What happens in the body by electrical acupuncture?
「電気鍼によって身体内では何が起こる？」

Hiroshi ENDO LAc PhD. 遠藤 宏
IARMS Workshop lectures and technical seminars in Okayama.
(社) 国際良導絡医学会主催 ワークショップ講演会テクニカルセミナー in 岡山
倉敷芸術科学大学 教授

Types of electrical acupuncture 電気鍼の種類

1. AC electrical acupuncture
   交流電気鍼
2. DC electrical acupuncture
   直流電気鍼

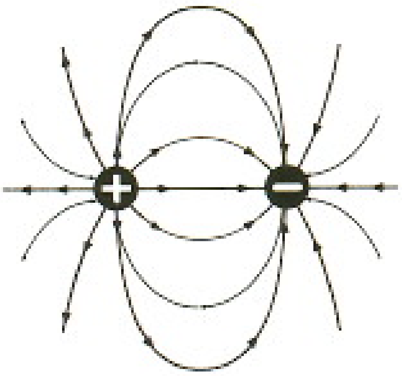
AC electrical acupuncture 交流電気鍼

Actually use pulse acupuncture
実際はパルス鍼を使う

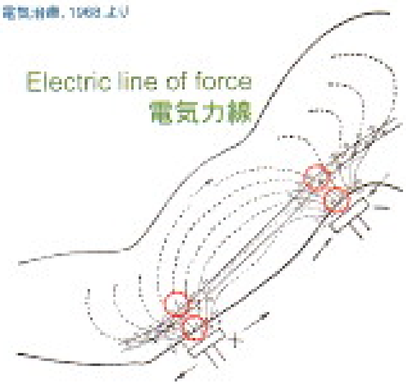
Electrical stimulation
電気的刺激

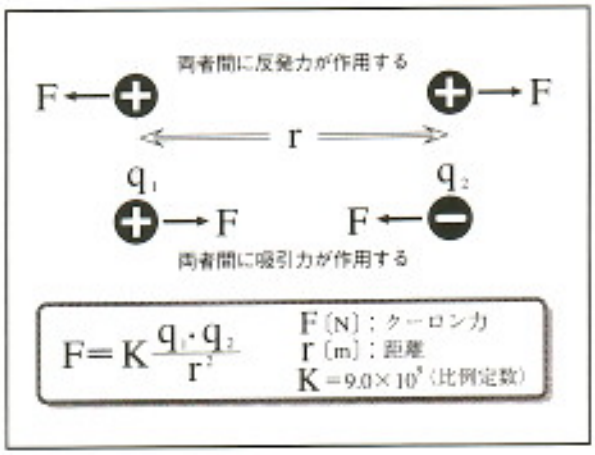
