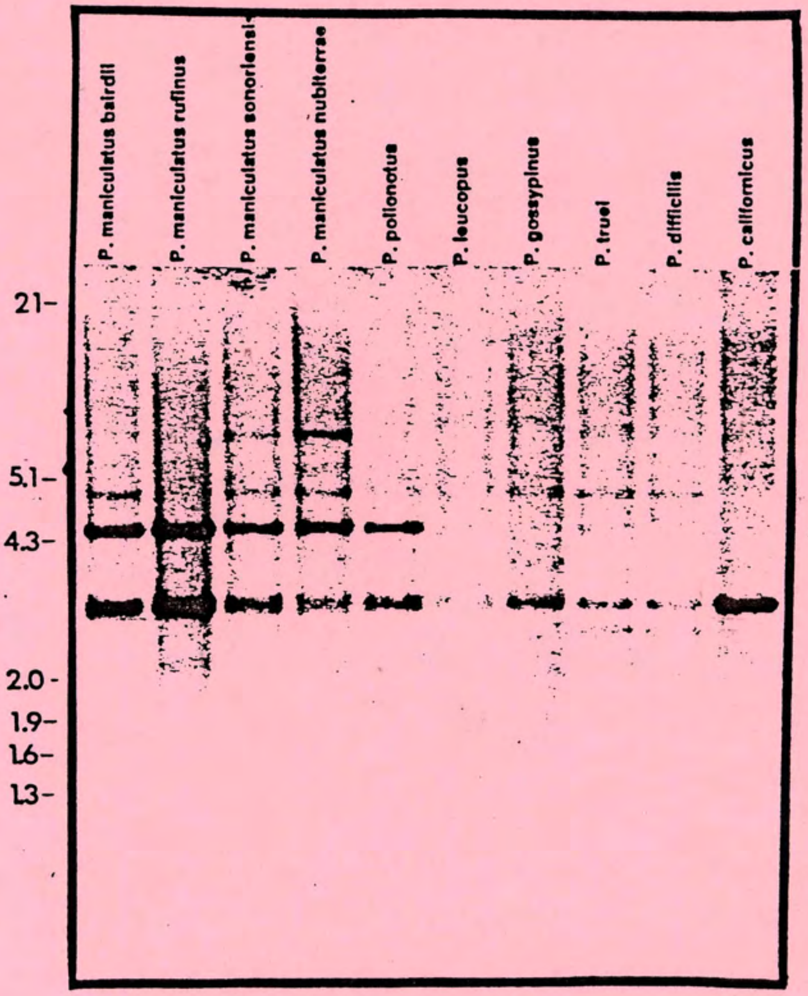
PEROMYSCUS NEWSLETTER

NUMBER TEN



SEPTEMBER 1990

COVER: Concerted gene evolution illustrated by Southern blot of *Xba*I-cleaved DNA from several species and subspecies of *Peromyscus* run on a 1% agarose gel and hybridized to a nick-translated 1.5kb insert of LINE-1 probe pDK55. (Courtesy David Kass)

Welcome to PEROMYSCUS NEWSLETTER Number 10.

With this issue **PN** completes its 5th year. With each issue we have introduced innovations in a continuing effort to improve our effectiveness. In the earlier issues we compiled extensive "gene lists" based on genetic variants reported reported from both natural populations and by formal mendelian analysis. These have become rather repetitious and in the future we will update these on a bi-annual, rather than an annual basis. We hope to devote the space conserved to other aspects of *Peromyscus* biology. Thus, while no gene lists will appear in this issue, we are including a reference table of the issue and page of the most recently updated lists.

John A. King is our featured "Peromyscus Pioneer" for September 1990. We want to thank Bob Robbins, Dick Terman, Lee Drickamer, Richard Snider and Bill McIntosh for helping supply information.

In the very first issue (March 1986) we included a list of *Peromyscus* species modified from Hall's *Mammals of North America* 2nd edition. A number of changes have occurred since that time in systematics of the genus, most notably Mike Carleton's review in the recently published *Advances in the Biology of Peromyscus*. On page 16 of the current issue we list species based on Carleton's analysis, but listing alternatives where a consensus might not exist.

The role of the Peromyscus Genetic Stock Center at the University of South Carolina is being expanded in two new directions:

> 1.) A **"Molecular Bank"** is being established to maintain *Peromyscus* molecular probes, DNA libraries and species-specific DNA samples. These will become available to the research community through the Stock Center. For more details about the *Peromyscus* Molecular Bank, see page 5.
>
> 2.) A *Peromyscus* **Behavior Mutant Center** is being established as a part of the overall mission. The behavior mutant center is located at the Aiken Regional Campus of the University and will be under the direction of Suellen Van Ooteghem. See page 9.

Inclusion of live stocks of several additional species (*P. truei, P. boylii* and *P. californicus*) to the Center during the next 18 months is also planned. Eventually, several cell culture lines will become available through the Center also.

We continue to encourage entries for the "Contributions" section. The ultimate success of PN depends on its use as an informal forum for *Peromyscus* researchers. Please consider sending us your update before the next issue. We will mail a reminder. Deadline for PN # 11 is **February 15, 1991.**

WDD

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University of South Carolina
Columbia SC 29208

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CONTENTS

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News, Announcements and Comment.

Twenty presentations at the annual meeting of the American Society of Mammalogists had "*Peromyscus*" in the title and several others included information concerning the genus. The meeting was held June 9 - 13 at Frostburg State University, Maryland.

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ADVANCES IN THE STUDY OF PEROMYSCUS, Edited by Gordon Kirkland and James Layne, can be purchased from Texas Tech University Press. It is available in both hardbound and soft cover editions.

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Our thanks to Bill McIntosh who recently donated several additional cartons of journals and reprints of historical interest to the Stock Center. These included reprints on *Peromyscus* as well as genetics and mammalogy journals from the 1930's, 40's and 50's.

