CURRICULUM VITAE

Ken Lukowiak

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Date of Birth - January 10, 1947

Place of Birth - Newark, NJ., U.S.A.

Citizenship - Canadian

Marital Status – Married (Ms. Kim McKenney), two children (Kai-age 31 and Bryn- age 28)

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DEGREES HELD

B.Sc., Iona College, June l969 - Biology.

Ph.D., State University of New York, Albany, August l973 - Neurophysiology
1980

RESEARCH EXPERIENCE

1969 -1973 Thesis work under direction of Dr. Jon W. Jacklet,
S.U.N.Y., Albany.
1973 - 1974 Post-doctoral Fellow, Human Development Studies Program, University of Kentucky Medical Centre.
1974 - 1975 N.I.H. Post-doctoral Fellow, Department of Physiology & Biophysics, U.K. Medical Center, with Dr. Bertram Peretz.

1975 - 1978 Assistant Professor, Department of Physiology, McGill University Montreal PQ Canada.

1978 - 1980 Assistant Professor, Division of Medical Physiology, University of Calgary.

1981 - 1986 Chairman, Neuroscience Research Group, Faculty of Medicine, University of Calgary.

1980 - 1985 Associate Professor, Department of Medical Physiology, University of Calgary.

1985 - present Professor, Department of Physiology & Pharmacology University of Calgary.

1981 - 1991 Visiting Professor, Tribhuvan University, IOM, Kathmandu, Nepal.
(1981, 1983, 1985, 1991; 1999; 2000)

1992 - 1993 Visiting Professor, Fiji School of Medicine, Suva, Fiji. Acting Deputy Head of School (FSM Jan-Aug..... 1993)

1996 - 1998 Professor, Department of Physiology AGU (on leave from Calgary)

2005 - Present Adjunct Professor of Medicine Patan Academy of Health Sciences (Nepal)
2011 - Present Visiting Professor Bugando Medical School (CUHAS), Mwanza Tanzania - Neuroscience to Med Students

TEACHING EXPERIENCE

Graduate Teaching Assistant, S.U.N.Y., Albany, 1969 - 1972.
Introductory Biology, Fall l969 to Spring 1971.
Systemic Physiology, Summer 1971.
Neurophysiology, Spring 1972, 1973.

Developmental Psychobiology, University of Kentucky, Spring, 1974.

Honours Neurophysiology Program, McGill University, 1975-1977.
Advanced Neurophysiology, Fall 1975-1977.
Neuroscience Research Seminar, Spring 1976, Spring 1977, 1978.
Introductory Physiology, 1976, 1977.

Neuroscience Course (Med. II) Fall 1978. (Calgary)
MDSC 6l7, Excitable Tissue, 1978 - 1989.
Neuroscience I, (Core Course) 1989-present
Neuroscience II, (Core Course) 1994, 1995 1998 - present
Physiology (Med I) l978-l983.
MDSC 701, Developmental Neurobiology, 1984, 1986.
Neurophysiology, Teaching to Neurology-Neurosurgeon Residents, l984, 1986.

Human Physiology to all levels of Medical students in Fiji

Human Physiology to all levels of Medical students in Bahrain

Integrative Human Physiology (Course for 4th year undergraduates in Honours program) Course co-ordinator and principal teacher (1988-2003)

MDSC 409 Brain and Society (course for 4th year BHSc Honours undergrads; 2006-**present**
Neurol 201 (Introductory course for Honours BSc program in Neuroscience 2009 -2011
Neuro 451 (4th yr course for Honours BSc program in Neuroscience 2011-**present**)
MDSC 402 (3rd yr course for O'Brien-BSc HS program) 2010-**present**
MDSC 507 (Global Health for O'Brien-Bsc HS program) 2012-**present**
Neuroscience for Med Students in Tanzania (CUHAS) 2010-**present**
Neuroscience for Med students @PAHS (Kathmandu, Nepal) 2010-**present**