Flow direction of the electric

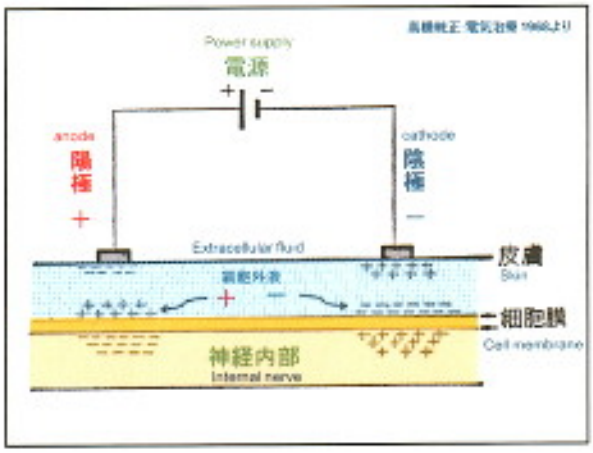
電流は直線的だけでなく、放物線上にも流れます。

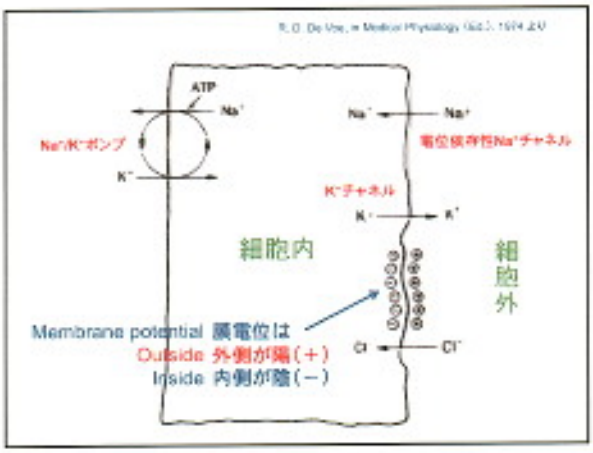


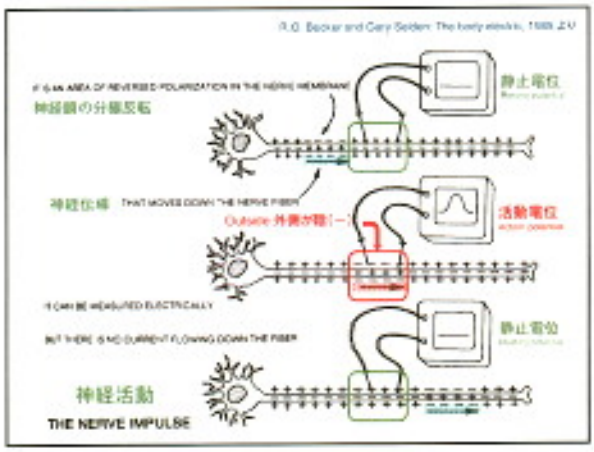
電流は電極近くだけでなく、遠くにも流れます。

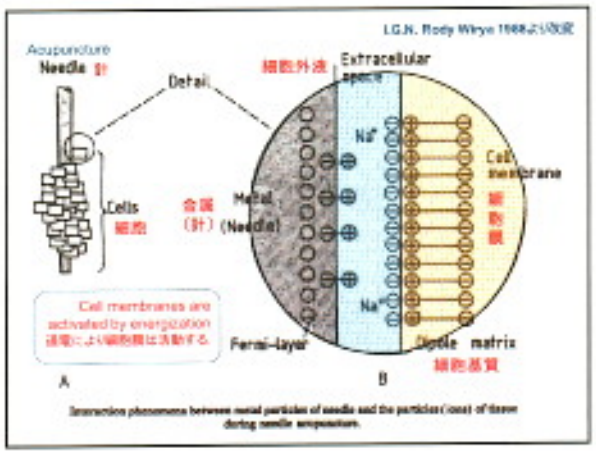


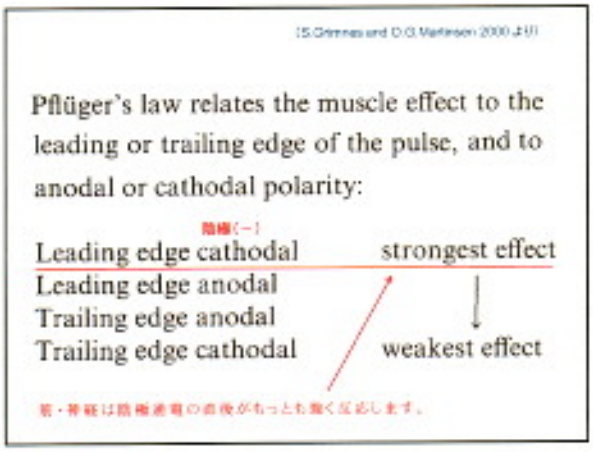

両者間に反発力が作用する
F
F
r
q_1
q_2
F
F
両者間に吸引力が作用する
$F = K\frac{q_1 \cdot q_2}{r^2}$
F〔N〕：クーロン力
r〔m〕：距離
K＝9.0×10⁹（比例定数）

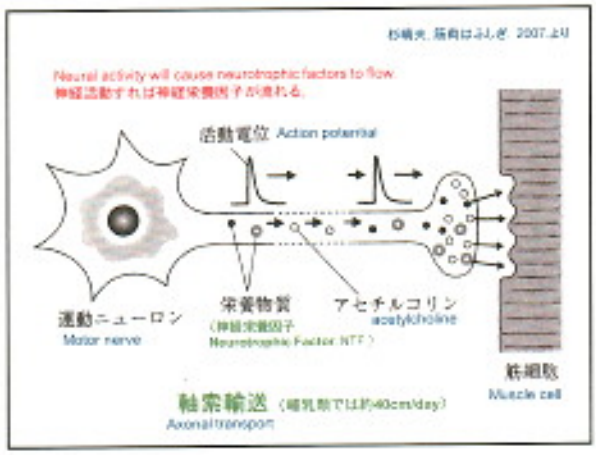

Power supply
電源
anode
陽極
cathode
陰極
Extracellular fluid
細胞外液
皮膚
Skin
細胞膜
Cell membrane
神経内部
Internal nerve