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Kim Nelson has moved to Penn State University where she has assumed a position in the Institute of Molecular Evolutionary Genetics. (See her entry in "Contributions")

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The *Peromyscus* Genetic Stock Center is interested in learning of any breeding stocks of *Peromyscus* that are being maintained on a permanent or semi-permanent basis. We are also interested in learning of any *Peromyscus* cell lines, molecular probes or libraries that are being maintained. If any readers have these stocks or materials, whether currently available or not, we would appreciate the information.

Please communicate with:
W.D. Dawson, *Peromyscus* Stock Center, University of South Carolina, Columbia, SC 29208.

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THE PEROMYSCUS STOCK CENTER MOLECULAR BANK

The *Peromyscus* Genetic Stock Center will soon initiate a **Molecular Bank**. This new service will begin in **January 1991**. We will be maintaining and supplying molecular materials of *Peromyscus* origin at that time.

Specifically, the service will stock and provide:

1. Probes and clones of *Peromyscus* origin.

2. Genomic and cDNA libraries.

3. Purified high molecular weight DNA from many *Peromyscus* species.

During the coming months we will be soliciting probes and libraries for donation to the *Peromyscus* Molecular Bank. Donated materials will be available for 1.) unrestricted distribution, 2.) conditional distribution, or 3.) distribution only with permission of the original donator. In addition, we intend to develop several probes at the Stock Center by screening *Peromyscus* libraries with *Mus* or human probes.

We will also be seeking living, fresh-killed or fresh frozen animals or tissues from which we may prepare high molecular weight DNA. At this time we do not anticipate maintaining frozen specimens or tissues in the Molecular Bank, since these are already available from several other sources.

Molecular materials will be provided from the bank to researchers for a modest user fee. The charge structure will be published in future issues of **PN**.

The *Peromyscus* Molecular Bank will be operated by the Genetic Stock Center in collaboration with the South Carolina Institute for Biological Research and Technology (SCIBRT), with partial support from the National Science Foundation.

We are very excited about the prospects for the *Peromyscus* Molecular Bank and hope that it will provide a convenient and valuable service to the research community.

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PEROMYSCUS STOCK CENTER

What is the Stock Center? The deer mouse colony at the University of South Carolina has been designated a genetic stock center under a grant from the Biological Research Resources Program of the National Science Foundation. The major function of the Stock Center is to provide genetically characterized types of **Peromyscus** in limited quantities to scientific investigators. Continuation of the center is dependent upon significant external utilization, therefore potential **users are encouraged to take advantage of this resource.** Sufficient animals of the mutant types generally can be provided to initiate a breeding stock. Somewhat larger numbers, up to about 50 animals, can be provided from the wild-type stocks.

A user fee of **$5 per animal** is charged and the user assumes the cost of air shipment. Animals lost in transit are replaced without charge. Tissues, blood, skins, etc. can also be supplied at a modest fee. Write or call for details.

Stocks Available in the Peromyscus Stock Center:

WILD TYPES	ORIGIN
P. maniculatus bairdii (BW Stock)	Closed colony bred in captivity since 1948. Descended from 40 ancestors wild-caught near Ann Arbor MI
P. polionotus subgriseus (PO Stock)	Closed colony since 1952. Derived from 21 ancestors wild-caught in Ocala Nat'l. Forest FL. High inbreeding coefficient.
P. polionotus leucocephalus (LS Stock)	Derived from mice wild-caught on Santa Rosa I., FL. Bred by R. Lacy. 3rd to 5th generation in captivity
P. leucopus (LL Stock)	Derived from 38 wild ancestors captured between 1982 and 85 near Linville NC. Fifth to seventh generations in captivity.
P. maniculatus X *P. polionotus* F_1 Hybrids	Sometimes available.

MUTATIONS AVAILABLE FROM THE STOCK CENTER

Coat Colors	**ORIGINAL SOURCE**
Albino *c/c*	Sumner's albino deer mice (Sumner, 1922)
Ashy *ahy/ahy*	Wild-caught in Oregon ~ 1960 (Teed *et al.*, 1990)
Black (Non-agouti) *a/a*	Horner's black mutant (Horner *et al.*, 1980)
Blonde *bl/bl*	Mich. State colony (Pratt and Robbins, 1982)
Brown *b/b*	Huestis stocks (Huestis and Barto, 1934)
Dominant spotting *S/-*	Wild caught in Illinois (Feldman, 1936)
Gray *g/g*	Natural polymorphism. From Dice stocks (Dice, 1933)
Ivory *i/i*	Wild caught in Oregon. (Huestis, 1938)
Pink-eyed dilution *p/p*	Sumner's "pallid" deer mice. (Sumner, 1917)
Platinum *pt/pt*	Barto stock at U. Mich. (Dodson *et al.*, 1987)
Silver *si/si*	Huestis stock. (Huestis and Barto, 1934)
White-belly non-agouti a^{w}/a^{w}	Egoscue's "non-agouti" (Egoscue, 1971)
Wide-band agouti $A^{Nb/-}$	Natural polymorphism. Univ. Michigan stock (McIntosh, 1954)
Yellow *y/y*	Sumner's original mutant. (Sumner, 1917)

Note: Some of the coat color mutations are immediately available only in combination with others. For example, silver and brown are maintained as a single "silver-brown" double recessive stock. Write the Stock Center or call (803) 777-3107 for details.

MUTATIONS AVAILABLE FROM THE STOCK CENTER (continued)

Other Mutations and Variants	**ORIGIN**
Alcohol dehydrogenase negative Adh^{o}/Adh^{o}	South Carolina BW stock. (Felder, 1975)
Alcohol dehydrogenase positive Adh^{f}/Adh^{f}	South Carolina BW stock. (Felder, 1975)
Epilepsy *ep/ep*	U. Michigan *artemisiae* stock. (Dice, 1935)
Flexed-tail* *f/f*	Probably derived from Huestis flexed-tail (Huestis and Barto, 1936)
Hairless-2 *hre/hre*	Egoscue's hairless (Egoscue, 1962)
Juvenile ataxia *ja/ja*	U. Michigan stock. (VanOoteghem, 1983)

Enzyme variants. Wild type stocks given above provide a reservoir for several enzyme and other protein variants. See Dawson *et al.* (1983).