PRINCIPLE RESEARCH INTERESTS

Neuronal Mechanisms of Learning and Memory
Neurophysiology of Invertebrate Behavior
Developmental Neurobiology
Mechanisms of Plasticity in Invertebrate Nervous Systems
Peripheral Neural Circuits
Neural-active Peptides
Central Pattern Generators
Neuroethology
Behavioural ecology
Predator-prey interactions
Undernutrition and human development
Masai Birthing Practices
The Garcia-effect

PROFESSIONAL SOCIETIES

Canadian Society of Zoologists
Society for Neuroscience
International Brain Research Organization
International Society for Neuroethology

COMMITTEES OF INTERNATIONAL SOCIETIES

1984-1990 Chairman, Visiting Lecture Traveling Program for IBRO
1984-1990 Member, IBRO Central Committee

COMMITTEES OF NATIONAL SOCIETIES

1981-1984 Councilor for Canadian Association for Neuroscience
1981-1983 Auditor for Canadian Physiological Society

UNIVERSITY WIDE COMMITTEES

1981-1986 Member, Board of Directors, VRRI
1982-1984 Member, Executive Board of VRRI
1990- Board of Directors TUCFA (university of Calgary, Faculty Association)
GFC (Governing Body of the University) 1994- 2015; 2016-2020; 2023-present
Board of Governors, The Faculty Association, 1990-1996
Executive Faculty Council CSM 2013-2015; 2016-2020

GRANTS

Human Development Studies Program 1973-1974
N.I.H. Post-doctoral Fellow 1974-1975

On-going Competitive Research operating grants

MRC -Canada; CIHR 1975-present (operating grants; 125,000/yr to 2013)
NSERC Canada from 2013 renewal 2019 - 2025 @ 55,000/yr)

Alberta Heart Foundation 1979-1981
AHFMR - Major Equipment 1980, 198l, 1982, 1983,1985, 1991, 1995
Alberta Heart Foundation 1981-1985
NSERC (with A.G.M. Bulloch) 1991-1997
MRC Term Grant (with A.G.M. Bulloch) 1984-1989
NATO Grant (2 years) 1988-1990
NATO Grant (2 years) 1995-1997
Canadian Commission for UNESCO 1986-1990

GRAD STUDENTS AND POST DOCTORAL FELLOWS

Peter Ruben (Ph.D., November l98l) Professor, Simon Fraser University (Vancouver, BC)
Jeff Goldberg (Ph.D., July l983) Professor and Head Dept of Biology, Univ. of Calgary
Sam Weiss (Ph.D., July l983), Professor and Head Hotchkiss Brain Institute Univ. of Calgary
Sandra Wernham (M.Sc., 1982)
Karen Voshart (l98l-l982 withdrew)
Daniela Gadotti (M.Sc., 1985)
Elaine Colebrook (M.Sc., 1987)
David Cawthorpe (M.Sc., 1988)
Janet Richmond (Ph.D., 1989)(Professor, Univ of Illinois)
Manuel Martinez-Padron (Ph.D.1991) Assistant Professor University of Madrid
Michael Wickham (M.Sc., 1989 -1992, Director, ER Canmore Hospital))
Nadine Ewadinger (M.Sc., 1989- 1993)
Dan Bing-Wang (M.Sc.1991-1994)
Zhong-Ping, Feng (Ph.D. 1995- 1998) Associate Professor, Dept of Physiology, Univ of Toronto
Zara Haque (MSc – 1997 – 1999)
David Munno (Ph.D. 1998 – 2003)
Susan Sangha (Ph.D. 2000 – 2004) Human Frontiers PDF Germany
Chloe McComb (MSc 2000 – 2002)