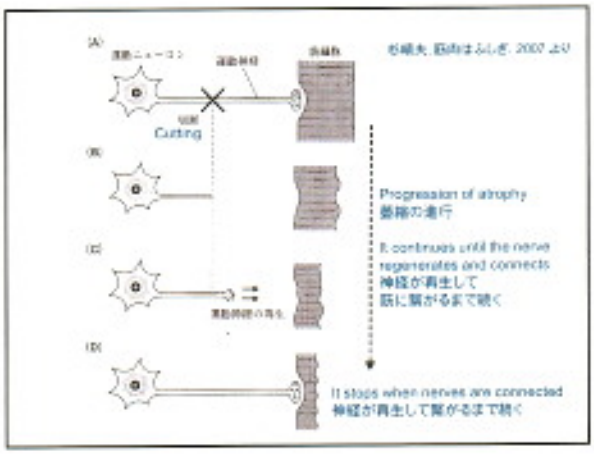

ATP
Na⁺
Na⁺
Na⁺
Na⁺/K⁺ポンプ
電位依存性Na⁺チャネル
K⁺
K⁺チャネル
K⁺
K⁺
細胞内
細胞外
Membrane potential 膜電位は
Outside 外側が陽（＋）
Inside 内側が陰（－）
Cl⁻
Cl⁻


神経膜の分極反転
静止電位
活動電位
Outside 外側が陰（－）
静止電位
神経活動
THE NERVE IMPULSE

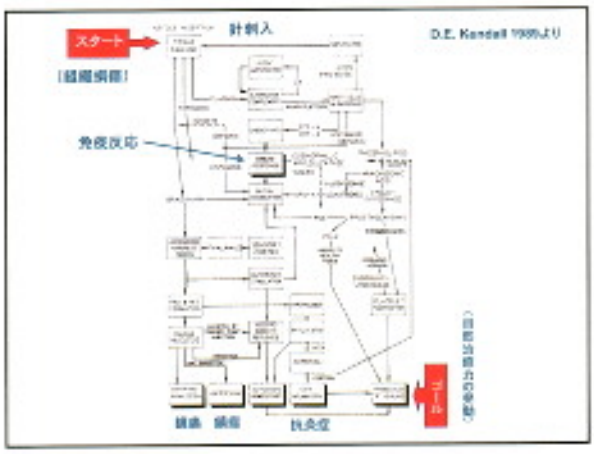

Acupuncture Needle 針
Detail
細胞外液
Extracellular space
Na⁺
Cell membrane
細胞膜
Cells
細胞
合金（針）
Metal (Needle)
Cell membranes are activated by energization
通電により細胞膜は活動する
Fermi-layer
Dipole matrix
細胞基質
A
B

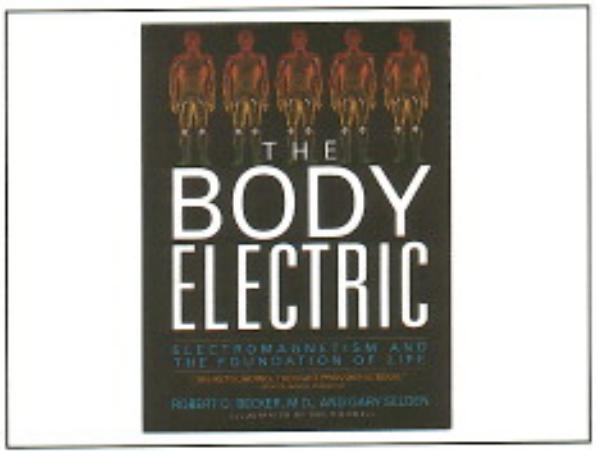

Pflüger's law relates the muscle effect to the leading or trailing edge of the pulse, and to anodal or cathodal polarity:
陰極（－）
Leading edge cathodal
strongest effect
Leading edge anodal
Trailing edge anodal
Trailing edge cathodal
weakest effect