*Available only on pink-eye dilution background.

Limited numbers of other stocks, species, mutants and variants are on hand, or under development, but are not currently available for distribution. For additional information or details about any of these mutants or stocks contact:

W. D. Dawson
Peromyscus Stock Center
Institute of Biological Research and Technology
University of South Carolina
Columbia SC 29208
(803) 777-3107

The Advisory Committee for the Stock Center:

Ira F. Greenbaum (Texas A&M University)
Rodney C. Honeycutt (Texas A&M University)
Clement L. Markert (North Carolina State University)
Suellen Van Ooteghem (Westinghouse Corporation)
Wallace D. Dawson (University of South Carolina)
Oscar G. Ward *ex officio* (University of Arizona)

PEROMYSCUS BEHAVIOR MUTANT COLONY

MOVES TO UNIVERSITY OF SOUTH CAROLINA, AIKEN

The behavior mutant colony known in *Peromyscus* has recently been moved to the University of South Carolina at Aiken (USCA), and will again be under the supervision of Dr. S. A. Van Ooteghem. This colony had been held in trust by Dr. W. D. Dawson at the University of South Carolina at Columbia (USCC). The purpose of this move is to establish two reciprocal, complementary *Peromyscus* stock centers.

The USCA stock center will focus attention on the behavior mutants, with the long term goal of improving these stocks and characterizing them more fully. This colony, physically removed from the USCC colony, will also hold representatives of each of the other mutant stocks identified in *Peromyscus*, and serve as a "failsafe" colony against the possibility of some catastrophic loss at USCC. The USCC colony will also have a reciprocal function, serving as a backup colony for the USCA behavioral stock center.

The behavior mutant stocks described below will be provided to interested investigators as available and upon request. Potential new behavioral mutations which are, or which can be transferred to a *P. m. bairdii* background are solicited.

Dr. S. A. Van Ooteghem
Biology Department
Box 29
USC - Aiken
Aiken, SC 29801

DESCRIPTION OF THE BEHAVIORAL MUTANT COLONY

WILD TYPE DEERMICE

Peromyscus maniculatus bairdii (BW) stock. This mutation-free wild-type stock is used to provide normative reference and control data. This stock also provides a stock with which mutant stocks are bred to minimize the effects of genetic drift.

CONVULSIVE MUTANTS

Four different convulsive mutants are maintained. Of these four, only two, Chemogenic Convulsive (*CNV*) and Epilepsy (*ep*), have been formally described in the literature.

Petit-mal type seizures:

This type of seizure is seen in two different mutant stocks. Animals are affected by aromatic chemical stimuli. Both mutations show autosomal dominant inheritance.

Convulsions in both mutations are characterized by ceasing normal exploratory behavior, sometimes associated with lacrimation, and sterotyped movement of one or more limbs, this may be followed by a fixed unmoving response in which the animal does not respond to outside stimuli, or in the most severe instances, by pronounced rigid spasms followed by loss of consciousness.

Alamogordo Convulsive (*ALG*)
Affected animals are convulsive after about three months of age and throughout life, with convulsions gradually increasing in severity. In severe seizures, these animals are likely to arch the head and back, to the point of falling over backwards in spasm. This latter behavior is more common in older animals.

Chemogenic Convulsive (*CNV*)
Affected animals are convulsive from about one month of age and throughout life, with convulsions gradually increasing in severity. *CNV/-* mutants tend to display convulsive behavior more readily then *ALG/-* mutants, however the episode is likely to be much less severe.

Grand-Mal Type Seizures:

Two different mutations exhibit this type of seizure in response to certain sounds (such as the sound of jingling keys). Both of these mutations are inherited as autosomal recessives. With both mutations, animals respond to the stimulus by ceasing normal exploratory behavior for a brief period, followed by dashing wildly about the enclosure falling while exhibiting spasmodic muscle movements. This may be followed by a slow recovery to more normal behavior or by a period of tonic rigidity (with or without a subsequent loss of consciousness).

Epilepsy (*ep*)
Convulsions can be elicited in these animals from about twenty-one days of age. These animals usually grow deaf however by about three months of age, and thereafter can no longer be made to convulse. A "waltzing" behavior is often seen in these animals. Differences in the Organ of Corti and the central auditory pathway are associated with this mutation.

Thompson Falls Convulsive (*tf*)
Homozygotes convulse throughout life and do not grow deaf. "Waltzing" is not commonly seen. The seizure pattern has a slightly later onset (about three months) and tends to be more severe, sometimes resulting in death.

Age Dependent Ataxias:

Boggler (*bg*)
This is an autosomal recessive mutation characterized by increasing ataxia, tremor, and loss of fine motor coordination. Additional finding suggest that diminished tactile responsiveness also occurs with advancing age. These deficits are correlated with axonal dystrophy and neuronal loss in the CNS.

Juvenile Ataxia (*ja*)
This is an autosomal recessive mutation which exhibits a marked ataxia from the time locomotor activity first begins until about forty-five days of age. The phenotype appears to be exaggerated or ameliorated by changes in dietary carbohydrates. Neuronal changes and loss is evident by 120 days of age.