Kashif Paravez (PhD 2002-2006) Medicine Univ of Toronto
David Rosenegger (Ph.D. 2002-2009; Research Assoc Bains lab)
Kara Martens (MSc 2004- 2006) Medicine Univ of Calgary
Mike Orr (2005 – 2008 (PhD; Post-doc in Seattle)
Jae Il-Han (2008-2010 MSc; Industry Korea)
Dr. John Edstrom (MRC - PDF) Research Professor University of Oregon
Dr. Peter deFur (AHFMR - PDF) Professor, George Mason University, Virginia
Dr. Janet Leonard (AHFMR - PDF) Professor, UC Santa Barbara
Dr. Jim Thornhill (MRC - PDF) Professor, University of Saskatchewan
Dr. William Colmers (AHFMR-PDF) Professor, University of Alberta
Dr. Mel Kelley (AHFMR-PDF) Professor, Dalhousie University
Dr. A.D. Murphy (AHFMR - PDF) Professor, Univ. of Illinois, Chicago
Dr. N. Syed (MRC - PDF) Professor and Head Cell Biology, University of Calgary
Dr. Wic Wildering (CNE-PDF) Assistant Professor, Dept of Biology Univ of Calgary
Dr. Gaynor Spencer (MRC-PDF) Associate Professor Brock Univ (Ontario)
Dr. Petra Hermann (NSERC PDF) Research Assistant professor Biology University of Calgary
Dr. Barbara Taylor (NSERC PDF) Associate Professor University of Alaska (Fairbanks)
Dr. Andi Scheibenstock (CIHR 1999- 2001) Physician Cranbrook, BC
Dr. H. Sadamoto (JSPS –2001-2003) Assistant Professor Tokushima Bunri University (Japan)
Dr Sarah Dalesman (2008 - 2012). Associate Professor Aberystwyth, Wales UK
Dr. Marvin Braun (2009 - 2011) Neurologist Univ of Calgary
Dr Hiroshi Sunada (PDF, 2011-2018) Assistant Professor Japan
Dr Anu Batabyal 2020-2023 Assistant Professor, FLAME University Pune India
Vero Rivi (PhD student-joint with Univ of Modena in Italy 2020-2022)

Undergraduate Honours Theses (BHSc -Faculty of Medicine and BSc Honours Neuroscience (Faculty of Science)
Pacaline de Caigny
Karla Hittel
Katherine Watson
Bogdon Knezevic (Rhodes Scholar)
Vikram Karnik
Jovita Byzitter
Lee Fruson
Hamza Riaz
Sarah Lee
Shawn Dodd
Naomi Ie
Ryan Tan
Romina Soudavari
Stephanie Krieger
Diana Kagan
David Chu
Bevin Wiley
Jasper Hollins
Grace Pele

Jazmyn Miro
Jillian Kitt
Kate Yakubets (Ukrainian refugee)

Editorial Boards

Journal of Experimental Biology – Editor – October 2004 - 2023
Molecular Neurobiology Editor 2008 - present
Communicative & Integrative Biology 2008 - present

Notable Awards;
Guenter Award (Univ of Calgary) International Education activities
Killam University of Calgary 2015 (mentorship for Undergrads)
Rhodes Foundation 2016 Mentorship for early career scientists

RESEARCH

DOCTORAL RESEARCH

A peripheral neural circuit in the siphon of *Aplysia* mediates significant behavioural modifications (habituation and sensitization) of a siphon withdrawal response. The withdrawal response and the behavioural modifications are not different when the central nervous system is removed. However, there is an interaction between the peripheral and central neural circuits mediating the behavioural responses of the siphon. Normally the adaptive behaviour is mediated by the integrated activity of both the peripheral and central neural circuits.

DEVELOPMENT NEUROBIOLOGY.

