, H. 98
KITA, H. 141
KITA, H. 323
KITA, T. 89
KITADA, Y. 381
KITAHARA, M. 38
KITANI, K. 473
KITANO, T. 436
KITASATO, H. 52
KITASATO, H. 60
KITOH, J. 232
KIYOHARA, S. 232
KIYOHARA, T. 446
KIYOHARA, T. 447
KOBAYASHI, H. 93
KOBAYASHI, K. 385
KOBAYASHI, K. 405
KOBAYASHI, K. 414
KOBAYASHI, N. 132
KOBAYASHI, S. 4
KOBAYASHI, S. 136
KOBAYASHI, T. 265
KOBAYASHI, T. 365
KOBAYASHI, Y. 385
KOBORI, M. 250
KOBORI, T. 66
KODAMA, H. 17
KOGA, M. 22
KOGA, R. 467
KOGURE, I. 85
KOHSAKA, S. 142
KOIKE, H. 73
KOISHI, H. 436
KOKETSU, K. 88
KOKETSU, K. 91
KOKETSU, T. 99
KOKUBUN, S. 294
KOMABAYASHI, T. 433
KOMABAYASHI, T. 435
KOMATSU, A. 327
KOMATSU, Y. 182
KOMETANI, K. 264
KOMODA, Y. 468
KOMUGI, H. 251
KON, K. 352
KON, K. 368
KONDA, N. 366
KONDA, N. 427
KONDO, H. 209
KONNO, K. 28
KOSAKA, M. 448
KOSHIHARA, Y. 347
KOSHIHARA, Y. 384
KOSHITA, M. 271
KOSUGI, T. 375
KOTAKE, H. 294
KOTATE, H. 298
KOTERA, K. 46
KOYAMA, H. 172
KOYAMA, H. 174
KOYAMA, T. 363
KOYAMA, T. 367
KOYAMA, T. 386
KOYANO, H. 308
KOYANO, H. 311
KUBA, K. 54
KUBA, K. 94
KUBO, K. 392
KUBOTA, K. 149
KUBOTA, T. 46
KUDOH, M. 218
KUDOH, M. 219
KUKITA, F. 67
KUMADA, M. 317
KUMAGAI, Y. 287
KUMAZAWA, T. 322
KUNO, M. 119
KUNO, M. 221
KURAHASHI, M. 455
KURAMITSU, M. 21
KURATA, H. 422
KURIOKA, Y. 213
KURIOKA, Y. 260
KURODA, Y. 405
KUROSAWA, M. 321
KUROSHIMA, A. 455
KUROSHIMA, A. 456
KUROSHIMA, A. 457
KUSACHI, R. 327
KUSANO, E. 361
KUSUNOSE, R. 166

L

LAHIRI, S. 382
LUO, C. P. 250

M

MAEDA, N. 368
MAEDA, N. 352
MAEKAWA, K. 121
MAENO, T. 97
MAEZAWA, R. 257
MANO, T. 246
MARKHAM, C. H. 130
MARU, E. 156
MARU, E. 81
MARUMO, F. 362
MARUNAKA, Y. 52
MARUNAKA, Y. 60
MARUYAMA, M. 155
MARUYAMA, N. 218
MARUYAMA, N. 219
MARUYAMA, T. 278
MARUYAMA, T. 303
MARUYAMA, Y. 112
MASHIMA, H. 293
MASUDA, M. 422
MASUDA, M. 439
MASUDA, Y. 336
MASUDA, Y. 337
MASUMURA, S. 431
MATSUBARA, I. 266
MATSUDA, M. 427
MATSUDA, M. 366
MATSUDA, T. 369
MATSUI, H. 387
MATSUI, H. 404
MATSUI, H. 21

MATSUI, N. 401
MATSUI, N. 426
MATSUKI, M. 155
MATSUMOTO, A. 360
MATSUMOTO, I. 402
MATSUMOTO, J. 470
MATSUMOTO, J. 469
MATSUMOTO, M. 109
MATSUMOTO, N. 253
MATSUMOTO, N. 252
MATSUMOTO, T. 29
MATSUMOTO, Y. 96
MATSUMURA, M. 289
MATSUMURA, Y. 55
MATSUO, O. 375
MATSUSHIMA, T. 113
MATSUSHITA, H. 179
MATSUSHITA, H. 14
MATSUTANI, T. 169
MATSUURA, S. 221
MATSUURA, S. 222
MATSUURA, T. 196
MATSUZAKI, S. 399
MATUMOTO, M. 84
MAYUZUMI, M. 424
MEED, J. F. 432
MERA, H. 250
MIENO, M. 406
MIHARA, H. 375
MIKAMI, T. 363
MIKAMI, T. 383
MIKI, K. 343
MIKOSHIBA, K. 142
MIMATA, T. 278
MIMORI, Y. 146
MIMURA, K. 191
MINOTA, S. 94
MINOWA, Y. 221
MINOWA, Y. 222
MISHINA, T. 362
MITARAI, G. 205
MIURA, M. 315
MIURA, R. 369
MIYACHI, E. 206
MIYAGAWA, T. 453
MIYAGAWA, T. 454
MIYAHARA, S. 409
MIYAKAWA, K. 325
MIYAKAWA, K. 346
MIYAKAWA, M. 367
MIYAKE, A. 107
MIYAKE, A. 173
MIYAMAE, S. 301
MIYAMOTO, H. 49
MIYAMOTO, J. 326
MIYAMOTO, Y. 383
MIYAMURA, M. 387
MIYAOKA, T. 246
MIYATA, H. 152
MIYAZAKI, E. 276
MIYAZAKI, E. 282
MIYAZAKI, M. 113
MIYAZAWA, T. 324
MIYOSHI, M. 82
MIZUMURA, K. 322
MIZUNO, T. 335
MIZUTANI, M. 306
MOCHIDA, S. 92
MOCHIDA, S. 93
MOCHIZUKI, M. 353
MONOI, H. 10
MORI, H. 27
MORI, H. 57
MORI, J. 81
MORI, J. 156
MORI, N. 375
MORI, S. 175
MORI, S. 379
MORII, M. 48
MORIMOTO, A. 438
MORIMOTO, S. 422
MORIMOTO, T. 6
MORIMOTO, T. 32
MORIMOTO, T. 75
MORIMOTO, T. 134
MORIMOTO, T. 343
MORITA, F. 214
MORITA, K. 94
MORITA, Y. 203
MORIYA, M. 276
MOROOKA, N. 335
MOROOKA, N. 336
MOTOKIZAWA, F. 257
MUNEOKA, Y. 283
MURAI, M. 251
MURAKAMI, M. 57
MURAKAMI, M. 27
MURAKAMI, M. 206
MURAKAMI, N. 438
MURAKAMI, N. 449
MURAKAMI, N. 445
MURAKAMI, S. 125
MURAKAMI, T. 139
MURAKAMI, T. H. 177
MURAMOTO, K. 140
MURATA, K. 227
MURAYAMA, H. 335
MURAYAMA, K. 60
MURAYAMA, K. 52
MURAYAMA, N. 239

N

NAGAI, I. 274
NAGAI, K. 351
NAGAI, K. 25
NAGAI, M. 314
NAGAI, T. 237
NAGAI, T. 274
NAGAI, T. 385
NAGAIKE, K. 142
NAGAMATSU, Y. 373
NAGAMI, K. 412
NAGAMI, K. 41
NAGAOKA, S. 16
NAGAOKA, S. 15
NAGASAKA, T. 428
NAGASAKA, T. 442
NAGASAKI, H. 471
NAGASAWA, T. 365
NAGASHIMA, CH. 342
NAGATA, K. 469
NAGATA, T. 214

NAGATA, T. 216
NAGATA, Y. 33
NAGATA, Y. 170
NAGAYOSHI, M. 169
NAITO, H. 165
NAITO, K. 46
NAKADA, H. 35
NAKAGAKI, I. 80
NAKAGAKI, I. 27
NAKAHARA, T. 169
NAKAHARI, T. 57
NAKAI, Y. 303
NAKAJIMA, H. 113
NAKAJIMA, Y. 116
NAKAMORI, H. 24
NAKAMURA, H. 2
NAKAMURA, H. 316
NAKAMURA, T. 203
NAKAMURA, Y. 137
NAKANO, S. 412
NAKANO, S. 41
NAKAO, S. 130
NAKASE, Y. 36
NAKASHIMA, T. 447
NAKASHIMA, T. 446
NAKASHIZU, Y. 139
NAKATSUKA, K. 160
NAKAYA, M. 419
NAKAYA, S. 358
NAKAYAMA, A. 335
NAKAYAMA, H. 366
NAKAYAMA, H. 426
NAKAYAMA, S. 306
NAKAYAMA, S. 307
NAKAYAMA, T. 450
NAKAYAMA, T. 444
NAKAYAMA, Y. 284
NAKAZAWA, K. 33
NANBA, T. 33
NARA, Y. 340
NARITA, K. 98
NARUSAWA, M. 412
NARUSAWA, M. 41
NASU, Y. 279
NEGI, T. 215
NEGORO, H. 403
NEYA, T. 307
NEZU, E. 395
NIIJIMA, A. 396
NIIJIMA, A. 323
NIIMI, H. 328
NIIZEKI, K. 353
NINOMIYA, I. 331
NISHI, K. 62
NISHI, S. 105
NISHI, S. 309
NISHIKAWA, H. 11
NISHIKAWA, H. 75
NISHIKAWA, H. 32
NISHIKAWA, H. 6
NISHIKAWA, Y. 120
NISHIKAWA, Y. 367
NISHIMURA, S. 56
NISHINA, Y. 12
NISHINA, Y. 13
NISHINO, H. 140
NISHINO, T. 382
NISHIO, K. 60
NISHIO, K. 52
NISHIURA, K. 165
NISHIURA, N. 331
NISHIYAMA, A. 26
NISHIYAMA, A. 28
NIWA, A. 103
NIWA, K. 444
NODA, K. 425
NOGUCHI, T. 411
NOHMI, M. 54
NOMA, A. 294
NOMA, A. 298
NOMOTO, T. 408
NOMURA, H. 333
NOMURA, H. 233
NOMURA, M. 170
NOSE, H. 343
NOTSU, T. 171
NUMAO, Y. 317

O

OBARA, S. 95
OBARA, S. 96
OBATA, K. 176
OCHI, K. 289
OCHI, R. 300
ODA, Y. 171
ODAGIRI, M. 144
OGASAWARA, T. 281
OGASAWARA, T. 465
OGAWA, A. 356
OGAWA, H. 240
OGAWA, K. 401
OGAWA, K. 426
OGAWA, M. 18
OGAWA, M. 40
OGAWA, S. 443
OGAWA, T. 185
OGAWA, T. 187
OGAWA, T. 453
OGAWA, T. 454
OGAWA, Y. 413
OGAWA, Y. 422
OGAWARA, M. 369
OGO, K. 359
OGO, K. 416
OHARA, K. 440
OHARA, K. 452
O'HATA, S. 38
O'HATA, S. 39
OHBA, M. 290
OHGA, Y. 350
OHHASHI, T. 277
OHHASHI, T. 338
OHHASHI, T. 344
OHKAWA, H. 305
OHKUSA, M. 236
OHNO, M. 125
OHNO, S. 120
OHNO, T. 200
OHNO, T. 456
OHNO, T. 457
OHSAWA, K. 42

OHTA, K. 4
OHTA, K. 136
OHTAKE, H. 22
OHTSUKA, T. 199
OHWATARI, N. 448
OHYE, C. 113
OIKAWA, T. 159
OISO, Y. 426
OKA, Y. 23
OKADA, H. 318
OKADA, J. 315
OKADA, Y. 421
OKADA, Y. 397
OKADA, Y. 106
OKADA, Y. 80
OKADA, Y. 398
OKADA, Y. 331
OKAI, O. 332
OKAMOTO, U. 373
OKAMOTO, Y. 295
OKAZAKI, S. 426
OKUBO, J. 345
OKUBO, S. 364
OKUDA, N. 452
OMOTO, M. 376
ONAI, T. 315
ONISHI, M. 29
ONISHI, M. 56
ONO, K. 160
ONO, T. 140
ONODA, N. 258
ONODERA, K. 100
ONOZUKA, M. 65
ONOZUKA, M. 66
OOMURA, Y. 141
OOMURA, Y. 409
OOMURA, Y. 323
OOTA, H. 474
OOTA, I. 274
OOYAMA, H. 224
OOYAMA, H. 225
ORI, M. 19
OSA, T. 281
OSADA, Y. 443
OSHIBA, S. 371
OSHIBA, S. 372
OZAKI, A. 146
OZAKI, H. 157
OZAKI, T. 163
OZAKI, T. 164
OZAWA, S. 407