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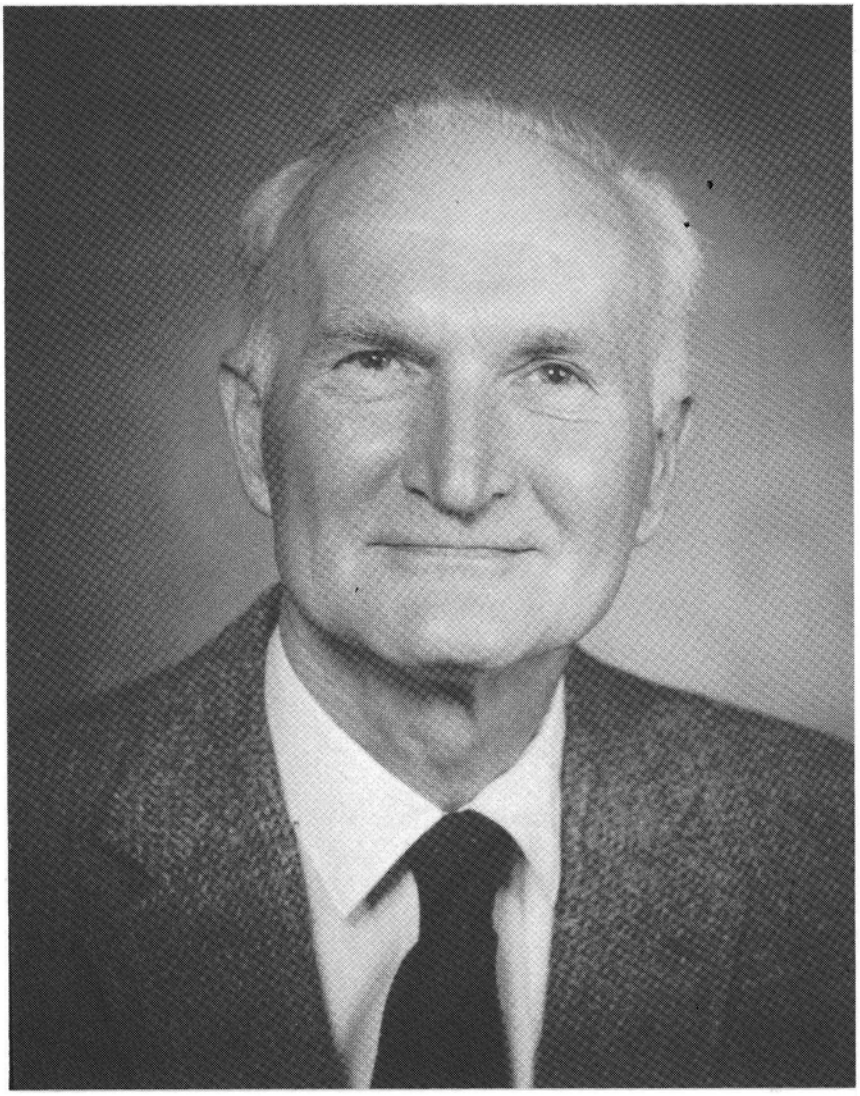

John A. King

PEROMYSCUS PIONEER

JOHN A. KING

Mention the name of John ("Jack") King to almost any PN reader and *BIOLOGY OF PEROMYSCUS*, the landmark 1968 volume he edited, will immediately come to mind. However, Jack King's contributions to *Peromyscus* biology are far more extensive. During an active five-decade professional career he published numerous papers on the behavior and development of deer mice and their allies, and stimulated a host of graduate students and associates to work with these animals. Many of today's most active *Peromyscus* researchers can attribute their interest directly to King.

John Arthur King was born in Detroit on June 22, 1921 and spent much of his youth in that area. From an early age Jack had an interest in animals, undoubtedly nurtured by reading the works of Ernest Thompson Seton, one of his early heroes. By nature, Jack loved the outdoors and developed a keen ability observe nature, particularly the behavior of creatures around him.

In 1939 he enrolled as a freshman at the University of Michigan and soon became acquainted with the museum curator, William Burt. Burt arranged for King to accompany the new assistant curator, Emmet Hooper, on a collection trip in northern Michigan during the following summer, where Jack was introduced to field mammalogy. After receiving a B.A. degree in 1943 Jack's academic career, like that of many others during World War II, was interrupted by military service as a lieutenant and became an air tranport pilot in the Army Air Force.

Following his discharge King devoted the winter of 1945-46 to living alone in the Black Hills tending a herd of horses, trapping small mammals and hiking. Later he journeyed for three-months from Central America to Argentina and from there undertook a voyage aboard a cargo vessel from Buenos Aires to Rotterdam, and back to the U.S. His spare hours during these wanderings were spent reading Julian Huxley's *Evolution: A Modern Synthesis* and he became intrigued with Sewall Wright's concept of genetic drift.

By autumn 1946 King had returned to Ann Arbor and entered graduate school. In the role of graduate research assistant he travelled with Burt, Hooper and others to Mexico to observe biological changes wrought by the newly formed volcano, Paricutin. After completing a master's degree in 1948 he and choosing Lee R. Dice as a major professor, he began to consider a dissertation research project. He adopted Burt's suggestion that a prairie dog town might be a suitable situation for a study of genetic drift. Dice acquiesced to the proposal, and during the following two summers Jack lived among the prairie dogs in Wind Cave National Park, South Dakota. The second of these summers he was accompanied by his new bride, Joan McGinty, an undergraduate student he had initially met on a bus while returning to campus from Detroit. Throughout their marriage Joan has continued to maintain an interest in Jack's animal subjects, although she had a separate career in sociology.

Jack completed his Ph.D. at Michigan in 1951 as Lee Dice's final graduate student. His dissertation, "Social Behavior, Social Organization, and Population Dynamics in a Black-tailed Prairiedog Town in the Black Hills of South Dakota", published in 1955 (*Contrib. Lab. Vert. Biol.*, 67:1ff) was highly regarded and immediately established King's position in the dynamic, emerging area of animal behavior. From Michigan he moved to Jackson Laboratory, Bar Harbor, Maine, originally for a two year stint as a PHS postdoctoral fellow, but then remained as a staff scientist until 1960. His two children were born during these Bar Harbor years. At Jackson Lab he was closely associated with J.P. Scott, John L. Fuller and other prominent animal behaviorists. Initially King's work involved breed and strain differences among dogs and mice with respect to social environment. It was at this point in his career that King turned to *Peromyscus*, animals with which he was well familiar through his association with Dice.