In *Aplysia* habituation of the gill withdrawal reflex is mediated by a peripheral neural plexus. However, in mature *Aplysia* the CNS modulates this behaviour by suppressing the reflex amplitude and speeding the rate of habituation. I have found that in immature *Aplysia* this CNS modulation is not present. Thus, in *Aplysia*, as in vertebrates, behavioural inhibition is less in younger animals. At the neuronal level the excitability of identifiable neurons in immature animals to tactile stimulation of the gill is greater than in large animals. Preliminary evidence indicates that this greater excitability is due to less pre-synaptic inhibitory activity in small animals. More recently, I have found that the gill withdrawal reflex evoked by siphon stimulation is also an age dependent behaviour. Removal of the branchial nerve influence in young animals did not affect the behaviour, whereas, in older animals, this had significant effects. This preparation is thus suited for studying the behaviour and related neuronal activity during development.

INTERACTION BETWEEN PNS-CNS

In *Aplysia*, my laboratory has shown that the CNS and PNS interact to form an integrated system which mediates adaptive gill withdrawal reflex behaviours. In this system the PNS appears to mediate the basic reflex while the CNS exerts suppressive and facilitatory control over the PNS. The presence of the CNS

confers greater adaptability on the reflex. Studies are now underway to elucidate the mechanisms by which CNS control is mediated. It appears that a dopaminergic pathway, possibly involving an identified central neuron L9, is responsible for the CNS facilitatory control. Present work is focusing on the role played by gill ganglion as regards CNS modulation of the PNS in the gill.

BEHAVIOURAL STATE

How a preparation will respond to a standard stimulus is dependent on the specific behavioural state of the animal. For instance, following a meal, gill withdrawal reflex behaviours are suppressed compared to control preparations which are not food satiated. Similarly, in animals engaged in sexual activity, just before dissection gill withdrawal reflex behaviours are significantly suppressed. Thus, it is extremely important to take the particular behavioural state of an animal into consideration before coming to any conclusions concerning the neuronal mechanisms which underlie adaptive behaviour. We are presently pursuing how behavioural state is mediated. It is probable that peptides are playing a major role in modulating the level of responsiveness of various reflexes.

NEURAL ACTIVE PEPTIDES

We have obtained the first definite evidence that a peptide which was previously only found the vertebrate nervous system is present in the nervous system of *Aplysia*. This peptide is arginine vasotocin (AVT). In addition, AVT has been shown to have very potent behavioural effects at concentrations as low as 10^{-12} M. Not only does AVT affect gill behaviours but we have also been able to demonstrate an effect at a monosynaptic connection between a siphon mechanoreceptor neuron and a central gill motor neuron. AVT causes the suppression of this EPSP. Other peptides which are being studied include Met-enkephalin, FMRF amide, Ang II, Substance P, proctolin, SCPB. These studies involve the gill withdrawal reflex; the isolated heart and gill; and the central pattern generator responsible for feeding in *Aplysia* and *Helisoma*.

CLASSICAL CONDITIONING

An *in vitro* model system which can be classically conditioned has now been described. This is a tremendous breakthrough. A neural correlate of this associative learning has now also been obtained. Experiments are now in progress in an attempt to gain an understanding of the neuronal mechanisms which underlie this learning. An examination is also being made of the classic Hebb synapse model.

APLYSIA HEART PREPARATION

We have developed a preparation in which we can study the mechanism by which the CNS exerts long term control over cardiac behaviours. We have found that the *Aplysia* heart is sensitive to very low concentrations (to 10^{-15} M) of peptides which may be released directly on to the heart. In addition, we have found that the peptide effects are not mediated via cyclic AMP.

RAT HIPPOCAMPAL SLICE PREPARATION

We have been the first to study the action of Neuropeptide Y, using electrophysiological techniques, on a mammalian preparation. We have found that this peptide has potent pre- synaptic effects. We are presently looking at this peptide's effect on CA3 cells. In parallel with these experiments, we are using push-pull techniques to determine the behavioural effects of neuropeptide Y on awake, conscious rats. These experiments are being performed in collaboration with Dr. Quentin Pittman.