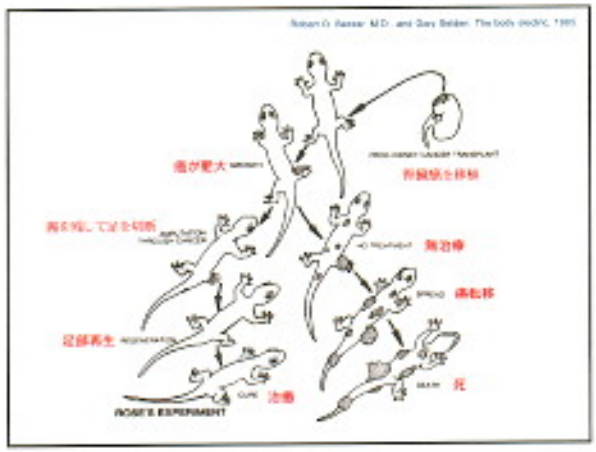


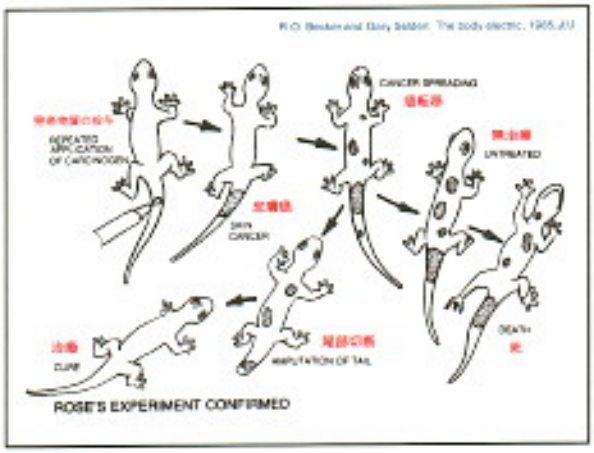


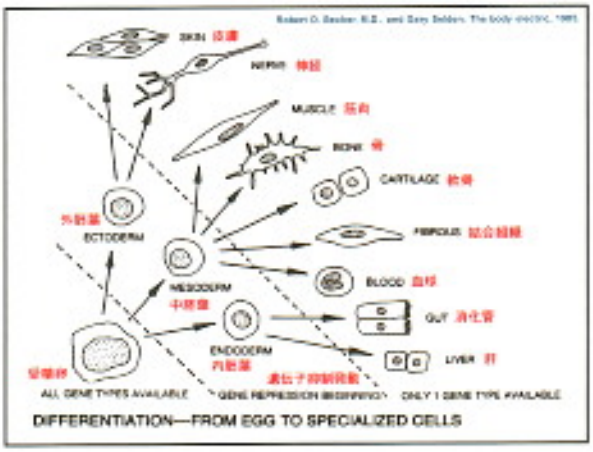
Mechanical tissue damage
機械的刺激（組織損傷）

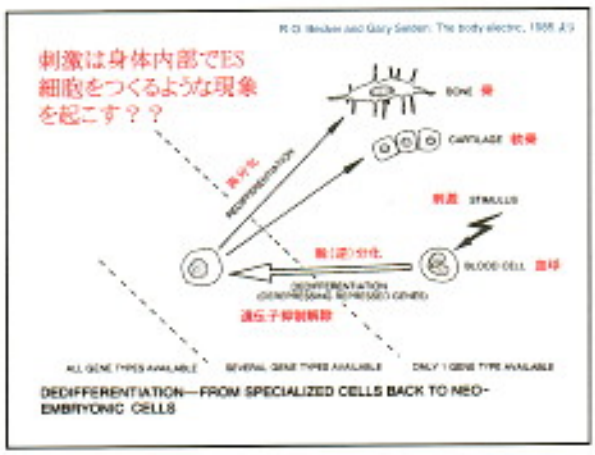












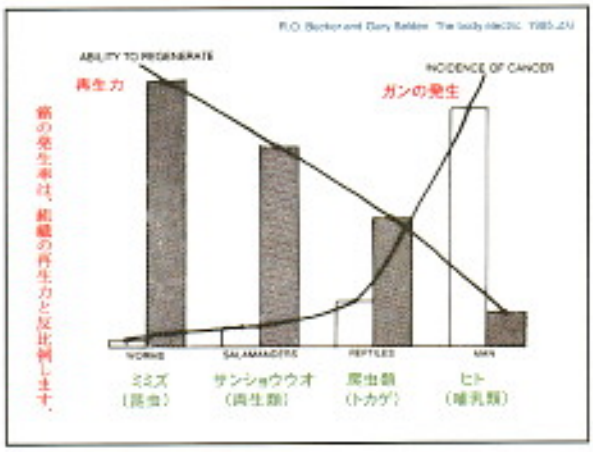
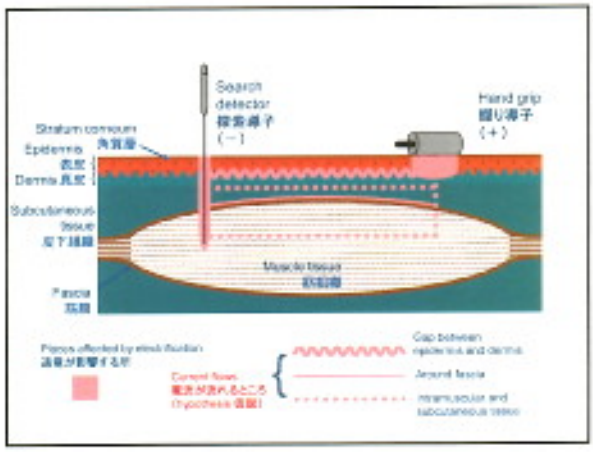