King obtained stocks of two races of deer mice, *P. m. bairdii* and *P. m. gracilis*, from the Michigan colony and undertook documentation of their comparative developmental and behavioral differences. The differences were many, despite the fact that these subspecies were interfertile in captivity. It became evident that genetic factors were influencing both behavior and physical development. Traits such as aggressiveness and eye opening differed significantly between the two forms. About this time the importance of infantile stimulation for physical maturation and behavioral development of rodents and other mammals was being recognized. King spent much of the following two decades exploring the interaction of genetics and environment through exposure of *Peromyscus* of different genotypes to a variety of early experiences. Among the interesting findings was that sometimes the very stimuli which enhanced learning in one race, inhibited it in the other. These "nature-nurture" studies, reported in several papers published during this period (1959, *J. Comp. Physiol. Pscychol.*, 52:82ff; 1959, *J. Hered.*, 50:14ff; 1961, *An. Behav.*, 9:142ff; 1959; 1968, *Papers. Mich. Acad. Arts, Sci. Let.*, 53:113ff; and others), perhaps, constitute the *Peromyscus* work for which King is best known.

In 1960 King was awarded a National Research Council fellowship to pursue a year of research at the University of Edinburgh. The next year he accepted a tenure track position in the Zoology Department at Michigan State University at Lansing, where he remained for the duration of his active career. At Michigan State, King continued his behavioral development studies for several more years, but also initiated studies on vision and selection for eye opening (1968, *Devel. Psychobiol.*, 1:30ff; 1970. *J. Comp. Physiol. Psychol.*, 71:22ff). Furthermore, at Michigan State King was now able to direct a significant number of graduate students, no doubt attracted by his congenial charm as well as his intellect and reputation. Among these were Richard Terman, Lee Drickamer, Edward Price, Bedford Vestal, Robert Robbins, Irvin Savidge, James Hill, William Barry, James Joslin, Gale Haigh and Bruce Cushing, who each made significant contributions to the biology of *Peromyscus* in their own right. In a sense, Jack King's most enduring contribution to the field is in the students he produced.

BIOLOGY OF PEROMYSCUS had its inception in discussions among King, Basil Eleftheriou and Dick Terman while Jack was still at Jackson Lab. Over the next several years the contributors were identified and the book took form. The American Society of Mammalogists special publication series

proved an appropriate vehicle. This volume still stands as an essential reference on all aspects of *Peromyscus* biology known up until its publication in 1968. King's own chapter on "Psychology" in the volume summarizes earlier studies on motor patterns and perception. The advances in this field have been immense since the 1968 volume appeared, and many have been attributable to King and his proteges.

King retired in 1986 and since then has led a life of active leisure travelling about the country, and visiting his two now-grown children, Kit, a staff scientist at NIH in the Washington D.C. area, and Andrea, who lives with her husband at Marquette, Michigan. He also enjoys pusuing his wide range of intellectual and recreational interests. Jack is an opera enthusiast and has broad humanistic interests, as well as scientific ones. For many years he has kept an extensive diary, outlining his activities and reflections on humans and animals. He continues to maintain contacts with friends, former students and colleagues in the scientific community. All who know Jack admire him for his frank, but cordial, generous and unassuming nature, his insight and his open availability for advice and service. He has published more than 50 research articles and reviews, about 30 of which dealt principally with *Peromyscus*. These included several invited chapters in published symposia. He has received broad recognition in his field, serving as President of the Animal Behavior Society in 1970, and Secretary of that organization from 1962 until 1965. He served as Associate Editor of *Ecology* and *Ecological Monographs*. King has been an active member of the American Society of Mammalogists, the American Society of Zoologists, the Society for the Study of Evolution and other professional organizations. He was a member of the original advisory committee for the *Peromyscus* Genetic Stock Center, and through his encouragement and advise was instrumental in its founding. Those of us who have had the pleasure of knowing Jack King, either on a personal or professional basis, will continue to hold him in highest esteem, and will ever be grateful for his enthusiasm and ready willingness to be helpful to others.

WDD

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PEROMYSCUS SPECIES LIST

ORDER RODENTIA

Suborder Myomorpha

Family Muridae or Cricetidae

Subfamily Sigmodontinae

Tribe Peromyscini

PEROMYSCUS (Sensu lato)

Genus *Peromyscus* (Sensu stricto)

(Subgenus *Haplomylomys*)

californicus-species group:

P. californicus (5)* - California Mouse

eremicus-species group:

P. eremicus (14)* - Cactus Mouse
P. guardia (3) - Angel Island Mouse (I)
P. interparietalis - San Lorenzo Deer Mouse (I)
P. dickeyi - Dickey's Deer Mouse (I)
P. pseudocrinitus - False Canyon Mouse (I)
P. eva (2) - Eva's Desert Mouse
P. caniceps - Burt's Deer Mouse (I)
P. merriami (2) - Merriam's Mouse
P. pembertoni - Pemberton's Deer Mouse (I)

(Subgenus *Peromyscus*)

hooperi-species group:

P. hooperi - Hooper's Mouse

crinitus-species group:

P. crinitus (8)* - Canyon Mouse

(Subgenus *Peromyscus* - continued)

maniculatus-species group:

P. maniculatus (64)* - Deer Mouse
P. oreas (2) - Vancouver Deer Mouse
P. sitkensis (2) - Sitka Deer Mouse (I)
P. sejugis - Santa Cruz Island Mouse (I)
P. polionotus (17)* - Oldfield or Beach Mouse
P. melanotis - Black-eared Mouse
P. slevini - Slevin's Mouse (I)

leucopus-species group:

P. leucopus (17)* - White-footed or Wood Mouse
P. gossypinus (7)* - Cotton Mouse

aztecus-species group:

P. aztecus - Aztec Mouse
P. specilegus
P. winkelmanni - Forest Mouse

boylii-species group:

P. boylii (12)* - Brush Mouse
P. levipes
P. stephani - San Esteban Island Mouse (I)
P. attwateri - Attwater's Mouse
P. simulus
P. madrensis
P. pectoralis (3)* - White-ankled Mouse
P. polius - Chihuahuan Mouse
P. oaxacensis - Oaxacan Deer Mouse
P. beatae

truei-species group:

P. truei (11)* - Pinyon Mouse
P. difficilis (5)* - Rock Mouse
P. nasutus (3)
P. bullatus - Perote Mouse
P. gratus (4)*

melanophrys-species group:

P. melanophrys (6)* - Plateau Mouse
P. perfulvus (2) - Marsh Mouse
P. mekisturus - Puebla Deer Mouse

(Subgenus *Peromyscus* - continued)

furvus-species group:

P. furvus	- Blackish Deer Mouse
P. ochraventer	- El Carrizo Deer Mouse
P. mayensis	- Mayan Deer Mouse

megalops-species group:

P. megalops (4)*	- Brown Deer Mouse
P. melanurus	- Black-tail Deer Mouse
P. melanocarpus	- Zenpoaltepec Deer Mouse

mexicanus-species group:

P. mexicanus (9)*	- Mexican Deer Mouse
P. gymnotis	- Naked-eared Deer Mouse
P. guatemalensis (2)	- Guatemalan Deer Mouse
P. zarhynchus	- Chiapan Deer Mouse
P. grandis	- Big Deer Mouse
P. yucatanicus (2)	- Yucatan Deer Mouse
P. stirtoni	- Stirton's Deer Mouse

Genus (=Subgenus) *Megadontomys*

M. (=P.) thomasi	- Thomas' Deer Mouse
M. (=P.) nelsoni	- Nelson's Deer Mouse
M. (=P.) cryophilus	

Genus (=Subgenus) *Isthmomys*

I. (=P.) flavidus	- Yellow Deer Mouse
I. (=P.) pirrensis	- Mount Pirri Deer Mouse

Genus (=Subgenus) *Habromys*

H. (P.) simulatus	- Jico Deer Mouse
H. (P.) chinanteco	- Chinanteco Deer Mouse
H. (P.) lophurus	- Crested-tailed Mouse
H. (P.) lepturus (2)	- Slender-tailed Deer Mouse

Genus (=Subgenus) *Neotomodon*

N. (P.) alstoni	- Volcano mouse

Genus (=Sugenus) *Osgoodomys*

O. (P.) banderanus (2) - Michoacan Deer Mouse

Genus (=Subgenus) *Podomys*

P. floridanus - Florida Mouse

Genus *Onychomys*

O. leucogaster - Northern Grasshopper Mouse
O. torridus - Southern Grasshopper Mouse
O. arenicola

EXTINCT SPECIES:

Subgenus *Haplomylomys*

Pliocene: *P. dentalis*, *P. pliocenicus*, *P. antiquus*

Early Pleistocene: *P. kansasensis*, *P. baumgartneri*, *P. hagermanensis*

Mid-Pleistocene: *P. irvingtonensis*, *P. cragini*

Subgenus uncertain or transitional

Mid-Pleistocene: *P. progressus*, *P. berendsensis*, *P. cumberlandensis*

Late Pleistocene: *P. nesodytes*, *P. anyapahensis*, *P. imperfectus*

Subgenus *Peromyscus*

Late Pleistocene: *P. cochrani*, *P. oklahomensis*

……

Approximate number of described subspecies given in () after specific epithet.
* Major species, *i.e.* non-insular, widely distributed and polytypic.
I in () after common name indicates exclusively insular species.

Reference to Tables Listing Genetic Loci

Tables listing genetic loci in *Peromyscus* were published in previous issues of PEROMYSCUS NEWSLETTER. Below is a cross reference to the most recently published tables and literature citations for each species or species group.

Tables of Genetic Loci Identified by Formal Mendelian Analysis:

Peromyscus maniculatus species group. Tables 1A, B, C and D. **PN #** 9 pp. 13 - 18.

Peromyscus leucopus species group. Table 1. **PN #** 8 pp. 12 - 13.

P. truei, P. eremicus and *P. californicus.* Table 2. **PN #** 8 pp 12 - 13.

Tables of Presumptive Genetic Loci Identified as Protein Electrophoretic or Immunological Variants:

Peromyscus maniculatus species group. Table 2. **PN #** 9 pp. 19 - 22.

Peromyscus (Megadontomys) thomasi. Table 3. **PN #** 8 p. 15.

Peromyscus (Podomys) floridanus. Table 4. **PN #** 8 p. 16.

Peromyscus californicus. Table 5. **PN #** 8 p. 17.

Peromyscus eremicus. Table 6. **PN #** 8 p. 18.

Peromyscus boylii species group. Table 7. **PN #** 8 p. 19 - 21.

Peromyscus truei species group. Table 8. **PN #** 8 p. 22 - 23.

Peromyscus leucopus species group. Table 9. **PN #** 8 p. 24 -26.

Table of Linked Loci and Linkage Map:

Peromyscus maniculatus. **PN #** 7 pp. 19 - 21 (map) and **PN #** 9 Table 3 p. 23.

CONTRIBUTIONS

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PEROMYSCUS NEWSLETTER IS NOT A FORMAL SCIENTIFIC PUBLICATION

Therefore ...

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THANK YOU !

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We are studying aging in *Peromyscus leucopus* in the laboratory, looking at reproductive biology and neuroanatomy. Although the standard "white mouse" strains of *Mus*, used in many research areas, have a life span of about 2-3 years, even 5 year old *Peromyscus* are capable of reproducing. We have found no statistically significant decline in several neuroanatomical variables between 12, 24, 36, and 48 month old mice and will be following the current animals throughout their "normal" lifespan.

We are interested in comparing these findings to other studies of "the elderly" in wild rodents species, either in the laboratory or under natural conditions.