ONGOING RESEARCH

OPERANT CONDITIONING

We have begun to operantly condition aerial respiratory behaviour in the pond-snail *Lymnaea stagnalis*. This animal periodically comes to the surface to breath (much like a diving mammal). However it can survive(for at least 36 h) without coming to the waters surface. In that situation gaseous exchange occurs across the skin in the water. The conditioning paradigm is as follows. The pneumostome area of the animal is stimulated just as the animal gets ready to open this structure to breath. Tactile stimulation of this organ prevents it from opening and the animal can not breath aerially. Over a one hour training period the animal learns not to open its pneumostome. Learning persists for at least 4 days. Yoked controls do not exhibit this behaviour. It appears that intrinsic membrane properties of neurons that make up the CPG (see below) are altered by the training paradigm. Thus learning may be the result of changing active channels in the membrane. The somata of RPeD1 is required for LTM formation of the learned behaviour.

EXTINCTION IS NOT UNLEARNING

We have found that we can extinguish (Pavlovian extinction) the learned behaviour that had been operantly conditioned. We further found that extinction is dependent on altered gene activity and new protein synthesis. As well the presence of the somata of a single neuron, RPeD1, is required. However, the phenomenon of spontaneous recovery is seen indicating that extinction is not unlearning only that it occludes the original memory.

RECONSOLIDATION OF MEMORY

Whenever a memory is made active it must go through a reconsolidation process in order to re- stabilize it. Reconsolidation is dependent on altered gene activity, new protein synthesis and the somata of RPeD1. However, we have now found that as a memory becomes more and/or better rehearsed reconsolidation first becomes independent of altered gene activity and the presence of RPeD1's somata. As the memory becomes even more entrenched reconsolidation finally becomes protein synthesis independent. We are uncertain what processes occur that underlie this change and how an active memory is no reconsolidated after being made active.

FORGETTING IS AN ACTIVE PROCESS

We have been able to demonstrate that in order to forget a non-declarative memory altered gene activity, new protein synthesis and RPeD1's somata are a necessary requirement. So too in order to forget the

snail must be able to perform the behaviour and not be reinforced. All these data support the hypothesis that forgetting is the result of retroactive interference.

CENTRAL PATTERN GENERATORS

Rhythmic behaviours such as locomotion, eating and breathing are thought to be mediated by neuronal circuits that produce rhythmic activity even when they only receive tonic input or no input whatsoever. These have been termed central pattern generators (CPGs). To determine how a circuit can produce such rhythmic activity has proven to be an extremely difficult task. We were the first group to be able to reconstruct a CPG in culture. We are now in the process of determining the membrane events that underlie the generation of rhythmic activity in a circuit.

NATURE VS NATURE

The nervous system posses a tremendous amount of plasticity. Many workers have attempted to determine the parameters to which this plasticity can be pushed. In other words, "How much of this plasticity is innate and how much of it is the result of the organism interacting with its environment?" We are now attempting to answer this question by rearing snails under conditions in which they will never have the opportunity to exhibit aerial respiration. We will thus be in a position to determine how the CPG is affected by the lack of use.

Configural learning

Configural learning, is a higher-order form of associative learning (Giurfa, 2003). This higher-order conditioning requires that the animal make meaningful comparisons between current sensory stimuli and its representation of previous sensory experiences, making it more 'cognitive' compared with lower-order learning

The Garcia effect

A unique form of conditioned taste aversion (CTA), the Garcia effect (Garcia, et al., 1966). We have recently demonstrated this in *Lymnaea* (Rivi et al., 2021b). In this form of CTA there can be a prolonged delay (hours) between a single novel taste experience and a feeling of nausea or sickness. The animal (including humans) then comes to avoid that food.

PUBLICATIONS (Peer reviewed journals only)

Ken Lukowiak, Professor Department of Physiology and Pharmacology. Peer-reviewed Publications. **Abstracts and book chapters not included**.