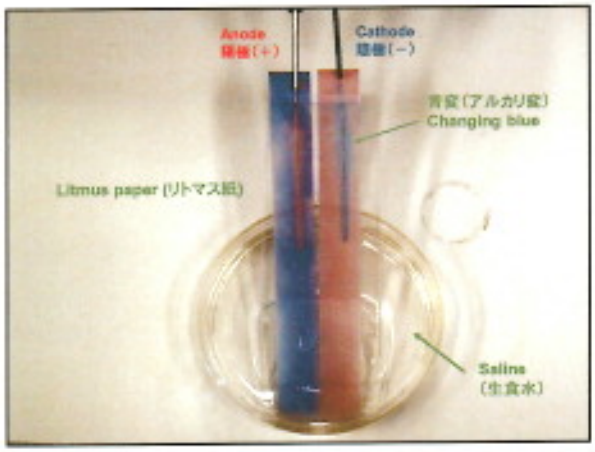
Photo-Nr. 10
Unterhautgewebe. Einwanderung von neutrophilen Granulozyten (Achidophil-zellen)

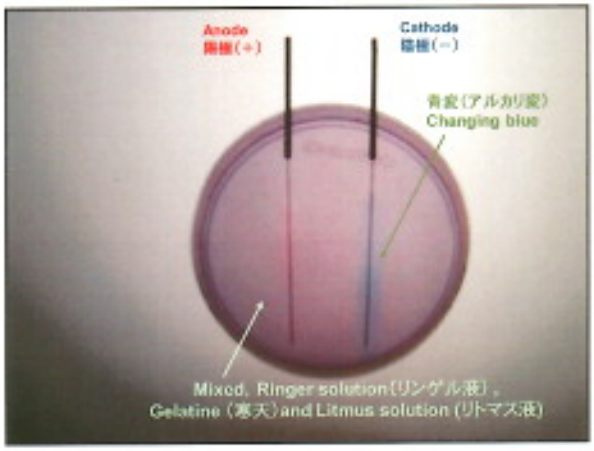
c) Gleichstrom legt 10 sec an der Nadel

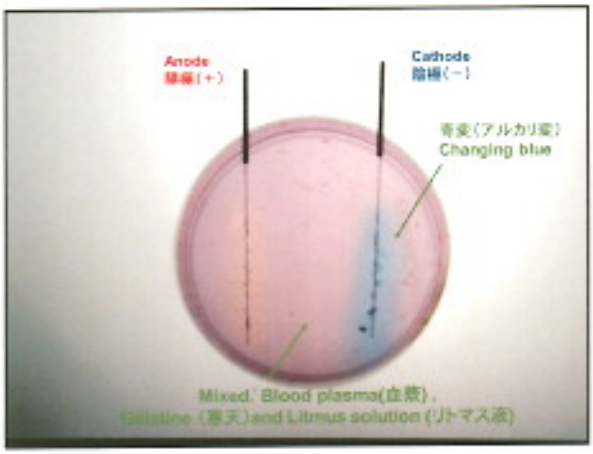
Photo-Nr. 24
Austritt von Zellen im Gewebe, leichte Erweiterung der Blutgefäße