* * *

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Our group is engaged in a project to map several genetic loci in *Peromyscus* which are homologous with those located on Chromosome 11 of house mouse (*Mus*). The loci are being mapped using restriction fragment length variants (RFLVs) and an allozyme polymorphism for erythrocytic esterase (*Es-1*). DNA restriction digests from 150 progeny of an interspecific backcross (*P. maniculatus/P. polionotus* X *P. maniculatus*) previously typed for *Es-1* (=*Es-3* of *Mus*) variation is being scored for RFLVs at the *Erbb, Il-3, Myhs, Cola-1, Krt-1, Myla* and *Tk-1* loci using *Mus* or human probes for Southern analysis. The objective of the study is to ascertain the extent of genetic linkage homology between *Peromyscus* and *Mus*.

In a separate study we recently demonstrated that the hairless-1 (*hr-1*) and hairless-2 (*hr-2*) loci in *Peromyscus* are non-allelic. (See **PN** #6 p.15-16)

* * *

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IMPACT OF SMALL MAMMALS ON REGENERATION OF NORTHERN RED OAK

The impact of small mammals on regeneration of northern red oak (*Quercus rubra*) was studied from October 1989 to December 1990 in Huntingdon County, Pennsylvania. Acorns were planted in two replicates each of three silvicultural treatments: 20% shelterwood, 70% improvement, and untreated mature forest. Four hundred acorns were planted in a 0.8-ha study site in each replicate, giving a total of 2400 acorns in each of six trials (Nov-Dec, Mar-Jun). One-half of the total acorns were direct-seeded in a shallow depression on the soil surface. Acorn loss was compared between autumn (Nov-Dec) and spring (Mar-Jun), among treatments and between acorn depths. Most acorn loss was attributed to white-footed mice (*Peromyscus leucopus*). Total acorn loss (direct-seeded, surface-seeded) in the 20% shelterwood ranged from 28% to 68% in autumn and from 96% to 100% in spring. Total loss in the 70% improvement ranged from 44% to 84% in autumn and from 94% to 100% in spring. Total loss in the untreated mature forest ranged from 67% to 88% in autumn and from 99% to 100% in spring. Loss of direct-seeded acorns ranged from 17% in the 20% shelterwood during autumn to 60% in the 70% improvement during autumn. Loss of surface-seeded acorns ranged from 40% in the 70% improvement during autumn to 83% in the 20% shelterwood during autumn. Preliminary evidence indicated that acorn loss was lower in autumn than in spring, and acorn loss in autumn was greater in untreated forest sites than in treated sites.

* * *

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Recently our group has investigated variation of serum and intestinal leucine aminopeptidase (LAP) by starch gel electrophoresis in *Peromyscus maniculatus bairdii*, *P. polionotus* and their F-1 hybrids. The animals were from colonies maintained at Benedict College, which are derived from those at the University of South Carolina. Hybrids were produced from crosses of *maniculatus* females to *polionotus* males.

No variants of serum LAP were found within each species. There were three bands of serum LAP, which differed between species in the rate of migratin and degree of concentration of the middle band. Hybrids investigated to date resembled the *maniculatus* parent. The isozyme of *maniculatus* and the hybrid was more affected by digestion for 15 min. with neuraminidase than the *polionotus* form, indicating less sialation in *polionotus*.

In each species there were two bands of intestinal LAP: a small, anodal band which migrated at a similar rate in both species and a slower, diffuse band which was termed the major band. This band was faster in *polionotus*. The hybrids displayed three electromorphs of intestinal LAP: one similar to *maniculatus*, one with the major band intermediate between the bands of the parent species and one with two major bands similar to each of the parental bands. Upon treatment with neuraminidase, the *polionotus* isozyme seemed unaffected but the *maniculatus* major band appeared more concentrated and slower. The hybrid form which resembled the *maniculatus* variant was similarly affected and the other hybrid isozymes were unchanged.

When both serum and intestine were run on the same gel, the major intestinal band appeared to co-migrate with the larger band in the serum, suggesting that this band in the serum is of intestinal orgin. We are continuing in our investigation of LAP examining the progeny of various inter-specific crosses and young mice of 7 to 21 days of age.

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COMPARATIVE MORPHOGENESIS OF MOLARS AMONG RODENTS

Studies on the comparative morphology and development of molar teeth among rodents including *Peromyscus* continue. As Montgomery recently showed in "Advances in the Study of *Peromyscus*", there exists broad similarity and also significant differences between *Peromyscus* and *Apodemus* (see PN#9 about the book). We think these two genera may provide a good model for morphological comparison among rodents which show a phylogenetic and ecological divergence. Equivalent numbers (N=54) of age known (from 0 to 90 days after birth) stocks of *Peromyscus*, *Apodemus* and *Microtus* were used for this study. Specimens of *P. maniculatus* were provided from *Peromyscus* Stock Center, *A. argenteus* by SK, and *M. arvalis* by MoS and MaS. Because of insufficient number of *A. speciosus* (chromosomal race 2n-46), this study has not finished completely. It is expected that other taxa belonging to such Orders as Chiroptera, Insectivora and Carnivora will be used for comparisons in the future study.

* * *

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MITOCHONDRIAL DNA EVOLUTION IN THE *PEROMYSCUS LEUCOPUS* SPECIES GROUP: GENETIC STRUCTURE IN POPULATIONS WITHIN A HYBRID ZONE.

ABSTRACT: Mitochondrial DNA variation was surveyed in populations of *Peromyscus leucopus*, the white-footed mouse, from New Hampshire to New Mexico. *P. leucopus* is characterized by two wide-spread chromosomal races, the northeastern and southwestern races. Large numbers of individuals were sampled from populations within a hybrid zone between the two chromosomal races. This study addresses two major issues; (1) the tempo and mode of evolution of mtDNA in *P. leucopus* and (2) the genetic consequences of hybridization between the two chromosomal races.