1) Lukowiak, K. and Jacklet, J.W. (1972). Habituation and dishabituation: Interactions between peripheral and central nervous system in *Aplysia*. Science 178: l306-1309

2) Lukowiak, K. (1973) Peripheral and central neural processes in habituation in reflexes in *Aplysia*. Ph.D. Thesis, S.U.N.Y., Albany.

3) Jacklet, J.W. and Lukowiak, K. (1975) Neural processes in habituation and dishabituation in model system. Prog. Neurobiol. 4: 1-57.

4) Lukowiak, K. and Jacklet, J.W. (1975). Habituation and dishabituation mediated by the peripheral and central neural circuits of the siphon of *Aplysia*. J. Neurobiol. 6: 183-195.

5) Peretz, B. and Lukowiak, K. (1975) Age-dependent control of the habituating gill withdrawal reflex and of correlated activity in identified neurons in *Aplysia*. J. Comp. Physiol. 103: 1-17.

6) Peretz, B., Jacklet, J.W. and Lukowiak, K. (1976) Habituation of reflexes in *Aplysia*: The relationship between central and peripheral nervous systems. Science 191: 396-399.

7) Lukowiak, K. and Peretz, B. (1977). The interactions between the central and peripheral nervous systems in the mediation of gill withdrawal reflex behaviour in *Aplysia*. J. Comp. Physiol. 117: 219,.

8) Lukowiak, K. (1977) Gill reflex habituation in *Aplysia*: Importance of peripheral termination's of the branchial nerve. Can. Physiol. Pharmacol. 55: 1252-1262,.

9) Lukowiak, K. (1977) Stimulation of the branchial nerve evokes suppression of the gill withdrawal reflex in young *Aplysia*. Brain Res. 132: 553 - 563.

10) Lukowiak, K. (1977) Facilitation, habituation and the retardation of habituation of L7's elicited gill withdrawal response in *Aplysia*. Brain Res. l34: 387-392

11) Lukowiak, K. (1979) Picrotoxin prevents habituation of the gill withdrawal reflex in *Aplysia*. Can. J. Physiol. Pharmacol. 56: 1079-1082.

12) Lukowiak, K. (1979) L9 modulation of L7's elicited gill withdrawal response in *Aplysia*. Brain Research l63: 207-222.

13) Lukowiak, K. (1979) L9 modulation of gill withdrawal reflex habituation in *Aplysia*. J. Neurobiol. 10: 255-271..

14) Ruben, P. and Lukowiak, K. (1979) Dopamine modulation of gill reflex behavior in *Aplysia*. Can. J. Physiol. Pharmacol. 57: 329-332.

15) Lukowiak, K. (1979) The development of CNS control of the gill withdrawal reflex evoked by siphon stimulation in *Aplysia*. Can. J. Physiol. Pharmacol. 57: 987-997.

16) Lukowiak, K. (1980) CNS control over gill reflex behaviors in *Aplysia*: Satiation causes an increase in the suppressive control in older but not young animals. J. Neurobiol. 11: 591-611.

17) Lukowiak, K., Thornhill, J., Cooper, K.E. and Veale, W.L. (1980) Vasopressin increases the central nervous system suppressive control over gill reflex behaviours and associated neural activity in *Aplysia*. Can. J. Physiol. Pharmacol. 58: 583-587.

18) Moore, G.J., Thornhill, J.A., Gill, V., Lederis, K. and Lukowiak, K. (1980) An arginine vasotocin-like neuropeptide is present in the nervous system of the marine mollusc *Aplysia californica*. Brain Res. 206: 213-218.

19) Lukowiak, K. and Peretz, B. Control of gill habituation and the rate of EPSP decrement of L7 by a common source in the CNS of *Aplysia*. J. Neurobiol. 11: 425-433, l980.

20) Lukowiak, K. and Sahley, C. (1981) The in vitro classical conditioning of the gill withdrawal reflex in *Aplysia*. Science 212: 1516-1518.