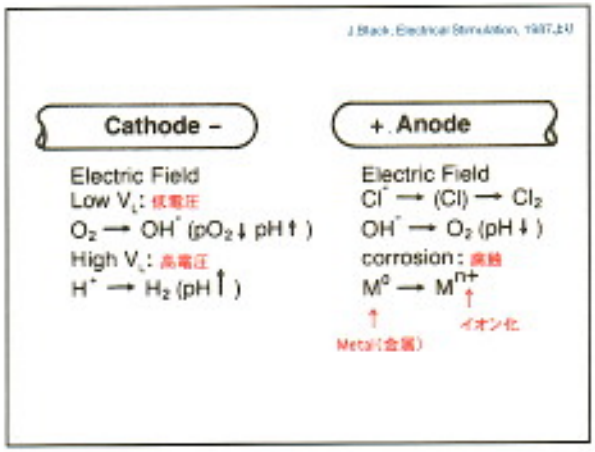
Biochemical stimulation
生化学的刺激

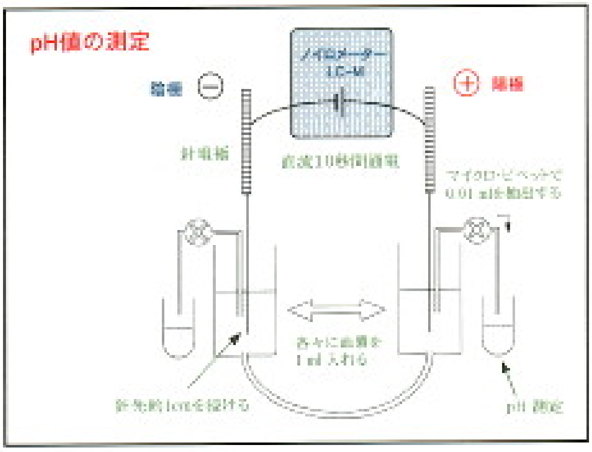


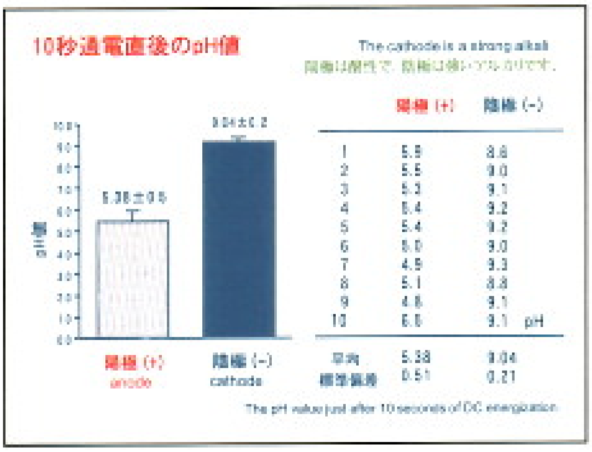




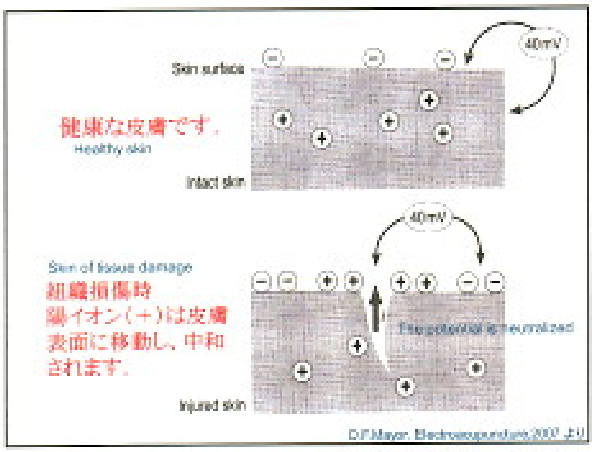


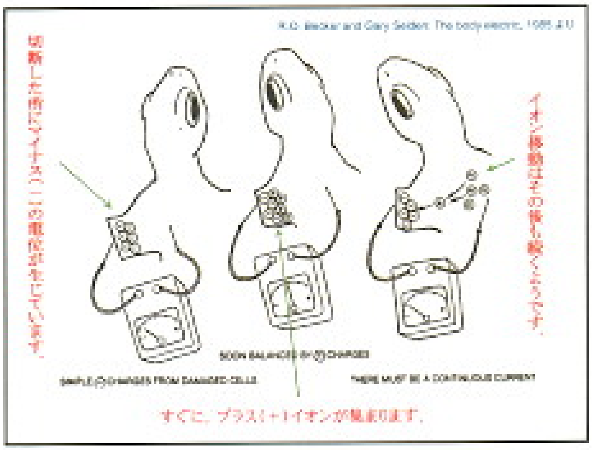


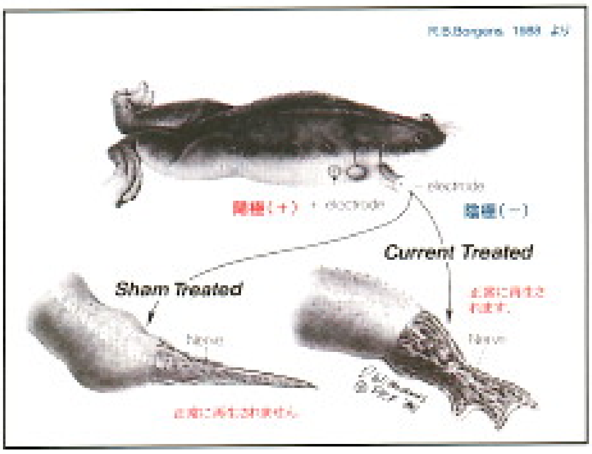


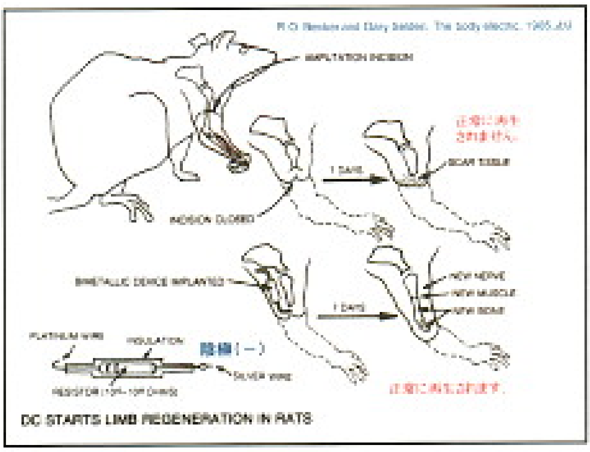


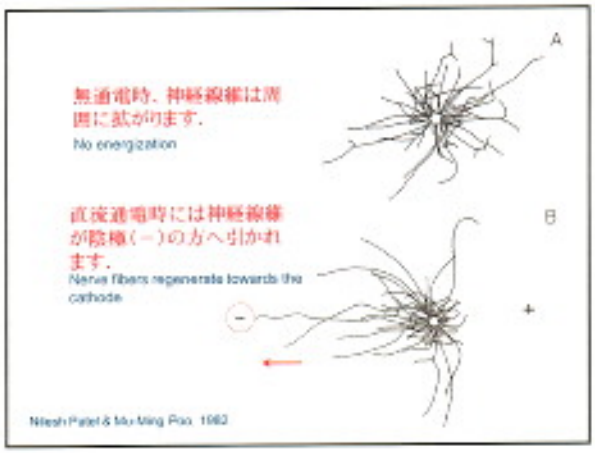
	陽極(+)	陰極(−)
1	5.9	8.8