P

PLESCHKA, K. 314
PRESTON, J. B. 118

S

SAEDA, Y. 374
SAEKI, M. 35
SAEKI, Y. 292
SAGAWA, S. 366
SAGAWA, S. 427
SAIKI, H. 419
SAITO, A. 59
SAITO, H. 138
SAITO, H. 432
SAITO, M. 115
SAITO, M. 332
SAITO, T. 53
SAITO, T. 77
SAITO, T. 78
SAITO, T. 335
SAITO, T. 337
SAITO, Y. 47
SAITOH, K. 218
SAITOH, K. 219
SAJI, M. 176
SAKADA, S. 74
SAKADA, S. 242
SAKAGUCHI, M. 338
SAKAGUCHI, T. 396
SAKAI, M. 148
SAKAI, S. 38
SAKAI, S. 37
SAKAI, T. 49
SAKAI, T. 83
SAKAI, T. 118
SAKAI, T. 119
SAKAI, T. 269
SAKAI, T. 385
SAKAI, Y. 280
SAKAKIBARA, M. 205
SAKAMOTO, S. 433
SAKAMOTO, S. 435
SAKAMOTO, Y. 279
SAKAN, I. 134
SAKATA, H. 184
SAKATA, Y. 438
SAKATA, Y. 449
SAMEJIMA, A. 152
SAMEJIMA, C. 425
SANO, A. 470
SANO, M. 84
SARASHI, A. 365
SASAKI, D. 163
SASAKI, K. 109
SASAKI, K. 140
SASAKI, K. 151
SASAKI, M. 181
SASAKI, S. 27
SASAKI, S. 80
SASAKI, S. 128
SASAKI, S. 164
SASAKI, T. 467
SATO, A. 4
SATO, A. 316
SATO, A. 136
SATO, A. 321
SATO, H. 452
SATO, M. 109
SATO, M. 308
SATO, M. 311
SATO, S. 445
SATO, T. 340
SATO, T. 79
SATO, T. 186
SATO, T. 236
SATO, T. 250
SATO, T. 252
SATO, T. 253
SATO, T. 431
SATO, Y. 143

SATO, Y. 270
SATO, Y. 272
SATO, Y. 316
SATOU, M. 255
SATOYOSHI, M. 413
SAWADA, S. 211
SAWAI, H. 371
SAWAI, H. 372
SAWAMURA, T. 35
SAWANOBORI, K. 339
SAWANOBORI, T. 299
SEGUCHI, H. 18
SEKI, S. 474
SEKI, T. 369
SEO, Y. 6
SETO, K. 138
SETO, K. 432
SEYAMA, I. 76
SHIBA, T. 376
SHIBA, Y. 283
SHIBA, Y. 19
SHIBA, Y. 20
SHIBATA, H. 428
SHIBATA, H. 442
SHIBATA, M. 447
SHIBATA, M. 446
SHIBATA, T. 292
SHIBAYAMA, H. 418
SHIBAYAMA, R. 291
SHIBUKI, K. 183
SHIBUTANI, H. 184
SHIBUYA, I. 458
SHIBUYA, N. 90
SHIGA, K. 12
SHIGA, K. 13
SHIGA, T. 352
SHIGA, T. 368
SHIGUMA, M. 27
SHIMABUKURO, S. 356
SHIMADA, H. 362
SHIMADA, K. 381
SHIMAMURA, M. 85
SHIMAOKA, K. 387
SHIMIZU, H. 112
SHIMIZU, T. 333
SHIMODA, S. 391
SHIMODA, Y. 206
SHIMOJI, K. 155
SHIMOJI, K. 112
SHIMONO, T. 146
SHIMOTAHIRA, K. 238
SHIMUZU, N. 141
SHINAGAWA, Y. 8
SHINGAI, T. 319
SHIOTA, M. 423
SHIRAISHI, T. 393
SHIRAKI, K. 366
SHIRAKI, K. 427
SHIRATAKA, M. 340
SHUKUYA, M. 337
SIMADA, Z. 345
SOEDA, H. 425
SOGAMI, M. 15
SOGAMI, M. 16
SOMEI, K. 109
SORIMACHI, M. 56
SUDA, K. 188
SUDA, T. 352
SUDA, T. 368
SUDOH, M. 419
SUEDA, K. 401
SUEDA, K. 426
SUGA, H. 334
SUGAI, T. 224
SUGAI, T. 225
SUGANO, Y. 428
SUGANO, Y. 442
SUGAYA, A. 65
SUGAYA, A 66
SUGAYA, E. 65
SUGAYA, E. 66
SUGAWARA, K. 201
SUGENOYA, J. 453
SUGENOYA, J. 454
SUGI, H. 262
SUGI, H. 265
SUGI, H. 267
SUGIE, I. 374
SUGIMOTO, K. 236
SUGISAKI, T. 411
SUGITANI, M. 212
SUGITANI, M. 215
SUGIURA, T. 417
SUGIYAMA, H. 108
SUGIYAMA, Y. 335
SUMIDA, S. 417
SUMINO, R. 126
SUMITOMO, I. 212
SUNANO, S. 282
SUZUKI, H. 157
SUZUKI, H. 180
SUZUKI, H. 210
SUZUKI, H. 391
SUZUKI, M. 409
SUZUKI, M. 423
SUZUKI, N. 172
SUZUKI, N. 174
SUZUKI, S. 117
SUZUKI, T. 303
SUZUKI, T. 402
SUZUKI, T. A. 252
SUZUKI, T. A. 253

T

TABATA, M. 203
TADAKI, E. 322
TAIRA, K. 253
TAIRA, K. 252
TAIRA, N. 296
TAJIRI, E. 414
TAKABA, S. 430
TAKABA, S. 440
TAKADA, M. 45
TAKAFUJI, M. 241
TAKAGI, Y. 178
TAKAHASHI, A. 269
TAKAHASHI, F 21
TAKAHASHI, K. 61
TAKAHASHI, M. 472
TAKAHATA, M. 133
TAKAHIRA, H. 147
TAKAI, A. 304

TAKAI, H. 270
TAKAI, H. 272
TAKAKI, M. 307
TAKAMATSU, K. 142
TAKAMATSU, T. 253
TAKANASHI, Y. 174
TAKANASHI, Y. 172
TAKANO, N. 388
TAKASHIMA, S. 445
TAKASUGI, S. 313
TAKATA, M. 86
TAKEBAYASHI, M. 213
TAKEBAYASHI, M. 260
TAKEDA, K. 335
TAKEDA, K. 337
TAKEDA, K. 361
TAKEGAMI, T. 172
TAKEGAMI, T. 174
TAKEGUCHI, N. 48
TAKEMIYA, T. 342
TAKENAKA, T. 31
TAKENAKA, T. 69
TAKEO, T. 163
TAKEOKA, M. 347
TAKEOKA, M. 384
TAKESHIGE, C. 250
TAKESHIGE, C. 251
TAKEUCHI, A. 100
TAKEUCHI, H. 68
TAKEUCHI, H. 426
TAKEUCHI, N. 90
TAKEUCHI, T. 346
TAKEUCHI, Y. 124
TAKIKAWA, Y. 90
TAKIMORI, T. 185
TAMAGAWA, K. 2
TAMAI, Y. 36
TAMARU, M. 169
TAMEYASU, T. 267
TAMURA, H. 68
TAMURA, M. 353
TAMURA, T. 451
TAMURA, Y. 426
TANABE, S. 23
TANAKA, H. 135
TANAKA, H. 267
TANAKA, I. 198
TANAKA, I. 310
TANAKA, I. 360
TANAKA, I. 400
TANAKA, M. 251
TANAKA, M. 254
TANAKA, M. 451
TANAKA, N. 424
TANAKA, T. 107
TANAKA, T. 124
TANAKA, Y. 224
TANAKA, Y. 358
TANAKADATE, A. 466
TANASE, K. 356
TANGE, S. 384
TANIGUCHI, H. 397
TANIGUCHI, I. 220
TANIMOTO, Y. 370
TANISHIMA, F. 413
TANJI, J. 150
TANNEN, R. 354
TASAKI, K. 210
TASAKI, K. 465
TASHIRO, Y. 35
TATEDA, H. 192
TATEDA, H. 193
TATSUNO, J. 81
TATSUNO, J. 156
TAUCHI, M. 208
TAUCHI, M. 197
TAUCHI, M. 198
TAZAWA, H. 357
TERANISHI, S. 27
TERANISHI, Y. 348
TERAO, N. 354
TERASHIMA, S. 261
TERUI, N. 317
TODA, K. 135
TODA, K. 158
TODA, T. 414
TOGAWA, T. 451
TOJO, H. 13
TOJO, H. 12
TOKIMASA, T. 88
TOKIMOTO, T. 222
TOKUDA, M. 21
TOMITA, S. 350
TOMITA, T. 304
TOMITA, T. 279
TOMITA, T. 202
TOMIYA, H. 337
TOMIYAMA, T. 175
TONOIKE, M. 213
TONOIKE, M. 260
TONOOKA, M. 335
TONOOKA, M. 337
TONOUE, T. 408
TOSAKA, T. 92
TOYAMA, K. 183
TOYODA, A. 101
TOYODA, J. 209
TSUBOI, M. 435
TSUBOI, M. 433
TSUCHIYA, K. 441
TSUCHIYA, T. 263
TSUCHIYA, W. 80
TSUDA, T. 66
TSUDA, T. 65
TSUJI, S. 179
TSUJIMOTO, T. 36
TSUJITA, J. 424
TSUKADA, Y. 142
TSUKADA, Y. 411
TSUKADA, Y. 169
TSUKAHARA, N. 123
TSUKAHARA, N. 171
TSUKAHARA, Y. 194
TSUKAHARA, Y. 113
TSUKEDA, K. 204
TSUKUDA, K. 123
TSUMOTO, T. 188
TSUMURAYA, Y. 287
TSURUTANI, T. 444
TSURUTANI, T. 450
TSUZUKI, S. 467
TYUMA, I. 349

U

UCHIDA, T. 172
UCHIDA, T. 174
UCHINO, K. 439
UCHIYAMA, H. 228
UEDA, G. 347
UEDA, G. 384
UEDA, K. 237
UEDA, K. 255
UEDA, Y. 349
UEHA, T. 410
UEHARA, S. 70
UEMURA, K. 118
UEMURA, K. 145
UEZU, E. 470
UMAZUME, Y. 268
UMEKITA, S. 96
UMEZU, M. 235
UMINO, O. 207
UOZUMI, M. 7
URATA, M. 302
USHIJIMA, H. 309
USHIKOSHI, A. 138
USHIKOSHI, A. 432
USUI, S. 269
UYEMURA, K. 70

W

WADA, M. 421
WADA, S. 287
WARASHINA, A. 9
WASHIO, H. 102
WATANABE, A. 83
WATANABE, A. 115
WATANABE, A. 332
WATANABE, J. 186
WATANABE, K. 425
WATANABE, K. 463
WATANABE, K. 464
WATANABE, M. 241
WATANABE, N. 474
WATANABE, S. 117
WATANABE, S. 154
WATANABE, S. 173
WATANABE, S. 336
WATANABE, T. 47
WATANABE, T. 167
WATANUKI, M. 424
WATARI, H. 11
WATARI, H. 12
WATARI, H. 13
WILSON, V. J. 129
WUTTKE, W. 394

Y

YABU, H. 276
YADA, T. 80
YAGI, K. 104
YAGI, N. 266
YAGISHITA, Y. 310
YAHATA, T. 457
YAHATA, T. 456
YAJIMA, Y. 216
YAMABE, K. 323
YAMABE, K. 141
YAMADA, E. 292
YAMADA, K. 66
YAMADA, K. 264
YAMADA, M. 197
YAMADA, S. 343
YAMADA, T. 235
YAMADA, T. 417
YAMAGAMI, K. 56
YAMAGISHI, S. 67
YAMAGUCHI, H. 23
YAMAGUCHI, K. 255
YAMAGUCHI, K. 396
YAMAGUCHI, N. 243
YAMAGUCHI, T. 275
YAMAGUCHI, T. 177
YAMAGUCHI, Y. 248
YAMAJI, K. 173
YAMAKAWA, T. 328
YAMAMOTO, C. 211
YAMAMOTO, D. 102
YAMAMOTO, H. 374
YAMAMOTO, J. 373
YAMAMOTO, K. 425
YAMAMOTO, K. 144
YAMAMOTO, K. 399
YAMAMOTO, M. 426
YAMAMOTO, M. 79
YAMAMOTO, S. 312
YAMAMOTO, T. 320
YAMAMOTO, T. 74
YAMAMOTO, T. 152
YAMAMOTO, Y. 172
YAMAMOTO, Y. 174
YAMANE, M. 329
YAMANE, S. 190
YAMAO, M. 38
YAMAO, M. 37
YAMAOKA, S. 462
YAMASHITA, ER. 406
YAMASHITA, H. 389
YAMASHITA, K. 406
YAMASHITA, M. 181
YAMASHITA, N. 61
YAMASHITA, S. 193
YAMASHITA, S. 232
YAMASHITA, Y. 327
YAMAZAKI, S. 79
YAMAZAKI, S. 420
YAMAZAKI, S. 242
YANAGIDAIRA, Y. 384
YANAGISAWA, K. 223
YANAGISAWA, T. 300
YANAGISAWA, T. 296
YANAIHARA, N. 393
YANO, J. 225
YANO, J. 224
YASUHARA, M. 165
YATANI, A. 288
YATANI, A. 302
YAWO, H. 80
YOKOTA, T. 127
YOKOTA, T. 120
YOKOUCHI, M. 369
YOKOYAMA, N. 34
YOKOYAMA, T. 145
YONEDA, T. 415