21) Thornhill, J.A., Lukowiak, K., Cooper, K.E., Veale, W.L. and Edstrom, J.P. (1981) Arginine vasotocin, an endogenous neuropeptide of *Aplysia*, suppresses the gill withdrawal reflex and reduces the evoked synaptic input to central gill motor neurons. J. Neurobiol. 12: 533-544.

22) Ruben, P., Goldberg, J., Edstrom, J., Voshart, K. and Lukowiak, K. (1981) What the marine mollusc *Aplysia* can tell the neurologist about behavioral neurophysiology. Can. J. Neurol. Sci. 8: 275- 280.

23) Lukowiak, K., Thornhill, J.A. and Edstrom, J. (1982) Methionine enkephalin increases CNS suppressive control exerted over gill reflex behaviours and associated neural activity in *Aplysia californica*. Reg. Peptide 3: 303-312.

24) Goldberg, J. and Lukowiak, K. (1982) Transfer of habituation shows an interaction between neuronal circuits of the gill withdrawal reflex in *Aplysia californica*. J. Exp. Biol. 96: 107-124.

25) Ruben, P. and Lukowiak, K. (1982) Habituation and dishabituation in isolated gill pinnules in *Aplysia*. Comp. Biochem. Physiol. 7lA: 585-589.

26) DeFur, P. and Lukowiak, K. (1983) Some *in vivo* and *in vitro* properties of the hemolymph of *Aplysia*. J. Exp. Biol. 101: 347-351.

27) Wernham, S. and Lukowiak, K. (1983) The effects of serotonin, dopamine and arginine vasotocin on the isolated *Aplysia* heart. I. Heart rate and amplitude of contraction. Comp. Biochem. Physiol. 75C: 295-303.

28) Goldberg, J. and Lukowiak, K. (1983) Transfer of habituation between stimulation sites of the siphon withdrawal reflex in *Aplysia*. Can. J. Physiol. Pharmacol. 61: 749-755.

29) Ruben, P. and Lukowiak, K. (1983) Modulation of the *Aplysia* gill withdrawal reflex by dopamine. J. Neurobiology 14: 271-284.

30) Lukowiak, K. and Freedman, L. (1983) The gill withdrawal reflex is suppressed in sexually active *Aplysia*. Can. J. Physiol. Pharm. 61: 743-748.

31) Austin, T., Weiss, S. and Lukowiak, K. (1983) FMRFamide effects on spontaneous and induced contractions of the anterior gizzard in *Aplysia*. Can. J. Physiol. Pharm. 61: 949-953.

32) Leonard, J.L. and Lukowiak, K. (1984) Male-female conflict in a simultaneous hermaphrodite resolved by sperm trading. Amer. Nat. 124: 282-286.

33) Leonard, J.L. and Lukowiak, K. (1984) An ethogram of the sea slug *Navanax inermis* (Opisthobranchia, Gastropoda). Z. Tierpsychol.: 65: 327-345.

34) Roth, J.D., Lukowiak, K. and Berry, R.W. (1984) Long-lasting inhibition of neuron R15 of *Aplysia*: Role of the interneuron II network. Comp. Biochem. Physiol. 78A: 83-89.

35) Hicks, T.P., Edstrom, J.P. and Lukowiak, K. (1984) Effects of octopamine and serotonin on neurones of *Aplysia californica*. In: Trace Amines and the Neurosciences (A.D. Boulton, Ed.) Humana Press. pp. 225-246.

36) Weiss, S., Goldberg, J., Chohan, K., Stell, W., Drummond, G.I. and Lukowiak, K. (1984) Evidence for FMRFamide as a neurotransmitter in the gill of *Aplysia californica*. J. Neurosci. 4: 1996-2000.

37) Leonard, J.L. and Lukowiak, K. (1984) The squishy revisited: A call for ethological affirmative action. Behavioral and Brain Sciences 7: 394-397.