2	5.5	9.0
3	5.3	9.1
4	5.4	9.2
5	5.4	9.2
6	5.0	9.0
7	4.9	9.3
8	5.1	8.8
9	4.8	9.1
10	6.5	9.1 pH
平均	5.38	9.04
標準偏差	0.51	0.21





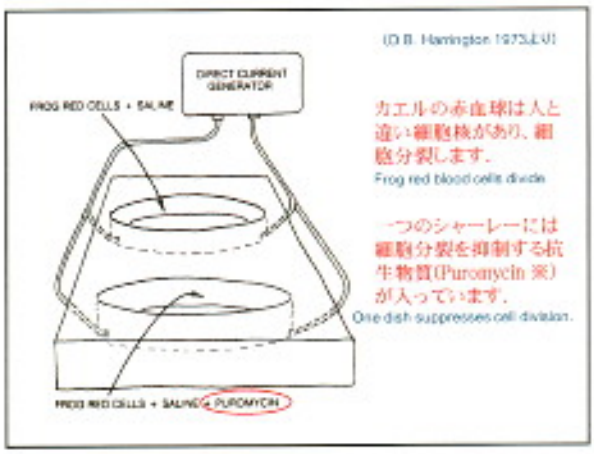


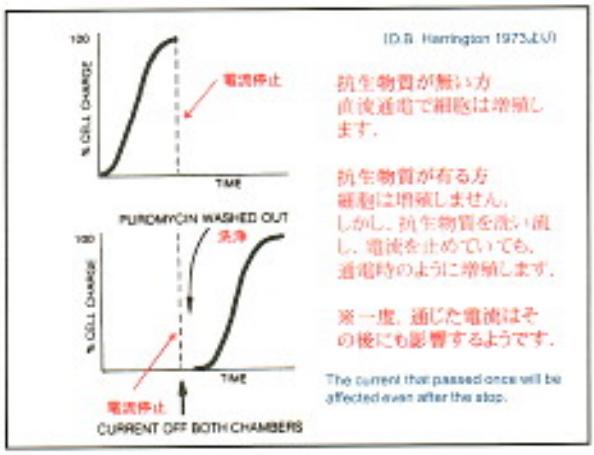


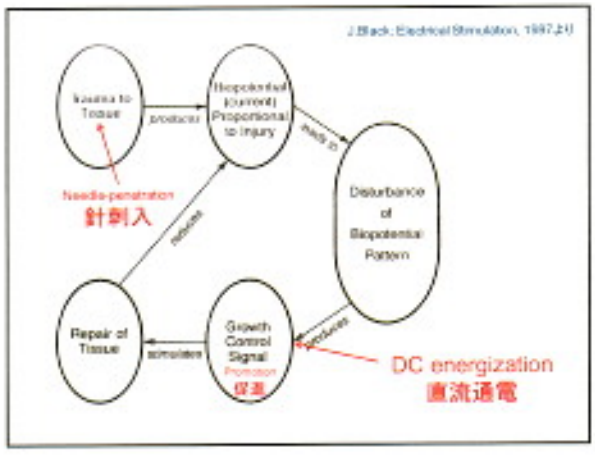

無通電時，神経線維は周囲に拡がります．
No energization
直流通電時には神経線維が陰極（－）の方へ引かれます．
Nerve fibers regenerate towards the cathode
A
B
−
+
Nilesh Patel & Mu-Ming Poo 1982