YONEMURA, I. 384
YONEMURA, K. 310
YONEMURA, K. 360
YONEZAWA, H. 59
YONEZAWA, H. 458
YONEZAWA, N. 230
YONEZU, T. 23
YOSHIDA, H. 336
YOSHIDA, K. 451
YOSHIDA, K. 128
YOSHIDA, K. 443
YOSHIDA, M. 280
YOSHIDA, M. 5
YOSHIHARA, M. 139
YOSHII, M. 61
YOSHIMATSU, H. 323
YOSHIMATSU, H. 141
YOSHIMURA, K. 395
YOSHIOKA, T. 31
YOSHIOKA, T. 268
YOSHIOKA, T. 69
YOSHIOKA, T. 41
YOSHIOKA, T. 412
YOSHIZAKI, K. 311
YOSHIZAKI, K. 308
YOSHIZAKI, K. 75
YOSHIZAKI, K. 6
YOSHIZAKI, K. 32
YUKIE, M. 168
YUMURA, Y. 335
YUSA, S. 413

生理学教育シンポジウム

——VTR利用による生理学教育——

千葉大，医，生理
司会 本間三郎
慈恵医大，生理
司会 酒井敏夫

生理学教育委員会は，すでに出版した生理学実習書を中心に，2つの主要テーマの実現に努力してきた．第1の課題は，生理学実習書の英訳を行い，海外にその評価を問うことである．しかし，英訳は考えることは容易でも，その仕事は難業で直ちに完成させるにも幾多の問題が横たわっている．その英訳書の改訂が必要であるとの意見が強い．そこで委員会は，現実習書の完訳のための準備として，その抄訳を委員の手で行い，ブタペストの国際生理科学会議に展示することを企図した．この事は，勝木先生からの要請でもあり，早速この計画を実現させた．第2の課題は，生理学実習書内の幾つかの項目をVTRとして，実習書の利用を一層高めることであった．生理学実習におけるVTR利用の開発に関しては，本間が中心となり，昭和54年度 科学研究費補助金 総合研究 (A) "VTRによる生理学実習教育メディアの開放研究" が大きな推進力になった．今回の教育シンポジウムには，その1，2が紹介されるが，このほか各班員が1本ずつ，班研究成果として製作した．班研究の分担研究者には，現教育委員会委員全員が参加した．

このほか，すでに生理学実習の現場でVTRの利用を行っておられる畠山教授，伊藤文雄教授には，その中の一部をデモンストレートしていただいた．短時間の持時間の中では，製作された内容をすべて映写することが困難であったので，製作および利用にまつわる問題点の解説を中心にシンポジウムが行われた．製作されたVTRは，生理学実習書の姉妹編として，ブタペストの生理学教育コーナーにも紹介することになっている．近々のうちに，これらの製作されたVTRのリストを日本生理学会の各位に送り，希望される方には実費でリプリントをお分けする段取りになっている．

骨格筋の活動電位

帝京大，医，生理
杉晴夫
小林孝和

このたび総合研究 (A)，VTRによる生理学実習教育メディアの開発研究班よりの補助金により骨格筋の活動電位の記録の実習に使用するVTRを作製したので，これにつき簡単に説明する．

本学の医学部学生は一学年約130～150名であり，学生を10のグループに分け10項目の実習をグループをrotateさせつつ10日間にわたり実施している．したがって1つのグループの人数は12～14名となる．骨格筋の活動電位の場合，実験装置2セットを準備しグループをさらに2つのサブグループに分けているが，それでも7，8名の学生にたいし上記の項目の実習をおこなうには多くの問題がある．たとえば筋神経試料の作製，微小電極の製作，3MKCl の充てん，電極の刺入，刺激装置，前置増幅器，オシロスコープ等の操作等の説明を7，8名の学生に円滑に一度におこなうことはできず，2，3名の学生にたいして反復して同じ説明をくり返さねばならない．したがって，上記の実験手順に関するVTRを作製し，実習開始前にこれを映写することは実習時間の短縮と実

習担当者の労力を大いに軽減することになる．当教室には16ミリ映写器があるが，VTR は各教室に備えられていないので，本 VTR のオリジナルは16ミリフィルムである．16ミリフィルムは解像力，鮮明さにおいて VTR よりすぐれているが，反復映写の容易さ等で後者におよばない．また，この VTR は音声は録音せず，説明はそのつど実習指導者にまかせるようにしてある．音声の有無にもそれぞれ一長一短があると考えられる．

Tendon Reflex

千葉大，医，生理
本　間　三　郎

目的：臨床的に用いられている腱反射検査法を実習する．腱が叩かれることにより，筋中の筋紡錘が引き伸ばされ，一次終末が反応する．そこからでる第Ⅰ群ａ線維にインパルスが発生し，脊髄にいたり単シナプス性にｄ運動ニューロンに興奮性シナプス後電位（EPSP）を発生する．個々の EPSP が加重し，それが臨界膜電位に達すると運動ニューロンは発射し，それが下行して筋にいたり，筋が収縮する．腱反射は伸張反射の活動により起こる．ヒトの腱反射を実習することにより，伸張反射の機構を知り，インパルスの伝導，伝達および反射中枢における促進や抑制について考察する．全身のいろいろの筋について腱反射を試み，その反射中枢のある脊髄分節の位置を勉強する．

実習編：ビデオは腱反射実施法を示す．ハンマーと診療用ベッドを用意し，被検者となる学生はショートパンツを着用する．膝反射法を示し，この反射の刺激閾値をきめる．閾値の高低，反応の高進から臨床における記録法を実習する．反射増強法を試みる．アキレス腱反射も試み，その他上腕二頭筋反射，上腕三頭筋反射，橈骨反射を行う．

問答編：腱反射の機構を知るため，筋紡錘に関する学習がはじまる．筋が引き伸ばされると，第Ⅰ群ａ線維にインパルスが発生し，筋が伸ばされるほどインパルス頻度が増すことを知る．インパルスの伝導速度が学習された後，反射弓の機構が説明され，膝反射中枢がどの高さの脊髄分節にあるかが問われる．アキレス腱反射中枢の分節位置も質問され，正解が出されれば伸張反射の機構へと進む．

姿勢制御が説明されたあと，過剰反応として疾患における間代性収縮が示される．最後に伸張反射機構を理解するための数個の設問がなされている．

筋紡錘からの求心性発射

名大，医，生理
伊　藤　文　雄

目的：この実習では感覚器からの求心性放電を観察する１つの例として，比較的容易に単位放電が記録でき，且つ刺激の大きさを変えられる筋紡錘を用いた．学生はこの実習から感覚の順応の時間的経過を学び，更に刺激の大きさの対数にほぼ比例して求心性放電頻度が高まることを理解する．学生は実習前，および学習中も適時ビデオにて実習の方法を修得し，またビデオの最後では実習のまとめについての指針も収録されているので，教官による直接指導の必要はない．そこで教官３人で50人の学生の10項目にわたる実習の指導も可能になった．

特色：1）学生でも容易に単一求心性放電が記録できるような標本の作り方を示している．2）神経幹はパラフィン隔絶されているので，３時間にもおよぶ反復実験中にも乾燥するようなことは

ない．3) 筋の伸張（刺激の大きさ）が大幅に，且つ適宜変えられる．単純な装置であるから自家製で充分であり，且つ学生にアイデアの必要性を教えるものである．4) この実験では記録紙も不要であり，また現像の必要もない．学生は電子カウンター（自家製）で1秒毎の放電頻度を読み，他の1人がノートに記載する．5) 原紙1枚のポスターを用意して，ビデオで説明できない点などを示してある．

改良点：1) 学生レポート中で優秀なものを例としてビデオの最後か，ポスターに提示すると，学生にとっては良い参考になる．2) 将来は学生が実際に実習している場面を挿入し，学生自身に作らせると一層親密感を持つと考える．毎年一項目ずつ，このようにして改訂しようと計画している．

心送血量の間接測定

山形大，医，生理
望月政司
田沢皓

肺内ガス交換に関する生理学実習の項目は，欧米はじめ我が国でも，呼気ガス分析の実際を練習するのがせいぜいであった．幸い，O_2/CO_2 分析装置も開発されたので，心送血量の間接測定法を実習に採り入れて見た．また，今回は VTR を解説の補助手段として利用し，実習への理解を速める努力をも行った．ガス交換に関する真の理解は，換気面ばかりではなく，灌血面での知識を得てはじめて達成される．この意味でこれまで長期に亘り測定法の確立が要望されてきたが，高精度の測定は得られていなかった．最近著者らは，肺胞気 Pco_2 を静脈血 Pco_2 より低い範囲に保ちながら再呼吸を行わせ，呼気 CO_2 曲線から静脈血 Pco_2 を推定する方法を開発することができた．そこでその方法を実習に用い，心送血量の精度測定を試みた．

実習項目は心送血量の測定であるが，学生はそれと関連して，CO_2 排泄量，O_2 摂取量，肺胞気および静脈血 Pco_2，換気量などの測定法を習得しなければならず，その他，CO_2 解離曲線，Fick の原理，Haldane 効果などの基礎知識も得ておかねばならない．したがって，本実習を習得することは，呼吸生理学のかなり広い分野を学習することになる．肺胞気—および静脈血 Pco_2 の測定値などの心送血量におよぼす誤差は結構大きい．そこで，丁寧に実験操作を繰り返すことへの配慮，また，know-how 的技術の習得も重要になってくる．この意味で，今回，測定操作を極めて理解し易く解説した VTR を作ったことは，実習に対する理解を深める以上に，精度を高めるのにも大いに役立つものと思われる．本実習では，学生が交互に被験者になって実験を行うので，相互の信頼を得るためにも，また，協力の精神を培う上でも，測定精度を高めることは効果的である．この目的を達成するためにも，この VTR が役立てば，また大いなる幸いである．

呼吸運動に対する迷走神経の役割

慈恵医大，生理
酒井敏夫
本間生夫
小林啓三

生理学実習書の「家兎を用いての呼吸・循環調節の実験」に沿って VTR は作製された．学生が動物実験をする場合，実験手技にはいるまでの麻酔，手術操作に時間がかかる．呼吸の実験に限ら

ず，前段階は全ての動物実験にほぼ共通している．そこで30分のVTRのうち前半の15分程，手術操作を供覧している．VTRでは実験結果を示すことより，くわしい操作の供覧のほうが，学生は何回でもその部を繰り返し観察できるので有意義である．VTRの最後には設問がはいっている．解答がわからない場合にはVTRを前に戻して，そのPartをよく観察すればわかるようになっている．ビデコーダーには，auto search controllerが付いており，VTRテープの好きな番地を呼び出すことができる．あらかじめ各項目と番地を定めておけばVTRの操作は非常に楽である．

VTRの製作には後からミキシングできるという利点がある．この実験においても，血圧の連続記録を見せながら，総頸動脈の結紮解除の操作を間にはさんだ．言葉で手技を説明するより，血管鉗子を見せて動脈の閉鎖を見せた方が印象深い．

VTRの実験の最後の項目は横隔神経のneurogramを記録し，肺迷走神経反射，特にHering-Breuer intlation retlexを供覧している．この神経露出の手技は学生で，しかも1回限りの実習では不可能に近い．しかし，肺伸展受容器の興奮による吸息抑制反射の理解には大変都合が良く，実習以外にも講義の補助として，VTRは広く使えるものと思う．

反転洞房試料の実習

埼玉医大，第二生理
林　秀生
堀内噎子
有田彰
高山和恵

このビデオテープレコーディングは，入沢教授の代理で1979年に行われたものである．内容は日本生理学会編集の生理学実習書中の項目とほぼ同一であり，心筋の機械的活動に関する実習である．反転洞房試料の特徴は，脂肪層を含む厚い心外膜を反転操作により内側に向け，薄い心内膜を外側に向けることにより，イオン環境の変化や薬物投与の効果を，試料の外側の液を変えることにより，容易に観察できる点である．この示説では，試料作製過程を省略して，Frank-Starling機構と液温変化のビデオを供覧する．

まずこのビデオ作製上の問題点を列記する．

1) テープ幅と録画方式に関しては，1/2″幅で録画されたテープは，1/2″用編集機がないために，3/4″U規格のテープに一旦移した後に編集を行ったので，画質劣化をきたした．

2) auto gain controlのついた機械を使用したため，silentな時期から音声が始まる時に音量が著しく大となる現象が発生した．

3) グラフの線が細く，かつ文字が小さくて数が多いので非常に見難い．以上は次回に改善の予定である．

ビデオは，学生が実習前にこれを見ることによって，1．試料作製の具体的手技を知り，2．どんな実習をするかについて概念を得ることが可能となる．又各項目に関連して質問がなされているので，問題の把握が容易となる．

本実習ではDiastolic Volume, Heart Rate, Stroke Volume, Minute Volumeの4つの量を測定する．実習項目としては1．内圧を変えてFrank-Starling機構を確める．2．液温を変えてHeart Rateの温度係数を求める．3．Caおよび　4．アセチルコリンとアドレナリンの収縮と拍動数とに対する効果を調べる，をとりあげている．データを直ちにグラフ化でき，具体的に討論できる点が，本実習の大きな特色である．