A total of 343 individuals was sampled for variation using five restriction enzymes, <u>Bam</u>HI, <u>Eco</u>RI, <u>Eco</u>0109, <u>Hin</u>PI, and <u>Pvu</u>II. These enzymes produced 21 polymorphic restriction sites for a total of 49 different haplotypes. Relationships between haplotypes were determined using parsimony analyses (PAUP, D. L. Swofford) and minimum mutation networks. The two phylogenies recognized a major division between the northeastern and southwestern chromosome races of *P. leucopus*. Because of considerable homoplasy in the data, minimum mutation networks provided a better representation of the data. Several processes may be involved in determining the patterns of relationships among haplotypes. These may include (1) evolutionary "hotspots" for mutations at particular enzyme sites, (2) the high mutation rate of the mtDNA molecule combined with a transition to transversion substitution bias, (3) recombination between different molecules, (4) the unusual nature of restriction enzyme recognition sequences relative to other sequences within the mitochondrial molecule, and (5) the lack of resolution from restriction fragment polymorphism analyses relative to DNA sequence data. It is recommended that sequence data from a region of the genome will provide better data for the determination of phylogenetic relationships between taxa than will restriction fragment analyses. At the population level, restriction site data from a few enzymes provide sufficient data for the determination of gene flow patterns and mating structure within populations. The geographic patterns of variation in mtDNA molecule in *P. leucopus* are consistent with limited differentiation between chromosomal races and substantial rates of gene flow within a race. These data contrast with those from *Peromyscus maniculatus* where geographic patterning of mtDNA indicates long-term extrinsic barriers to gene flow and/or extinctions of intermediate genotypes in a species with limited gene flow.

NELSON (Continued);

Of the above 343 individuals, 294 were from 21 localities within a hybrid zone between the two chromosomal races in central Oklahoma. Forty haplotypes were sampled within the zone and of these 80% were rare, occurring in 5 or fewer individuals. One haplotype was common on the eastern side of the zone and three other haplotypes common in western populations. The clines for mtDNA markers are consistent with clines for chromosomes (Stangl, 1986) and allozymes (Nelson et al., 1987) and all indicate asymmetric introgression with more eastern markers in western populations. Measures of disequilibria between mtDNA haplotypes and nuclear markers were small but significant, indicating that mating within the zone is not random. Although gene flow measurements from rare protein alleles and mtDNA indicate a high level of gene flow between populations, non-random mating and selection may account for the maintenance of genetic differentiation within the hybrid zone.

* * *

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MOVEMENT PATTERNS IN *PEROMYSCUS MANICULATUS GRACILIS*

Animals move to search for shelter, food, or mates, to avoid predators, or competitors to defend their territories or simply to expand their home ranges. Any one or a combination of these factors will affect the relative fitness on a individual. *Peromyscus* are no exceptions. Thus, an understanding of the spatial and temporal distribution of these woodland mice is essential before population dynamics can be understood fully.

In *Peromyscus*, movements of individuals can broadly be categorized into two classes: (i) those involving dispersal of individuals and, (ii) localized movements that reflect differences in activity linked to normal requirements eg. food. The former set of movements (dispersal) has generated four explanatory hypotheses: (i) the mate search hypothesis (MSH), (ii) aggressive exclusion hypothesis (AEH), (iii) nest-site search hypothesis (NSSH) and, (iv) density release hypothesis (DRH). The MSH suggests that breeding males are promiscuous and wander in search for sexually active females. The AEH suggests that adults expel juvenile males from the resident population. The NSSH suggests that females are limited by nest sites in which they can rear their young and therefore wander during breeding periods in search for suitable nest-sites. The DRH postulates that a random sample of a population disperses in response to density-related factors. We have been testing these hypotheses through selective removal techniques since 1988 on a population of *P. m. gracilis* in the Wildlife Research Station, Algonquin Park, Ontario, Canada. This population has been monitored for the past 37 years and in 1988 and 1989 the population dynamics were characteristic of non-peak years. In 1990, the population peaked, thus making it possible to test the 4 dispersal hypotheses.

Our field and laboratory results do not support the AEH. The MSH and NSSH are supported during the non-peak years when breeding takes place throughout the study period (April-August). The DRH is fully supported during the peak year when breeding stops in June but, it is not supported in non-peak years. In addition, our results support the hypothesis that overwintered females inhibit the reproduction of young of the year of the same sex.

This year (1990) three further hypotheses were tested: (i) that trapability of mice is independent of weather, (ii) detection and consumption of food substances does not vary with wetness of food and (iii) that an increase in the proportion of insects in the diet of the mice is, in part, due to the readiness with which they (insects) are located. The results of these investigations show that wet seeds are located more readily than dry seeds. Insects, however, are easily located when paired with dry seeds but are less so when paired with soaked seeds. Further, we have demonstrated that once seeds have been located, more wet seeds are consumed that dry seeds in the presence or absence of water. The outcome of these findings show that more mice are recorded in live traps as well as on snap traps during rainy periods because this is the time food (mainly seeds) is, not only easily located, but also, that more of it is consumed. We argue that the changes in the proportion of insects and seeds that have been recorded in some studies in the food habits of *Peromyscus* is, in part mediated by differences in water levels in the available seeds and, the ease with which insects are located in drier environments; during drier periods insects could be located more readily than seeds and vice versa during wet periods.

The present studies form part of my Ph.D. thesis under the supervision of Prof. R. J. Brooks. I intend to publish the findings formally once I have finalized with the write-up. The studies have benefitted a great deal from my field assistants C. Shilton, J. Howell, D. Foscarini and E. Reid.

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* * *

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My interest in *Peromyscus* focuses primarily on aging and senescence. Specifically, I am looking at how the ecological vulnerability of populations is related to their survivorship patterns when raised in the laboratory. In order to do this I am seeking reliable survivorship curves and maximum longevity data from non-inbred lab colonies of *P. maniculatus* and *P.leucopus* (colonies established both from island and from mainland populations originally, if possible).

It is often reported that *P. leucopus* and *P. maniculatus* can live 7 and 5 years respectively in the lab (as compared to 3 years for *Mus musculus*), yet there is little difference between the mortality rates of these three species in the wild. Are these data accurate?

I would be interested in hearing from anyone who might be able to provide relevant survivorship curves or maximum longevity data.

* * *

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