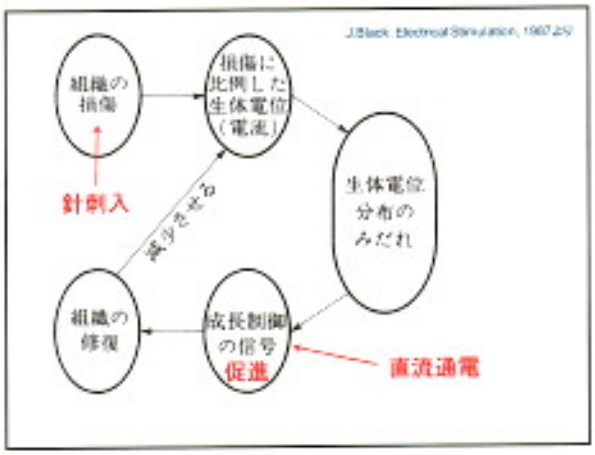

Energizing set
Cathode
陰極
Set seeds
(9V, 150μA)
Radicle grows well at the cathode

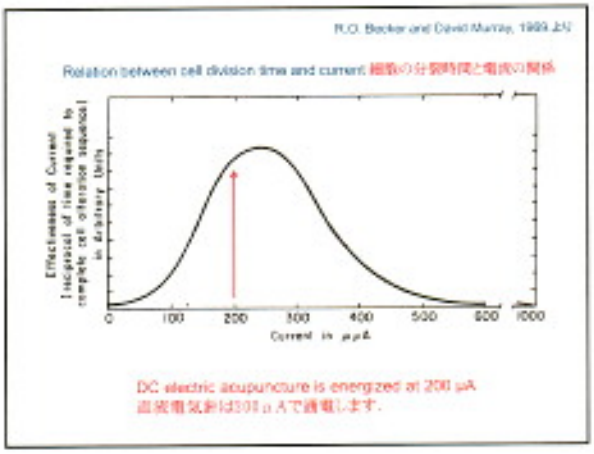

No energization
9V,150μA
Energization


(D.B. Harrington 1975より)
DIRECT CURRENT GENERATOR
FROG RED CELLS + SALINE
FROG RED CELLS + SALINE + PUROMYCIN
カエルの赤血球は人と違い細胞核があり、細胞分裂します。
Frog red blood cells divide
一つのシャーレーには細胞分裂を抑制する抗生物質(Puromycin ※)が入っています。
One dish suppresses cell division.


(D.B. Harrington 1975より)
% CELL CHARGE
TIME
電流停止
PUROMYCIN WASHED OUT
洗浄
CURRENT OFF BOTH CHAMBERS
抗生物質が無い方
直流通電で細胞は増殖します．
抗生物質が有る方
細胞は増殖しません．
しかし、抗生物質を洗い流し、電流を止めていても、通電時のように増殖します．
※一度、通じた電流はその後にも影響するようです．
The current that passed once will be affected even after the stop.


J.Black, Electrical Stimulation, 1997より
Trauma to Tissue
Biopotential (current) Proportional to Injury
Disturbance of Biopotential Pattern
Growth Control Signal
Repair of Tissue
needle-penetration
針刺入
DC energization
直流通電


J.Black Electrical Stimulation, 1987 より
組織の損傷
損傷に比例した生体電位（電流）
針刺入
減少させる
生体電位分布のみだれ
組織の修復
成長制御の信号
促進
直流通電


R.O. Becker and David Murray, 1969 より
Relation between cell division time and current 細胞の分裂時間と電流の関係
Effectiveness of Current (reciprocal of time required to complete cell division expressed in arbitrary Units)
0
100
200
300
400
500
600
1000
Current in μμA
DC electric acupuncture is energized at 200 μA
直流電気針は200μAで通電します。


DC electrical acupuncture
直流電気針（ER, EAP）
The cathode(-) is energized for about 7-10 seconds at DC 12V, 200μA.
Predicted effect 予想効果
1. It efficiently stimulates excitable cells (muscle, nerve, secretion, etc.).
2. Effective stimulation (tissue damage) is obtained in a short time.
3. Induce natural healing power.


Thank you for your listening.
ご静聴ありがとうございました。