心筋の自動性と収縮性

北里大，医，生理
畠山一平

北里大学医学部の生理学実習室には建設当時からTVシステムをも含む情報システムが組み込まれている．すでに8年間の経験を持つが，ほとんどすべての生理学実習項目にTV放送システムが活用されている．26組のビデオ機器をも含む同一構成の実習機器システムは実習室内示説実験室に備えた中央装置により制御される．ビデオ信号は綜合的な大規模放送機構である「映像情報センター」からの送信を受けることもできるし，実習室内放送システムを活用し実況放送あるいはVTRによるビデオテープ再生を行なうこともできる．いずれの場合も最大5通りの異なった内容のものを同時に送ることができる．そのため実習システム26組をあらかじめ5群に分け，それらの群の中のどれにどのような信号を送るかを制御するマトリックス板が備えられている．

「心筋の自動性と収縮性」と題する実習は1日約4時間を所要時間とし2日間にわたり実施しているものである．今回供覧するのはその第1部であり，主としてウシガエルの遊離心室標本の作成手技を解説したものである．全か無法則，階段現象，収縮力学，心室筋の特徴を実地に理解することを目的とする．この実験の後同じくウシガエルの洞房標本について基本的な観察を行なわせている．この場合には期外収縮，不応期について理解を深めると共に活動電位記録により洞心房間の興奮伝導時間を測定し神経伝達物質の作用を検討する．まとめとして，心室筋との性質の違いという点から第1部の実験結果との比較検討を行なう．実験手技上特記したいのは収縮曲線の記録法である．液面の移動を浮きの上下とし，独自の工夫になる偏位トランスデューサ（比較的大変位もまた微小偏位も測定できる）を用い容積曲線を記録しているので拍出量の変化を追うことができる．

〔生理学研究のあり方シンポジウム〕

問題の提起
——開会の言葉に代えて——

神戸大学
岡本彰祐

Ⅰ

日本生理学会大会における教育シンポジウムは，回を重ねるにつれて，ますますさかんになりつつあることは，まことに喜ぶべきことである．しかし，生理学教育のあり方という問題は，生理学研究のあり方と，ほとんど不可分に近い関係をもつものと考えられる．ここに，このシンポジウムを企画した第一の理由がある．

生理学研究のあり方を討議することは，その教育のあり方を討議することよりも，はるかに困難である．問題が複雑，多元的であること，また研究の本質という深遠なテーマにふれること，さらにまた，私共会員がこのような問題の討議に不慣れであることなどがあげられる．

幸いにも，本日のシンポジウムには，意外に多数の会員の御出席を得た．本日のシンポジウムのなにがしかの成果が今後の学会活動に継承されていくことを期待したい．

Ⅱ

生理学研究のあり方について，最近東南アジア諸国との医学研究の国際交流の準備をすすめる過程で痛感したことがある．（日本学術振興会が行う東南アジア諸国との医学研究者の国際交流において，神戸大学医学部は拠点校としての責務を負っている.）

それは，日本と東南アジア諸国との研究の基本姿勢の差異であって，日本の研究の主流が academic problem-oriented であるのに反して，東南アジアでは medical problem-oriented である．この喰い違いを解決するためには，medical problem を academic problem-oriented な日本の学者の前に示して，協力を願う方法が考えられている．

しかし程度の差こそあれ，同じようなことが，医学と生理学の間にあるように思える．英国の基礎研究と medical problem とのギャップが意識され，克服への努力が多年つづけられていることなど，改めて想起すべきであろう．

Ⅲ

研究のあり方には，研究の方法の論議がその中核にある．近年の日本の経済力の強化により，われわれの研究の困難さを単純に貧困の故とみなすことが許されなくなった．しかも現実に，各研究者の方法の差異により，研究の進展度に大きな差異が生じつつあることは明らかである．

この場合，研究の方法とは，テーマの選択，実験材料の選択，実験手段の創造，テーマと実験手技の結合のあり方などなどのほかに，如何にして情報の洪水のなかにあって創造性をつくり上げていくか，如何にして自己の立地条件を活かしていくかなどの諸問題がふくまれる．

いずれにせよ，研究の方法の差異により，各個人の研究の速度と創造性に，測り知れないほどの差異が生じることに間違いはない．

話題Ⅰ．大脳生理学の在り方

徳島大，医，生理
松本淳治

大脳生理学の研究あるいは教育はどうあるべきか，などについての定見を持ち合わせていないので私の来し方を話しました．

酸化還元電位から大脳へ，いわば分析から総合

へ研究領域が飛び移った形になっているが，研究思想的方法論としては細胞主義（パブロフ），研究実験的方法論としては細胞主義（ウィルヒョウ）に立ってきた．医学における大脳生理学は人間を対象としており，人間における諸現象を動物に投影して実験をしてきたが，絶えず人間⇄動物間を可逆的に観察してきた．

ちょっとした発見といえば，それは自然が与えてくれた失敗，偶然を見逃さなかったに過ぎず，諸先輩の寸言忘るべからず．

以上が話の筋でした．

話題Ⅱ．視細胞における光受容機構

神戸大，医，第二生理
塙　　功

視細胞における光エネルギーの電気エネルギーへの変換は視覚研究の中心課題の1つである．この機構に関しては古くから多くの仮説が提唱されてきたが，近年各種測定技術のめざましい進展に伴って，最近，発表された視細胞に関する形態学的，生化学的，電気生理学的研究成果は不十分ながらも，その問題解明に一歩ずつ近づきつつあるように感ぜられる．ここでは主として脊椎動物の視細胞，特に杆状体細胞における光受容機構に関する研究方法ならびに最近の知見について述べてみたい．

視細胞におけるエネルギー変換は，まず光エネルギーが外節円板膜上のロドプシンを異性化し，続いて視細胞電位に変換される．しかし円板膜と視細胞外節膜とは不連続であるため，この間を媒介する internal transmitter の存在が考えられるが，これに関して Ca^{++} (Hagins and Yoshikami, 1971) および Cyclic GMP (Bitensky ら 1971) が有力視されている．しかしいずれの物質が transmitter であるかについては，現在にいたるも研究者間に意見の一致が認められず，今後の新しい研究方法の開発が望まれる．

話題Ⅲ．内分泌生理学の研究から

群馬大，内分泌研，生理
山　本　　清

同じ生理学の研究であるから，他の領域の生理学研究と本質的に異るものではないが，内分泌生理には多少特殊な面もあるので，日ごろ考えていることのいくつかについて，この機会に申しのべる．

1．内分泌生理研究の対象について．ふつう内分泌腺の機能とホルモンの作用が研究対象とされているが，ホルモンの合成から分解排泄にいたるまでの全場面を，広く対象にとりあげたい．すなわち，ホルモン供給系としての内分泌腺，ホルモン運搬系としての体液，ホルモン受容反応系としての標的器官，ホルモン消却系としての分解排泄器官，これらすべてが研究対象として重要なものと考える．その上に，これらすべての器官にわたって，その機能を統御する調節系が，特に内分泌生理では重要な研究対象となる．このように，研究対象を分析して考えておくことは，それぞれの研究者が現に研究していることが，内分泌現象および生命現象全体のうちのどこに位置し，生体の全活動とどうかかわるかを認識する上で必要なことと思う．

2．内分泌機能の特性について．内分泌系は，神経系とともに，生体機能の2大調節系である．調節とは，単なる促進または抑制ではなく，ある状態が，生体の必要にとって低すぎる時は高め，高すぎる時は低めて，生体が置かれているその時々の状況に応じた機能状態を設定するということであって高度の生理機能ということができる．内

分泌系と神経系は緊密な協同関係にある．すなわち，体制神経系は外部環境の変化に，反射的または意識的な行動を以て対処し，内分泌系は自律神経系と共に，体制神経系による外部活動を可能にするような内部環境の自律的調整に当たるものである．両調節系が緊密な連けいをとるためには，両者を機能的に結びつける組織がなければならない．それが神経分泌細胞を含む視床下部である．神経分泌細胞は，一方では神経細胞としての性質によって上位からの神経性刺激を受けいれ，他方では内分泌細胞としての性質によって，神経性刺激を神経ホルモンの体液性刺激に転換して，支配下の内分泌系の機能を，受けいれた神経性刺激の性質と強度に応じて調整する．

3．内部環境の適応的変動と内分泌系の方向性調節について．生体の活動時には，その活動を支援するような調節が行われて，内部環境が変動する．この内部環境を適応的に変動させるのが内分泌系の大きな役割の1つである．この役割を果たすためには，外部環境の変化の質と量が，正しく内分泌系に伝えられる必要がある．外部刺激を受容した求心性神経情報が中枢神経系で処理され，体制神経系と自律神経系へ伝えられると同時に，視床下部の神経分泌細胞核と自律神経核を介して内分泌腺へ伝えられ，このことによって生体活動にふさわしい内部環境の適応的変動が起こる．この際，内分泌腺の機能は，中枢神経系の一方的支配下にある．すなわち，内分泌系は，刺激によって興奮または抑制されるという一方向きの方向性調節（feedforward regulation）を受けるのであって，生体の刺激-興奮系一般と異るところはない．この方向性調節は，刺激が有効な期間だけの時限的なものである．ここで方向性調節を強調するのは，次にのべる反回性調節と，それにもとづく内部環境の恒常性維持が強調される一方で，適応的変動を起こすという内分泌機能の重要な一面がほとんど無視されているからである．

4．内部環境の恒常性維持と内分泌系の反回性調節について．非活動安静時に内部環境の恒常性を維持する内分泌系の役割は広く認められている．恒常性が維持されるのは，外部環境に大きな変動がなく，したがって神経系からの刺激がとだえている期間に，内分泌腺と内部環境因子の間で，負の反回性調節（negative feedback regulation）が働くからである．この種の調節の一般形式は，因子Aに生じた変動が，因子Bに作用してBを変動させ，Bに起った変動が因子Aに反回作用して，因子Aに生じた変動を復元するというものである．因子Aの変動が復元すれば，因子Bへの作用が消滅し，したがって因子Bの変動も復元する．このようにして，AとBの両者は，どちらに変動が起っても，負の反回性調節関係で結ばれていることによって，いずれも一定の恒常的状態へ復帰することができる．生体内の反回性調節は，常に負の性格のものである．正の反回性調節（positive feedback regulation）ならば，Aに起った変動がBの変動をひき起こし，それがAに正の方向で反回作用すれば，Aの変動をさらに助長し，したがってBの変動も助長され，AとBの変化はとどまるところを知らないこととなる．いわゆる悪循環（circulus vitiosus）である．内分泌学の領域では，前述の刺激—興奮関係またはpositive feedforward regulationとして単純に理解できる現象を，原理的に生体ではありえないpositive feedback regulationと称して混乱をひき起していることが甚だ多いのであって，あいまいな概念の設定と乱用はさけなければならないことを痛感する．内分泌系の機能と内部環境を構成する諸因子は，持続的な負の反回性調節のもとにあるが，活動時に限って，時限的な方面性調節を受けて恒常性から一時的に逸脱する．しかし，活動が止めば，再び負の反回性調節によって恒常性へと回帰するのである．

5．In vitroとin vivoの研究について．内分泌系の機能は，上述のように，神経系からの刺激，および多くの内部環境因子から多重支配を受けている．また内分泌腺は相互に網の目のような複雑な関係で結ばれている．これは，機能調節系に必然的に内在するものである．調節するものが，調節されるものから正確な情報を受けとるのでなければ，適確な調節をおよぼすことはできないものであり，調節されるものからの情報はすべて，調節するものの機能に必然的に影響するからである．内分泌腺と多くの因子との間の関係を，1対1の単純な対応に分解して実証するには，in vitroの分析的研究が必要となる．これが，内分泌生理学の研究では，in vitroの研究が特に重要視される理由である．ただし，in vitroの研究成

果を in vivo の現象の解釈に適用するには，きびしい制限があることを知らねばならない．In vitro で確認された機構は，in vivo でも働いていることは確実であるが，in vivo では，その機構の展開を変貌させる因子，甚しい時は完全に抑圧してしまう因子がいくつもありうる．研究者にとって既知の条件は，研究に際して除外するかまたは考慮にいれて処理することができるが，未知の条件または因子については手のつけようがない．そうした未知の条件が存在する限り，in vitro の研究は，in vivo の事実をそのまま反映するものではないのであるから，すべて模型実験と考えておくのが安全である．模型実験の結果から生体内の現実に近づくためには，互いに矛盾しない多くの傍証と生命現象全般についての考慮を背景とする思索を必要とする．

6．生理学的思索の重要性について．研究によって明らかにされた事実を提示羅列することで満足するのではなく，既知の事実と関連させて総合的に思索することによって，はじめて研究結果の生理的意義が明らかになる．最近の放射免疫測定法の開発によって，超微量のホルモンの測定が容易になったことは結構であるが，測定結果に立脚した思索がおろそかにされてはならない．たとえば，内分泌腺内のホルモン量の測定から，内分泌腺のホルモン合成機能と分泌機能をいうことは，原理的に不可能であることはいうまでもないのであって，他の傍証的事実とあわせて思索してはじめて，測定結果の生理的意義が明らかになる．また，実験によって確認できる事実であっても，生理学の一般概念に適合しないことが思索によって明瞭になれば，生理的に意義のないものとして排除されなければならない．以上は，実験事実の解釈，意義づけにおける思索の重要性を示す例であるが，思索はまた研究を進める上でも大きな意味をもっている．実験に先だって作業仮説をたてる場合にも思索を必要とするが，考えては実験し，実験しては考えているうちに，事実に測した思索が進んで，実験が一段落する頃には，考えがある程度固まっているし，次の研究の方向と段どりも，はっきりした姿をとりはじめているということになり，個性的な研究を展開してゆく上で，思索の重要なことはいうまでもない．以上は，生理学の研究者にとっては自明のことであるが，多くの関連領域の研究者を擁する内分泌学界では，しばしば痛感するので，特につけ加えた．