38) Goldberg, J.I. and Lukowiak, K. (1984) Transfer of habituation in *Aplysia*: Contribution of hererosynaptic pathways in habituation of the gill withdrawal reflex. J. Neurobiol. l5: 395-411.

39) Weiss, S., Goldberg, J.I., Edstrom, J.P. and Lukowiak, K. (1984) Cholinergic receptors in the *Aplysia* gill. J. Neurobiol. 15: 325-332.

40) Drummond, G.I., Wernham, S. and Lukowiak, K. (1985) Stimulation of adenylate cyclase in the heart of *Aplysia* by biogenic amines. Comp. Biochem. Physiol. 80C: 129-133.

41) Leonard, J.L. and Lukowiak, K. (1985) The standard ethogram: A two-edged sword? Z. Tierpsychol. 68: 335-337.

42) Cawthorpe, D.R.L., Rosenberg, J., Colmers, W.F., Lukowiak, K. and Drummond, G.I. (1985) The effects of small cardioactive peptide B on the isolated heart and gill of Aplysia californica. Can. J. Physiol. Pharmacol. 63: 918-925.

43) Colmers, W.F., Lukowiak, K.D. and Pittman, Q.J. (1985) Neuropeptide Y reduces orthodromically evoked population spike in rat hippocampal CA1 by a possibly presynaptic mechanism. Brain Res. 346: 404-408.

44) Mpitsos, G.J. and Lukowiak, K. (1985) Associative and non-associative learning in gastropod molluscs. In: The Mollusca, Vol. 8: "Neurobiology and Behavior" (ed. A.O.D. Willows) Academic Press, N.Y. pp. 95-267.

45) Murphy, A.D. Stell, W., and Lukowiak, K. (1985) Peptidergic modulation of patterned motor activity in identified neurons of *Helisoma.* Proc. Nat. Acad. Sci. 82: 7140-7143.

46) Edstrom, J.P. and Lukowiak, K. (1985) Frequency dependent action potential prolongation in *Aplysia* pleural sensory neurons. Neuroscience 16: 451-460, 1985.

47) Weiss, S., Goldberg, J.I., Lukowiak, K. and Drummond, G.I. (1985) Effect of dopamine and serotonin on cyclic AMP and contractility in the gill of *Aplysia californica*. J. Comp. Physiol. l56: 57-66.

48) Lukowiak, K., Goldberg, J., Colmers, W.F. and Edstrom, J.P. (1986) Peptide modulation of neuronal activity and behaviour in *Aplysia*. In: Comparative Aspects of Opioid and Related Neuropeptide Mechanism. G. Stefano and M. Leung, Eds. (CRC) pp. 129-144.

49) Leonard, J.L. and Lukowiak, K. (1985) Courtship, copulation and sperm-trading in the sea slug, *Navanax inermis* (Opisthobranchia : Cephalaspidea). Can J. Zool. 63: 2719-2729.

50) Leonard, J.L. and Lukowiak, K. (1986) The behavior of *Aplysia californica* Cooper (Gastropoda; Opisthobranchia): I. Ethogram Behaviour 98: 320-360.

51) Lukowiak, K. (1986) In vitro classical conditioning of a gill withdrawal reflex in *Aplysia*: Neural correlates and possible neural mechanisms. J. Neurobiol. 17: 83-101.

52) Richmond, J.E., Bulloch, A.G.M. and Lukowiak, K. (1986) Peptidergic modulation of a neuromuscular junction in *Aplysia*: Bioactivity and immunocyctochemistry. Brain Res. 370: 159-164.

53) Gadotti, D., Bauce, L.G., Lukowiak, K. and Bulloch, A.G.M. (1986) Transient depletion of serotonin in the nervous system of *Helisoma*. J. Neurobiol. 17: 431-447.

54) Leonard, J.L. and Lukowiak, K. (1987) Sperm-sharing: A form of cheating by sperm trading snails. Nature 325: 737-738.

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ABSTRACTS (Over 350) Not listed here in order to save trees!