以上のように話の要点をまとめて見たが，要約したために具体性を欠き，わかりにくいものになったことをおそれる．多少とも参考になれば幸いである．

〔会　報〕

日本生理学会昭和55年度第1回常任幹事会議事要録

日　時：昭和55年3月26日(水)　午後2時～6時
会　場：神戸大学医学部大会議室
出席者：加藤正道，広重　力，田崎京二，高木貞敬，本間三郎，伊藤正男，佐藤昌康，酒井敏夫，島津　浩，塚田裕三，古河太郎，星　猛，真島英信，内藤耕二，大原孝吉，御手洗玄洋，宮川　清，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，纐纈教三，塙　功
議　長：岡本彰祐（当番幹事）

Ⅰ．報　告

1. 庶務報告(伊藤庶務幹事)：昭和55年1月より3月の期間入会55名，退会74名（物故者なし）の移動があり，現在会員総数2,904（評議員数792名，特別会員20名含）を数えることが報告された．

第21回日本医学会総会が昭和58年4月8日(金)～4月10日(日)大阪で開催されることが報告された．

学術会議々員選挙に関しては，生理学会関係の人は学会での後援を予定していることが報告された．

山田財団へは3件申請されたが，採択されなかったことが報告された．

2. 会計報告(星会計幹事)：昭和54年度決算が報告された．収入の部では生理学実習書売上げによる印税は減収したが，未納会費の徴収により会費収入は1,626,421円増加し，支出の部では通信費，会合費，旅費などの節約により54年度は1,875,904円の黒字を計上し昭和55年度繰越金総額3,502,325円となることが報告された．

3. 日本生理学雑誌編集報告（塚田編集幹事)：ISSnumberを記すことにしたこと，54年度41巻総頁数730頁となった（40巻は626頁）こと，現在42巻4号を印刷中であること，表題集に関して53～54年度は教室負担としたが，校費で支払うことができない教室もあったため委員会で検討した結果，55年度以降再び生理学会負担に戻すことにしたことなどが報告された．

表題集の記録は，日生誌に準じて記録してほしいとの要請があった．

4. JJP編集会計報告(真島編集委員長)：編集委員高木健太郎が3月15日より本田良行に変更されたこと，無麻酔実験による報告は国際慣行に従い原則として採用しないこと，しかしEthical Committeeに相当するものの許可があれば採用される場合もあること，JJP刊行部数は1,400部であり，そのうち国内で827部，外国で508部購買または寄贈されていること，55年度は国内会員購買費は6,000円で据置くが，外国会員の購買費は68$より80$に値上げすること，などが報告された．

5. 生理学教育委員会報告(大村委員長)：日本生理学会編集生理学実習書の英訳が完成し，Cardiac functions, Renal function and regulation of body fluid (Experiments on human subjects) およびMechanical response of skeletal muscleの項については全訳がなされたこと，心臓機能，呼吸，脊髄反射および誘発電位の実験に関してはVideoが完成したことおよびこれらはブタペストの国際生理科学連合の教育のExhibitionに発表される予定であることなどが報告された．

英訳した生理学実習書の印刷費，入手希望者への配布方法（無料か有料かその他）についての討論があった．

6. 会則委員会報告(島津委員長)：とくに会則上の問題がなかった旨が報告された．

7. 研究費委員会報告(田崎委員長)：文部省科学研究費補助金に係る意見調査依頼が日本学術会議よりあったことが報告され，委員長より各幹事にこの件は学会の意見として答える内容のものであるので，各常任幹事の意見を知らせてほしいとの要請があった．

本間常任幹事からは本間学術会員が報告すべきことについても附記してほしいとの発言があった.

8. 昭和55年度科学研究費補助金の配分について(高木二段審査委員):3部門に公平になるように努力していることが報告された.

9. 評議員選考委員会および評議員(1980年度)推薦候補者報告(真島委員長):会則内規の評議員選考基準の項における多年とは満3年以上のことであり,満5年以上の研究歴があるものとは医科系の研究者に適用されるものであって他学部においては7年以上の研究歴をもつ研究者であるという基準が再確認された.

1980年度評議員候補者として47名が提出された.いずれも前記基準を満す研究者であることが報告された.

10. 交流委員会報告(内薗委員長):交流委員会の所期の目的は一応達成されたと思われるので,交流委員会の解散と改組を考えたい旨,報告された.

11. 国際交流委員会報告(本間委員長):国際交流基金の取扱いについておよび生理学国際交流委員会の件について報告された.

12. 生理学用語委員会報告(酒井委員長):昭和55年1月生理学用語集に関するアンケート調査を行い,この機会に「第4次生理学用語集への覚え書」を作製したことが報告され,次に本委員会の活動に際して委員会運営費が必要となるのでこの経費の承認を得たいとの提案があった.

13. 国際生理科学連合および生理科学研究連絡委員会報告(勝木理事):IUPS 大会への中国の招待につき IUPS Councel meeting から我国の意見を求められ,勝木理事は中国の希望を満す事が台湾の意見を重んずるよりも重要であろうと回答したことが報告され,中国の参加問題,特に台湾との関係についてはブタペストでの会議に参加する5人に委任してほしいとの提案があった.

1986年または1989年の IUPS 日本開催の可能性について議論があった.

14. 日本生理学史編集委員会報告(名取委員長):編集の段階に入っていないことが報告された.

15. 第58回(昭和56年)日本生理学大会に関する報告(松本幹事):昭和56年4月1,2,3日徳島郷土文化会館で開催することが報告された.

16. 第57回日本生理学大会に関する報告(岡本当番幹事):出席者約1,400名,口演286題,ポスターシンポジウム展示187題,計473題が発表されることが報告された.

Ⅱ. 議 題

1. 前回議事録が承認された.

2. 昭和55年度予算案が承認された.振替手数料を自己負担にするように検討することが決議された.

3. 昭和56年度会費値上げについて:56年度から一般6,000円,準会員8,000円に値上げすることが承認された.

4. JJP 会費値上げについて:56年度から7,000円に値上げすることが承認された.

5. 特別会員推薦について:高木健太郎教授の特別会員推薦について中山幹事より説明があり承認された.

6. 名誉会員推薦について:J. C. Eccles 教授の推薦が12名の会員よりなされ,承認された.

7. 会則変更について:5項の文中,会員は年額5,000円を6,000円に,準会員として年額5,000円を8,000円に変更することが承認された.

8. 交流委員会の改組について:交流委員会は今回提出された報告書をもって所期の任務が終了したので発展的に解散することが承認された.

9. 生理学用語委員会昭和55年度活動計画が承認された.

10. 教育委員会昭和55年度の活動計画が承認され,その活動資金の一部として国際交流基金より12,700円が支出されることが承認された.

11. 国際交流委員会昭和55年度の活動計画:海外的にも体面を保つ形態をとることができたので本委員会は解散することが承認された.

12. 第59回(昭和57年度)日本生理学大会に関する件:昭和57年度慶応大学で開催されることが承認された.

13. その他

第60回(昭和58年度)日本生理学大会は医学会総会との関連において関西地区で開催される可能性が附議された.

第57回日本生理学会評議員会および総会議事要旨

日　時：昭和55年3月28日　午後4時～5時30分
会　場：神戸大学講堂
出席者：400名
議長団：岡本彰祐，塙　　功（当番幹事）

議長は開会にあたって，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，評議員数および特別会員について報告がなされた．(表1)．

2) 昭和54年度会計決算報告（星会計幹事）：昭和54年度の決算報告がなされた．(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41巻（昭和54年度）の編集内容は次の通りであった．41巻1～12号（8・9号合併学会号)．発行11回，総頁数730頁．次いで42巻の編集進行状況につき，42巻は少し遅れているが号数を発行月に合せるよう努力しているとの説明があった．

表題集に関して53，54年度は教室負担としたが，支払方法につき若干の困難が生じているため，委員会で検討した結果，55年度以降再び生理学会負担にする旨報告されましたが，未納の教室は支払ってほしいとの要請があった．(表3)．

4) JJP 編集会計報告（真島委員長）

JJP 編集委員改選の結果，高木健太郎委員の代りに本田良行委員が加わったこと，および昭和54年度 JJP 編集決算，昭和55年度予算案，刊行状況などの報告があった．(表4・5)

5) 教育委員会報告（大村委員長）：日本生理学会編集「生理学実習書」の英文パンフレットが完成し，心臓，筋および腎の実習項目の一部については全訳がなされたこと，このパンフレットがブタペストの IUPS の教育の展示に出品されること，実習書の心機能，呼吸，脊髄反射および誘発電位に関してビデオが完成したことなどの報告があった．

6) 研究費委員会報告（田崎委員長）：科学研究費のあり方についての日本学術会議よりの意見調査に対し委員会において回答を作成中であるとの報告があった．

7) 昭和54年度科学研究費配分経過報告（高木第二段審査委員）：第二段審査は第一段審査委員の合計点上位のものより採択されること，提出された申請書に対し，大体比例配分されるとの報告があった．

8) 交流委員会報告（代理　伊藤幹事）：生理研の約8割が完成し，本委員会の所期の目的を達成したため，解散と改組を考えたいとの報告があった．

9) 国際交流委員会報告（本間委員長）：国際交流事業として若手研究者の国際会議出張の旅費，発展途上国の研究者に対する援助などが考えられるが，このためには膨大な資金を必要とし，学会事業として行うことは困難であるとの報告があった．

10) 生理学用語委員会報告（酒井委員長）：医学書院出版の生理学用語集の改訂を目的として本委員会が昨年4月発足し，新しい用語集に対するアンケート調査が行われたこと，この総括を日生誌ブルーページに掲載する予定であることなどの報告があった．

11) 国際生理科学連合および生理科学研究連絡委員会報告（代理　伊藤幹事）：台湾，中国の扱い方が IUPS で問題になっているが，この件に関する日本の意見については代表団に委任してほしいとの要請があった．

12) 第58回（昭和56年度）日本生理学会大会に関する報告（松本幹事）：徳島大学医学部松本，井上，歯学部塚田により，56年4月1～3日徳島郷土文化会館にて開催することが報告された．

13) 第57回(昭和55年度)日本生理学会大会に関する報告（岡本当番幹事）：出席者約1,400名，口演286題，ポスターシンポジウム展示187題，計473題の発表があることが報告された．

2．議題

1) 昭和54年度決算ならびに昭和55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.(表2, 6)

2) 昭和56年度会費値上げについて：昭和56年度より会費を一般6,000円，準会員8,000円に値上げしたいとの提案が星会計幹事よりなされ，評議員会の承認を得て総会に附議し承認された.

3) JJP 会費値上げについて：昭和56年度より6,000円を7,000円に値上げしたいとの提案が真島幹事よりなされ，評議員会の承認を経て総会に附議し承認された.

4) 会則変更について：会費値上げに伴う会則の一部変更に関し，評議員会の議を経て総会の承認が得られた.

5) 評議員推薦について：評議員選考委員会が提案した新評議員候補者はすべて評議員会において承認された.(表7)

6) 特別委員推薦について：吉村寿人，高木健太郎各委員の特別会員推薦につき川上正澄，中山昭雄会員よりそれぞれ推薦の辞が述べられた後，評議員会より推薦することが承認され，更に総会の賛同を得た.

7) 名誉会員推薦について：J. C. Eccles 教授の多年に亘るキャンベラなどでの日本生理学会員の教育および学会発展のための貢献に対し，教授に直接指導をうけた本学会員12名が教授を名誉会員に推薦した．この件は評議員会により推薦することが承認され，更に総会の賛同を得た.

8) 生理学用語委員会昭和55年度活動計画について：アンケートに基いてなるべく早く出版したいので専門的なところは協力をお願いしたいとの要請が評議員会において承認され，更に総会の賛同を得た.

9) 教育委員会昭和55年度活動計画について：昭和55年度活動計画案が提出され，評議員会の議を経て総会の承認が得られた.

10) 第59回（昭和57年度）日本生理学会大会に関する件：伊藤庶務幹事より第59回（昭和57年度）日本生理学会大会開催候補地として慶応大学と群馬大学が条件を備えているが，常任幹事会においては慶応大学において開催の方針が承認された旨報告された．これに対し，高木貞敬会員より群馬大学は第61回（昭和59年度）開催を希望するとの発言があった．伊藤庶務幹事より両候補地の希望につき更に考慮の上最終決定することを庶務幹事に委任されたい旨発言があり了承された.(註：この件については，第59回日本生理学大会を慶応大学において開催することに決定する旨後日庶務幹事より議長に連絡があった.)

表1．日本生理学会庶務報告

（昭和54年12月末現在）

会員		
一般会員	2,667名	
特別会員	20名	
準会員		
学校図書館	121部(116件)	
研究所，書店など	115部(66件)	
寄贈および交換		
外国	17部(16件)	
国内	18部	
合計	2,958	

特別会員(20名)

東 龍太郎	勝 義孝	勝木 新治
勝木 保次	久保 秀雄	小玉 作治
黒津 敏行	斉藤幸一郎	鈴木 正夫
瀬尾愛三郎	冨田 恒男	戸塚 武彦
西丸 和義	福田 邦三	福原 武
松田幸次郎	簑島 高	森 信胤
若林 勲	長嶋 長節	

表2．日本生理学会昭和54年度決算報告

（自 昭和54年1月1日 至 昭和54年12月31日）

収入

	54年度予算	54年度決算	増減	備考
① 前年度繰越金	2,435,178円	2,435,178円		
② 昭和54年度収入	16,420,000	18,046,421		
(内訳)				
会費	12,080,000円	13,386,362円	＋	
購読料	1,100,000	1,401,600	＋	
論文掲載料	1,500,000	1,798,834	＋	
広告料	1,000,000	978,400	－	11件

会誌分冊売	40,000	5,950	−	17冊
預金利子	50,000	70,634	+	第一勧業銀行
日本医学会奨励金	100,000	100,000		昭和53年度
印税	250,000	180,738	−	生理学実習書
その他収入	300,000	123,903	−	
①+② 合計	**18,855,178**	**20,481,599**		
差額		1,626,421		

	支出			
(内訳)	54年度予算	54年度決算	増減	備考
会誌印刷代	9,000,000円	8,831,891円	−	40巻11号～41巻10号
会誌発送代	1,400,000	1,402,271	+	40巻10号～41巻10号
編集会議費	60,000	77,240	+	日本生理学雑誌
校正料	220,000	213,812	−	同上
原稿査読料	30,000	31,500	+	同上
事務室使用料	696,000	757,000	+	東洋文庫支払い1月～55年1月
通信費	1,100,000	617,036	−	会誌外通信
事務費	850,000	814,044	−	印刷物，封筒，コピー代
備品費	70,000	86,700	+	邦文活字他
会合費	250,000	184,828	−	常任幹事会，委員会
旅費	900,000	774,700	−	同上
講演謝金	90,000	0	−	
人件費	2,000,000	2,056,203	+	アルバイト含む
職員健康保険	50,000	43,680	−	
職員退職金積立	100,000	100,000		
国際交流基金	800,000	800,000		
雑費	50,000	138,369	+	供花，J. J. P. 会費返却
予備費	1,189,178	50,000	−	日生誌校正佐々木氏謝礼
合計	**18,855,178**	**16,979,274**		
差額		1,875,904		
昭和55年度繰越金総額		3,502,325		

表3．日本生理学雑誌41巻（54年度）編集報告

41巻1～12号（8，9号合併）発行11回

41巻総頁数 730頁

40巻総頁数 626頁

(内訳)	編	頁
原著	2	18
短報	10	29
業績表題		119
口演演題		237
抄録		98
会報，その他		
(総目次・索引含)		151
広告		78

表4. JJP 昭和54年度決算および55年度予算

（昭和55年3月4日）

	54年度 予算額	54年度 決算額(見込)	54年度 摘要	55年度 予算額	55年度 摘要
製作費	8,300,000円	8,103,520円	880頁 6回	9,400,000円	920頁(5%増) cost 10%up
審査・英文校閲料	1,200,000	1,162,000		1,380,000	投稿原稿15%up
旅費・会議費	700,000	695,200		900,000	20%up
通信・消耗品費	880,000	880,000		1,150,000	郵税20%upを見込む
人件費	1,600,000	1,600,000		1,750,000	10%弱
雑事務費	640,000	640,000		700,000	10%
送料(外国)	2,860,000	2,852,000		4,140,000	郵税upを見込む
送料(国内)	1,715,000	1,626,860		2,000,000	
支出合計	**17,895,000**	**17,559,580**		**21,420,000**	
国内会員	3,780,000円	3,834,000円	639名 @6,000	3,900,000円	650名 @6,000
国内機関	1,440,000	1,440,000	120名 @12,000	1,950,000	150名 @15,000
外国購読	6,460,000	6,369,560	493名 @190 68ドル	9,200,000	500名 @230 80ドル
別刷バックナンバー	1,350,000	1,218,600		1,350,000	10%up
文部省助成	4,720,000	5,020,000		5,020,000	
繰越金	145,000	145,000		467,580	
収入合計	**17,895,000**	**18,027,160**		**21,887,580**	
差引繰越		467,580			

表5. JJP 刊行状況 (Vol. 29, No. 6) 刊行部数 1,400部

個人購読	694名	827	外国購読	493	508
団体購読	125		外国会員その他	15	
国内寄贈	8				

表6. 日本生理学会昭和55年度予算

（自 昭和55年1月1日 至 昭和55年12月31日）

	収入	備考
① 前年度繰越金	3,502,325円	
② 昭和55年度収入	16,910,000	
（内訳）		
会費	12,810,000	(会費 5,000円×2,847×0.9)
購読料	1,060,000	(会費 5,000円×236×0.9)
論文掲載料	1,500,000	
広告料	1,000,000	
会誌分刷売	20,000	
預金利子	70,000	(第一勧業銀行)
日本医学会奨励金	100,000	
印税	150,000	(生理学実習書)
その他収入	200,000	(大会案内掲載料)
①+② 合計	**20,412,325**	

	支出	備考
（内訳）		
会誌印刷代	10,400,000円	（41巻11号～42巻10号）
会誌発送代	1,500,000	（同上）
編集会議費	80,000	（日本生理学雑誌）
校正料	250,000	（同上）
原稿査読料	30,000	（同上）
事務室使用料	732,000	（12ヶ月）
書庫使用料	150,000	
通信費	800,000	（会誌外通信）
振替手数料	140,000	
事務費	850,000	（印刷物，封筒，コピー代）
備品	100,000	
会合費	250,000	（常任幹事会，委員会）
旅費	900,000	（同上）
人件費	2,200,000	
職員健康保険	60,000	
職員退職金積立	100,000	
国際交流基金	180,000	
雑費	100,000	
予備費	1,590,325	
合計	**20,412,325**	

表7．日本生理学会評議員（1980年度）

計47名（五十音順）

氏名	所属，現職
安倍紀一郎	熊大，医技短大，助教授
安楽　満男	鹿大，医，生理，助手
伊藤　漸	群大，医，外科，助手
井上　孝道	日医大，生理，講師
井深　信男	滋賀大，教育，助教授
稲葉　耕三	岡山大，医，生理，講師
今西　愿	大分医大，生理，助教授
牛山　順司	日歯大，総研，教授
小川　正晴	高知医大，生理，助教授
小沢　瀞司	自治医大，生理，助教授
小野塚　実	神奈川歯大，生理，講師
折田　義正	滋賀医大，内科，助教授
勝田　茂	筑波大，体育科学，助教授
加世田正和	防衛医大，生物
河南　洋	産業医大，生理，助教授
木村　実	自治医大，生理，助手
窪田　隆裕	大阪医大，生理，講師
倉橋　昌司	旭川医大，生理，助手
今田　育秀	産業医大，生理，助教授
三枝木泰丈	鶴見大，歯，生理，助教授
佐川寿栄子	産業医大，生理，講師
坂井　朗子	東京医大，生理，助手
上原　政治	埼玉医大，生理，講師
渡部　良夫	名保大，総合医研，教授
須貝外喜夫	金沢医大，生理，助手
菅谷　愛子	城西大，薬研，助教授
鈴木　均	東北大，医，生理，助手
田丸　政男	名保大，総合医研，発達生理，助手
高木　都	岡山大，医，助手
高頭　迪明	中外製薬，薬研
中条　正	金沢医大，生理，助手
中原　凱文	東海大，医，生理，講師
西川　弘恭	京府医大，生理，講師
畠瀬　修	岡山大，附属施設，講師
東　英穂	久留米大，医，生理，講師
東田　陽博	金沢大，がん研，講師
平井　直樹	杏林大，医，生理，助手
弘中　哲治	帝京大，医，薬理，助教授

福田　昭子　新潟大，医，生理，助手，新潟大附，看護学院講師
松本　修文　阪大，基礎工学，助教授
宮下　保司　東大，医，生理，助手
森　　順子　防衛大，生理，講師
矢野　二郎　金沢医大，生理，講師
山根　正信　川崎医大，生理，講師
渡辺　　誠　東北大，歯，補綴，講師
藁科　　彬　新潟大，医，生理，助教授
吉崎　和男　京府医大，生理，講師

昭和54年度第3回日本生理学教育委員会議事録

日　時：昭和55年3月26日(水)　午前10時
場　所：神戸大学医学部大会議室
出席者：広重　力(北大)，森　茂美(旭川医大)，本郷利憲(筑波大)，本間三郎(千葉大)，本田良行(千葉大)，菊地鎌二(東京女子医大)，酒井敏夫(慈恵医大)，市河三太(昭和大)，杉　晴夫(帝京大)，中馬一郎(阪大)，宮川　清(信州大)，大村　裕(九大)，田中育郎(熊本大)，橋村三郎(鹿児島大)
欠席者：望月政司(山形大)，入沢　宏(生理研)，片岡喜由(愛媛大)

1．議　題

(1)　日本生理学会編　生理学実習書　各項目要項の英文化について．

(2)　実習項目のビデオ作成について．

(3)　国際生理学会 Teaching Program について．

(4)教養課程における生物学実習について．

2．1の議題について下記のような討論を行った．

(1)

a．日本生理学会編　生理学実習書　各項目の要旨について各委員で訳した英文化は，昭和医大，市河教授および Simpson 教授の協力で立派なものが印刷されてできあがった．問答形式を取り入れ実習書としての機能を果たしていることがこの生理学実習書の特徴であるが，項目の要旨の訳だけではわかりにくいので次の3テーマについては全訳をした．

体液調節（星 教授）　筋　　肉（杉 委員）
心筋活動（後藤教授）　（かっこ内は全訳者）

b．完成した英文実習書の展示および配布方法

イギリスでは Dr. Hutter，インドでは Dr. Manchanda より実習書を配布する教授の名簿を作成してもらったのでこちらの方で配布する．

アメリカ合衆国には Dr. Brookhart，ドイツには高野教授を通してただ今交渉中である．国際生理学会におけるビデオ展示の場で英訳生理学実習書要旨を展示し，申込用紙を展示場において希望者を募る．

(2)　ビデオ作成について

a．科学研究費(研究代表者・本間委員)によって各委員が作成したビデオは一応完成した．昭和55年度日本生理学会教育委員会のシンポジュームで，いくらか供覧する．さらに，本年6月の55年度教育委員会で残りを供覧する．

b．作成したビデオはリスト作成のうえ，各大学でその配布方法を検討する．本間委員が6月までに配布方法について検討し，私案を出す．

(3)　国際生理学会 Teaching Program について

a．ブタペストの Forgas, I. 教授から，講演の正確な論題と著者名，および講演に要する時間の問い合わせがあった．実習書の説明とビデオの供覧を含み，レクチャー時間（約80分）ということを連絡した．

b．実習書の改訂

55年6月に教育委員会で議論することになっている．

(4)　医学部，歯学部の教養課程，生物学実習に関して，生物学会が行った報告によると教養部の生物学講議および，実習に関して医，歯学部はあまりにも無関心だという意見が出た．この意見に対処すべく本委員会から教養部生物学教育に関し要望書を出すことになった．その原案は田中，杉委員が作成する．

〔お知らせ〕

Mountcastle 教授の来日について

来たる10月14日に Johns Hopkins 大学生理学教室の Mountcastle 教授が日本学術振興会の招へい研究員として来日することになりました．主な催しとして下記の講演およびワークショップを予定していますので会員の方々はどうぞ御出席下さい．

1. 10月16日(木)午後4時．東京都神経科学総合研究所，日本生理学会・東京談話会特別講演，Neurophysiological study of the posterior parietal association cortex in behaving monkeys.

＊ なお東京談話会では関連する分野（感覚，知覚，高次脳機能など）の英文発表を募集しています（〆切9月20日，当番幹事，佐藤昌康，島村宗夫）

2. 10月23日(木)．京都大学霊長類研究所，ワークショップ："Single unit analysis in chronic monkeys"（連絡先　霊長研・久保田　競）

3. 10月27日(月)午後3時．経団連ホール，日本医学会シンポジウム「大脳連合野の構造と機能」特別講演．Functional mechanisms of the parietal association cortex.

4. 10月30日(木)午後3時30分．東京大学医学部，東京医学会講演会．Functional organization of the cerebral cortex.

お問合せ：〒183　東京都府中市武蔵台2の6
東京都神経研：酒田英夫

第7回(昭和55年度)日産学術研究助成候補推薦要領

1．助成の趣旨

自然科学を主とする学術の有意義な研究であって，国の助成となるべく重複しないもの（その期間が長期にわたる研究，学際的なグループによって行なわれる研究など）に対し助成を行ない，わが国の基礎学術の向上，進展に寄与しようとするものであります．

2．助成対象研究分野

助成対象を**資源・エネルギー，環境**の分野の基礎研究，および応用研究とし，本年度は当該分野のうち次のような研究を期待します．必ずしも実験を伴う研究のみでなく，いわゆるソフトの研究も含みます．ただしその場合は調査研究助成として扱います．

① 人間―自然系のあり方についての総合的・生態学的解析
② 環境の生物指標，並びにこれによるモニタリングに関する方法論的研究
③ 新しい原理に基づく環境の分析方法の研究
④ 汚染物質の環境中における変化機構に関する研究
⑤ 環境汚染物質の生体に対する作用機構に関する研究
⑥ 環境制御の新しい方法の研究
⑦ 病害動物に対する無公害駆除剤の開発，並びに生物学的駆除法の研究
⑧ 人畜疾病の化学療法剤のスクリーニングに関する方法論的研究
⑨ 資源の再利用（循環）に関する研究
⑩ 低落差エネルギーの利用に関する研究
⑪ エネルギーの貯蔵に関する研究
⑫ 代替資源の開発，並びに資源・エネルギーの利用効率の向上に関する研究
・⑬ 人間―機械系の解析による安全性向上の研究
・⑭ 資源・エネルギー，環境の立場から見た
　(イ) 海洋の利用
　(ロ) 林産資源の利用
　(ハ) 輸送システム　など

その他上記に類する研究

・印の研究はとくに調査研究として期待します．

例示した課題の内容については別添の説明資料(1)をご覧下さい．

「調査研究」については別添の説明資料(2)を

ご参照下さい.

3. 助成対象の研究者

貴学(協)会に関する自然科学分野の研究に従事しており，2～4年の期間を要する上記の研究を行なおうとする研究者および研究グループで，その研究成果が学術の進歩，発展に貢献するところが大きいと思われるもの.

4. 研究助成金額

- 総　額（研究全年度）　約170,000千円
  - 研究1件につき30,000千円（調査研究は5,000千円）を限度とします.
- 上記のうち第1年度（56/4～57/3）分　約85,000千円
  - 研究1件につき5,000千円*程度とします.
  - * 研究期間の長短，年度別の所要額の状況にもよりますので，あまりこの金額にとらわれる必要はありませんが最高額は8,000千円とします.

ただし調査研究については2,000千円程度とし，期間は2年とします.

なお，助成件数は調査研究を含み12～15件を予定しています.

5. 推薦件数

1学(協)会より1～2件とします.

6. 推　薦　者

学(協)会の代表者とします.

7. 推薦手続

所定の推薦用紙に必要事項を記入し，当財団宛に1部をご送付願います.

8. 推薦締切日

学会〆切日，11月10日

9. 選考方法

下記委員からなる選考委員会において選考の上，当財団理事会で決定します.

伏見康治(委員長)，向坊　隆，佐々　学，田島弥太郎，沼田　真，藤永太一郎（敬称略）

10. 研究助成金の贈呈

昭和56年3月贈呈式を行ないます.

11. 第2年度以降の助成金

多年度にわたり助成が決定した研究に対する第2年度以降の助成金については，年度別の助成金額を内定額とします.

(追　記)

イ. 候補者は必ずしも貴会会員であることを要しません.

ロ. 助成金の受領者に対しては，研究経過および研究結果の報告を求めますが，そのほかにはとくに条件はつけません.

ハ. 助成金受領者には将来，研究成果の発表をお願いする予定でありますのでご承知おき下さい.

(推薦書提出先・連絡先)

財団法人　日産科学振興財団

〒104

東京都中央区銀座6丁目17番2号

電話(03)543-5597

学会事務局より

1. 昭和55年度会費5,000円を（振込用紙本号添付）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

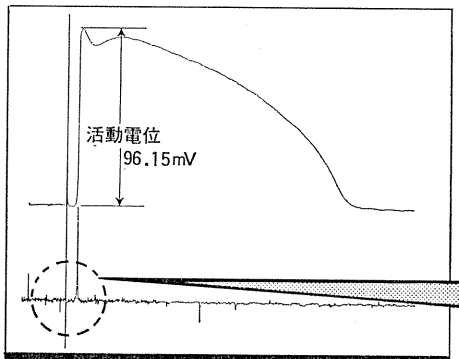
日本生理学会事務局

振替口座東京 3-86430

電話(03)945-2840

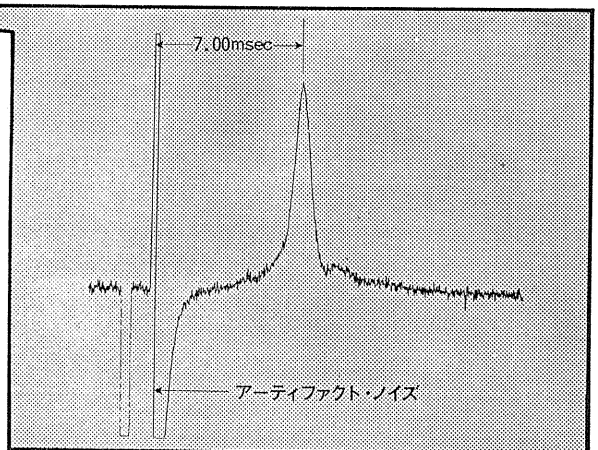
編集委員

塚田裕三(幹事)　馬詰良樹　植村慶一
田中励作　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)
永坂鉄夫(中部)　品川嘉也(近畿)　村上悳(中・四国)
河田溥(九州)



心筋活動電位(上段)とその微分波形(下段)をA/D変換速度200μsec(5kHz)で,各々2kワードで捕捉しました。

グラフは犬の心臓の筋肉に電気的な刺激を与え,**心筋活動電位(EMG)**をデジタル・オシロスコープで捕捉し,X-Yレコーダで記録した例です。ブラウン管上の観測波形を写真撮影するといった面倒なプロセスは一切必要ありません。デジタル・オシロではさらにブラウン管上でカーソル機能を使って、時間・電圧の計測がデジタルで可能です。



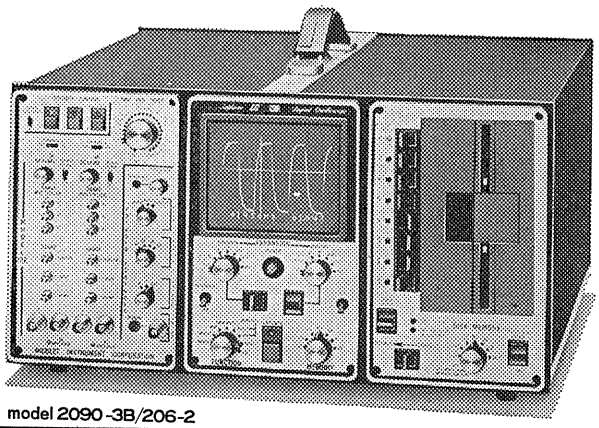
微分波形をより明確に観測するため,A/D変換速度を5μsec(200kHz)とし,4kワードで再捕捉。

デジタル・オシロスコープ、あらゆる生体現象の計測に

model 2090-3C/206-2特徴

■高分解能:12ビット(1/4096),50μV最高感度 ■2MHz(0.5μsec)A/D変換速度(最大) ■記憶容量:4kワード ■トリガー以前の波形観測 ■カーソル機能により,時間・電圧値をデジタル読み取り ■捕捉波形のデジタル拡大表示 ■フロッピー・ディスクによる大量波形記憶32kワード

デジタル・オシロスコープ
model 2090シリーズ



model 2090-3B/206-2

Nicolet is a Problem-Solving Company

NICOLET JAPAN CORPORATION

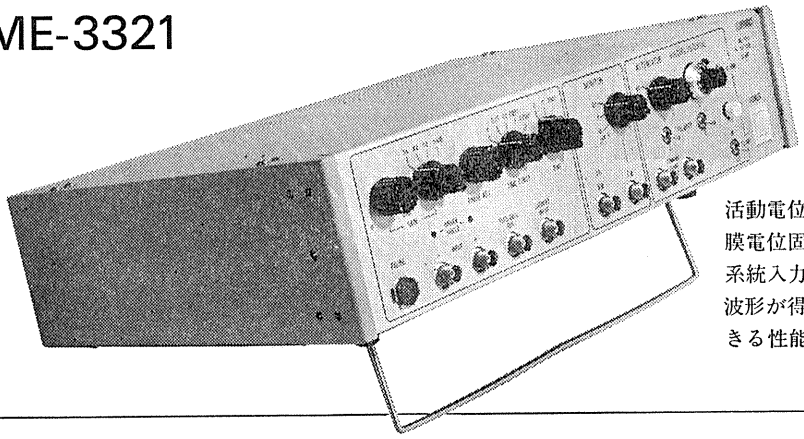
ニコレージャパン株式会社
東京都杉並区上高井戸1丁目23番11号(明和ビル) 〒168 TEL 03(329)2511代
大阪市淀川区西中島6丁目7番8号(大昭ビル) 〒532 TEL 06(305)2150代
名古屋市千種区都通4丁目13番地(IKKO今池セントラルビル) 〒464 TEL052(741)2150代

詳しい資料をご請求ください。

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

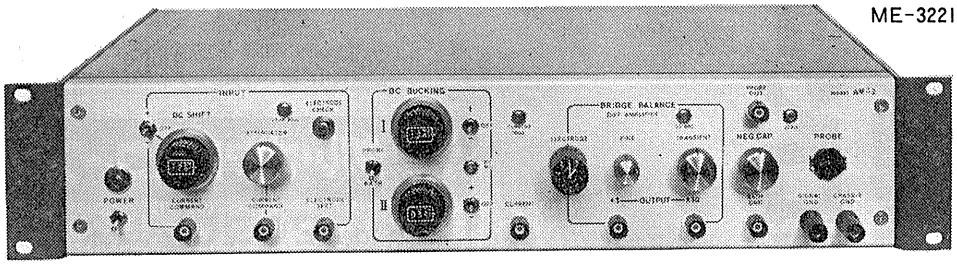


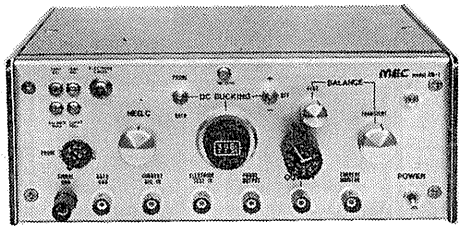
活動電位発生のメカニズムを追求する膜電位固定法のための専用装置で，2系統入力を組み合せた複雑なクランプ波形が得られ，高抵抗の電極を使用できる性能をもっています．

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バッキングつき
ME-3211 通電回路つき

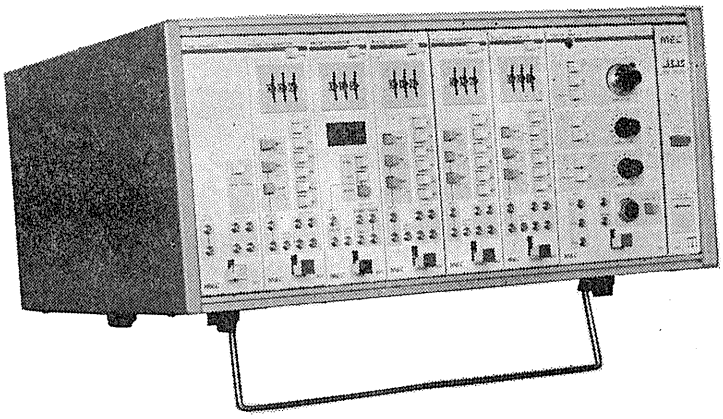
●細胞電位の研究をおこなうために特に設計された装置で，1000MΩまでと広範囲の電極が使用できます．
●差動増幅器を内蔵しています．
●ME-3221は，色素注入が可能なDCシフトなど，高度な機能を盛り込んでいます．

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
福岡営業所：〒814 福岡市西区荒山5－12－18 ☎(092)863-2757
工場：〒411 静岡県駿東郡長泉町下土狩1320 ☎(0559)87-8645

医用電子機器のパイオニア

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．

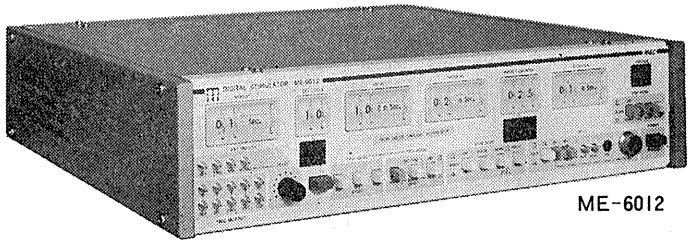
★構成ユニット

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——プログラマブルジェネレータ
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

研究用高級機 ME-6012

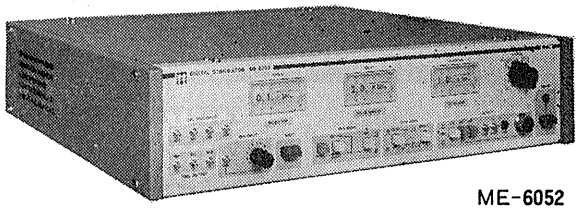


ME-6012

●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せが容易です．

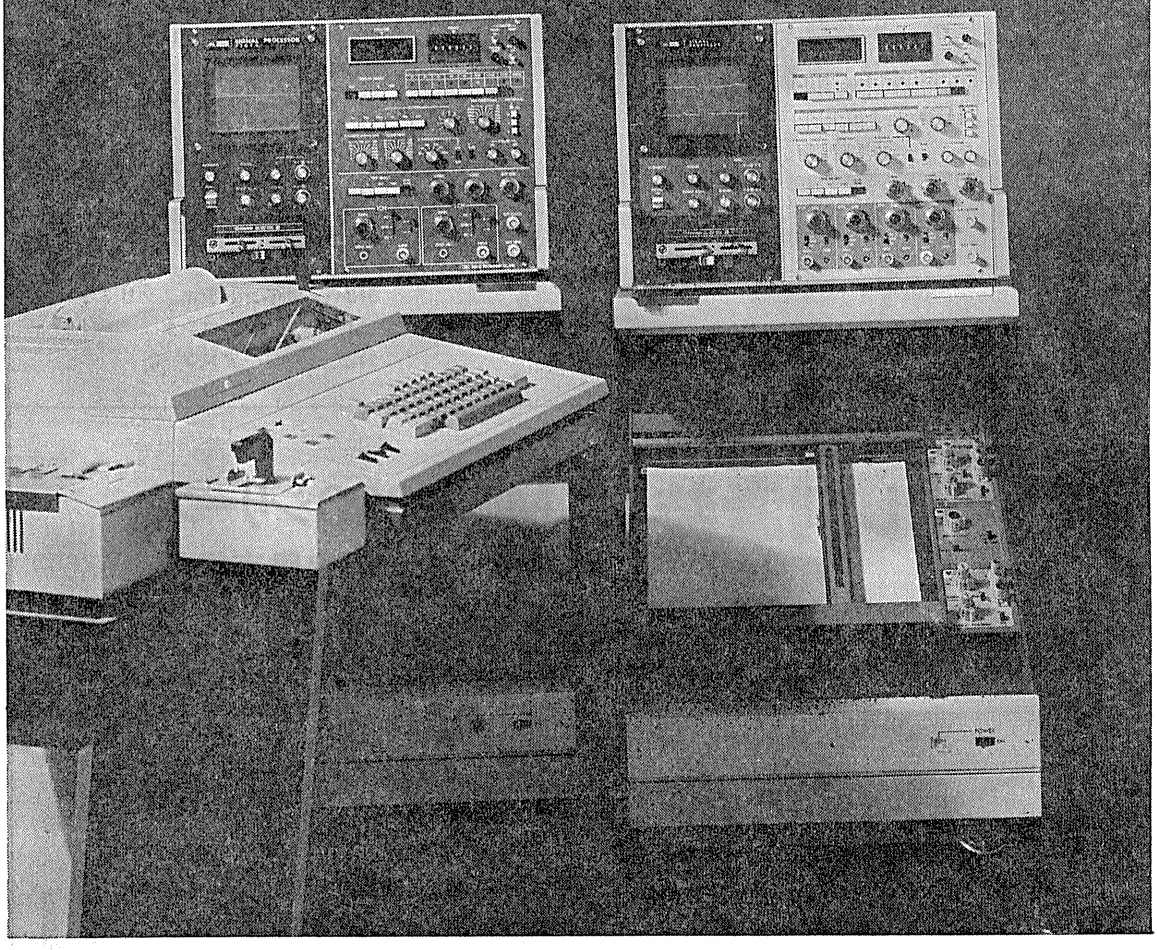


ME-6052

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
福岡営業所：〒814 福岡市西区荒山5－12－18 ☎(092)863-2757
工場：〒411 静岡県駿東郡長泉町下土狩1320 ☎(0559)87-8645

ますます機能が拡張、データ処理装置の決定版

シグナルプロセッサ



7T07A　●メモリ4K　●入力数2ch.
7T08　●メモリ8K　●入力数4ch.

ソフトウエアがさらに充実、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。

明日の健康と福祉を守る

SAN-EI 三栄測器

本社 東京都新宿区西大久保2-223-2 〒160☎03 (209)0811(代)
工場 東京都小平市天神町1－57 〒187☎0423(41)0821(代)

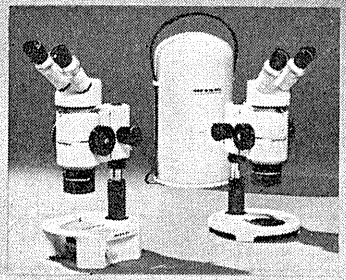
WILD
HEERBRUGG
(スイス) ウイルド・ヘールブルック社

ウイルドM8：この新しいズーム式実体顕微鏡なら、あらゆる試料が観察できます。明るくて、鮮やかに。



- 視野が大きい。
- 像の質がすばらしい。
- 歪と色収差がない。
- ズーム範囲は1：8。
- 運搬と保管に便利な金属製フードがつけられる。
- 操作は快適。
- 順応性のあるモジュール式設計のため、数限りない用途に使えます。

以上は、品質が高く多くの目的に使える、新しいズーム式実体顕微鏡ウイルドM8の誇る特長です。



〈常設ショールームのご案内〉
弊社本社内と大阪営業所内に、ライツとウイルドの顕微鏡その他関連機器を常時展示し、皆様のご利用をお待ちしております。

No. 6

日本総代理店
シイベル機械株式会社
顕微鏡部

本　　社　東京都千代田区丸の内3-4-1(新国際ビル)　☎ 03(216)4411
名古屋営業所　名古屋市中区錦1－17－13(名興ビル)　☎052(221)7181
大阪営業所　大阪市南区塩町通り4－18(豊田ビル)　☎ 06(271)2431

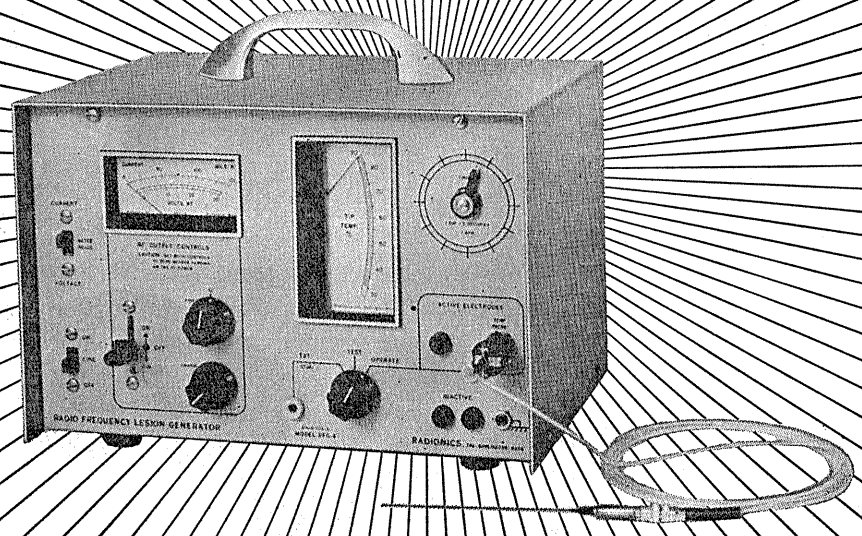
0.7mmのリージョンから脳浮腫までを
均一なサイズ、すばらしい再現性をもって作成する！

RADIONICS社

動物用

高周波 RF リージョン ジェネレータ

Model RFG-4



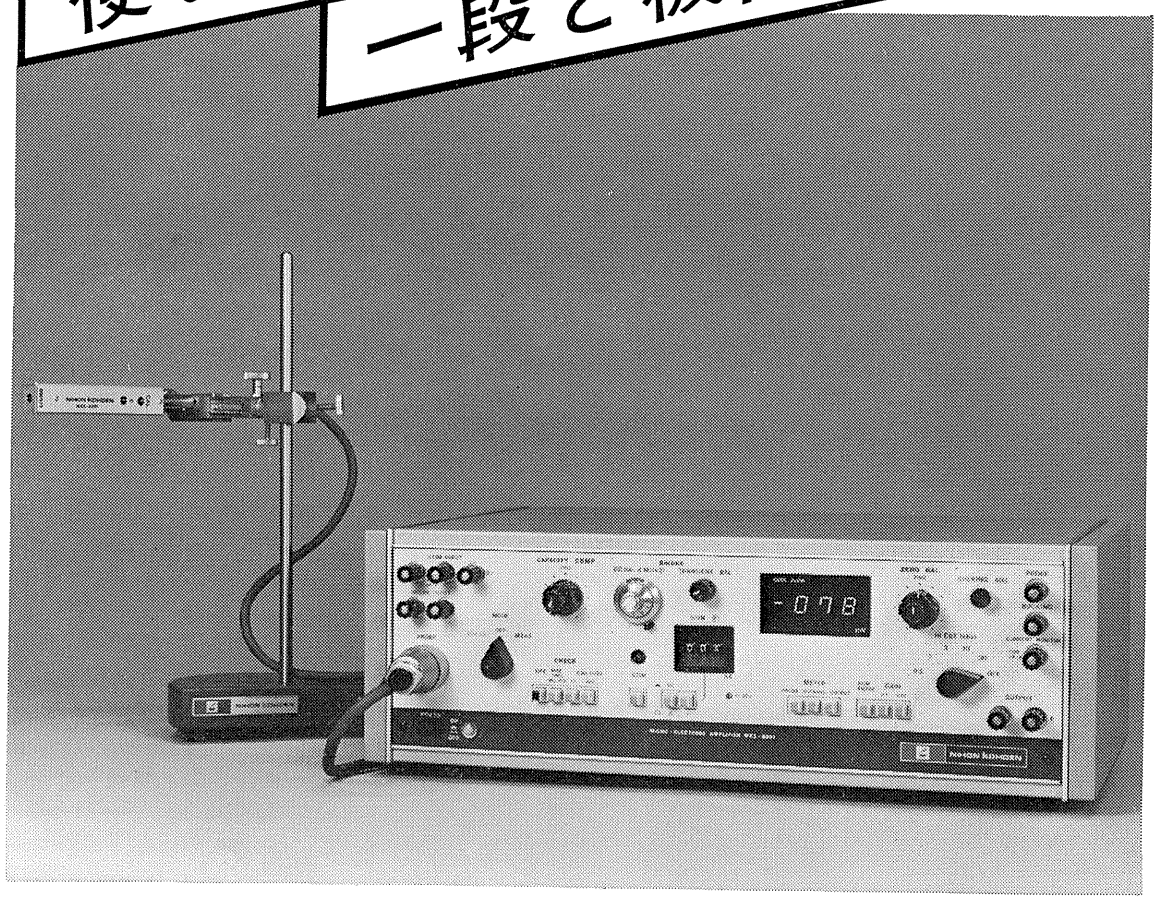
〔特長〕
- ❶電極先端の温度モニターが可能
- ❷こまかい温度コントロールが可能
- ❸刺激装置と組合せて、同一電極から刺激が可能
- ❹タイミング用の秒針を内蔵

日本総代理店

室町機械株式会社

〒103 東京都中央区日本橋室町４－３(大辻ビル)
電話(03)241-2444(代表)

使いやすさを追求 一段と機能アップ



通電誘導型
微小電極用増幅器
MEZ-8201

特長

1 DCポテンシヤルをデジタル表示します。
2 通電は定電流(最大600nA)で行えます。
3 通電電流をデジタル設定できます。
4 通電波形は2種類の刺激入力を加算できます。
5 プローブチェック、電極抵抗測定が簡単に行えます。
6 薬物・色素注入のための入力端子付です。
7 ハイカットフイルタ、ハムフイルタ付です。

エレクトロニクスで病魔に挑戦する

NIHON KOHDEN

日本光電
東京都新宿区西落合1−31−4 ☎03(953)1181大代表 〒161

日本生理誌・第42巻8・9号・昭和55年9月1日発行（毎月1日発行）
〔昭和27年5月6日　第3種郵便物認可〕

KN-70 NATUMEX（誘導電波感応方式）

動物自発運動測定装置



出　力

digital　signal　全運動用

Analogue signal　レコーダー用

digital　signal　大きい運動用

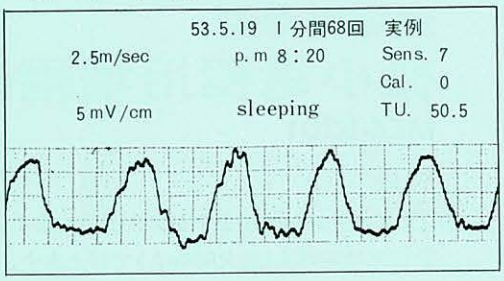
digital　signal　小さい運動用

digital　signal　立ち上がり運動用

〈特徴〉

1．センサーの感度が良いのでラット,マウスの静止状態での呼吸による体動もあざやかにキャッチできる。
2．光等を利用しないで動物の立ち上がりを測定できる。
3．センサーの感度が良いので,信号を極端に増巾する必要がなく1台1台の感度を揃えることができる。
4．本体にはExternal senser用のコネクターを有しラット用（800×750）のGIANT senserを接続できる。

〈データーの1例〉



〔注〕

データー処理装置はRIC8000Cを準備してあります。
8chの入力とカセットの記憶装置を有し，グラフの作成，平均，移動平均等必要なデーター処理を行います。

理化学器械・基礎医学器械・実験動物飼育機械器具・薬学研究器械・医科器械一般

株式会社 夏目製作所　東京都文京区湯島2丁目18番6号　電話 03（813）3251（代表）

昭和五十五年八月二十日印刷
編集兼発行人　塚田裕三　東京都文京区本郷三丁目二八―二一　東洋文庫（新館三階）日本生理学会
印刷者　三浦経夫
印刷所　鶴岡印刷株式会社　山形県鶴岡市山王町一四の二四
発行所　日本生理学会　〒一一三　東京都文京区本駒込一―二八―二一　東洋文庫
電話　九四五―二八四〇
振替東京　三―八六四三
定価　三千円