

AUSTRALIAN VETERINARY HISTORY RECORD



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**Editor: Dr. I.M. Parsonson, 2/1 Coape Street, Cheltenham,
Victoria 3192**

.....

Office bearers of the History Group:

President: Dr. J.T. Faragher

Secretary/Treasurer: Dr. J.H. Auty

3/400 Latrobe Street,

Melbourne, Vic. 3000

Phone 03 9328 5214

Librarian: Dr. R. Roe

Committee Members:

Dr. Paul Canfield

Dr. Tom Hart

Dr. Keith Hughes

Dr. Dick Roe

Dr. Andrew Turner

The Australian Veterinary History is a Special Interest Group of
the AVA (AVHS). All who are interested in any aspect of veterinary
history may join. Annual subscription is \$20. Enquiries to the President,
Dr. Trevor Faragher, 28 Parlington Street, Canterbury, Victoria 3126,
Australia. Tel/Fax 61 3 9882 6412.

email<faragher@netspace.net.au>

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ANNUAL MEETING of the Australian Veterinary History Group at the Melbourne Conference Centre Melbourne 14 May 2007.

Program for the meeting of the Australian Veterinary History Special Interest Group of the AVA 16th Annual General Meeting
Monday 14 May 2007 at the AVA Conference, Melbourne 2007.

ABSTRACTS OF PAPERS

8.00-8.50	Dr Roger Clarke, Bundoora Vic. Changes in small animal practice in the past 50 years
9.00-9.50	Dr Bryan Woolcock, Brisbane Qld. History of the Australian College of Veterinary Scientists
10.00-10.30	Morning tea
10.30-12.20	Plenary Session and Awards
12.30 - 2.00	Lunch
2.00-2.50	Dr Jakob Malmo, Maffra, Vic. Changes in veterinary practice in a dairying area in the past 50 years
3.00-3.50	Dr Jan Hills, Darwin NT. Changes in practice on the frontier
4.00-4.30	Afternoon tea
4.30-5.30	AVHS General Meeting
7.00	AVHS dinner To Be Announced

President's Report

(This report is repeated in this issue because of the important links that it provides for the AVHSIG as detailed in the report - Editor)

Another venture in online cooperation

All issues of this periodical, as readers know from information on the inside front cover, are archived in perpetuity by the University of Sydney. Other material published online by the AVHS has not been similarly archived – until now.

The National Library of Australia aims to build a comprehensive collection of Australian publications to ensure that Australians have access to their documentary heritage now and in the future. The Library has traditionally collected items in print, but it is also committed to preserving electronic publications of lasting cultural value. PANDORA, Australia's Web Archive was set up by the Library in 1996 to enable the archiving and provision of long-term access to online Australian publications. Since then the Library has been identifying online publications and archiving those that they consider have national significance. (Information about PANDORA can be found at: <http://pandora.nla.gov.au/index.html>)

Last month, the National Library asked the AVHS for permission to include Eminent Australian Veterinarians and Milestones in Australian Veterinary History, which are published on our web page, into the selective PANDORA Archive. In response, the AVHS licensed the Library, under the Copyright Act 1968, to copy these publications into the Archive. This means that the Library will retain both publications in the Archive and to provide public online access to them in perpetuity.

There are some benefits in having these publications archived by the Library. The Library will take the necessary preservation action to keep them accessible as hardware and software changes over time. The Library will catalogue these publications and add the record to the National Bibliographic Database (a database of catalogue records shared by over 1,100 Australian libraries), as well as to the Library's own online catalogue. This will increase awareness of our publications among people using libraries.

The titles are available at: <http://nla.gov.au/nla.arc-63330> (Eminent Australian Veterinarians) and <http://nla.gov.au/nla.arc-63217> (Milestones in Australian Veterinary History).

The AVHS, having enjoyed and benefited from cooperation in online ventures with the University of Sydney, is very pleased to now extend cooperation to the National Library of Australia.

Trevor Faragher

Australian Veterinary History Special Interest Group

Our next meeting will be held on Monday 14 May 2007 in Melbourne at the Annual conference of the AVA.

We are arranging a program of speakers on topics that will be of interest to members. After an annual general meeting, we will hold our traditional convivial dinner.

Mark your diary now. We look forward to seeing you there.

STOP PRESS

The Max Henry Memorial Library has arrived in the Gilruth Library at the Veterinary School of the University of Melbourne.

More information in the next issue.

SOUTHERN OCEAN DIVERS, PART ONE

Dr Michael Bryden

55 Central Avenue, St Lucia, Queensland 4067

Standing on the beach at Hurd Point, Macquarie Island, in January 1966, Dr Robert Carrick and I looked south over the expanse of the Southern Ocean that stretches to the shores of Antarctica, and discussed what the lives of elephant seals might be like when they are at sea. When they leave the island, do they remain within a few kilometres of the land, or do they range extensively across that vast ocean? How fast do they swim? Where and how do they sleep? How much time do they spend at the surface, and how much of it diving for food? What is the nature of their dives, how deep do they dive, and for how long can they breath-hold? We had no answers to any of these questions, and little idea of how it might be possible in the future to get answers.

A senior scientist and second-in-charge of CSIRO Wildlife, Robert was the driver of Antarctic biology at the time, when the offices of the Australian Antarctic Division were housed in a small building on St Kilda Road in Melbourne, and the staff did not include a permanent biologist. A few years beforehand, Robert had published a series of five papers on elephant seals, based on work begun soon after the establishment of a permanent research station at Macquarie Island in 1948 and continued until the early 1960s. Those papers, and three major papers on elephant

seals at South Georgia and Signy Islands in the south Atlantic, published between 1953 and 1956 by Dr Richard Laws (later Director of the British Antarctic Survey and elected to Fellowship of the Royal Society), revealed a great deal about the life of elephant seals during their terrestrial visits. But we knew virtually nothing of their life at sea, which constituted approximately two-thirds of the annual cycle.



Plate 1. Two bull elephant seals arguing over control of a harem

MACQUARIE ISLAND

January at Macquarie Island is like every other month: cold, damp and windy. The mean temperature year-round is 4°C, range generally about -4 to +8°C with little difference from season to season. It is overcast on most days, with little sunshine, and mist and rain are common in the summer months, sleet and snow more so in the winter. Wind is almost incessant (average wind speed 35-40 km/h), mostly from the west, with heavy storms and wind speeds in excess of 150 km/h from time to time. On my first visit to Macquarie, in March 1964, when I went with my PhD supervisor Professor Terry Robinson, I experienced just what the weather can come up with in those latitudes. We had to leave the island in a hurry because of a gathering storm, and within a couple of hours of putting to sea the captain of the Danish polar ship Nella Dan had her bow pointed into the teeth of a force 11 gale. Concerned that the ship would roll over if he steamed north toward Australia, he hove to and we spent nearly three days pointing due west before he could turn the ship for Melbourne again. Terry knew what heavy seas are, having been an officer in the Australian navy during World War II, but the storm we had just been through was fiercer than any he had experienced previously. A spot of land in the middle of the Southern Ocean, about half way between the southern tip of Tasmania and the shores of Antarctica, the island is a small section of the long submarine ridge that has been pushed up to roughly 250 metres above the sea surface. It is about 34 km long and 3 km wide, lying roughly north-south, and along most of its length it consists of a plateau that falls away on either side to narrow pebble or stony beaches. Sir Douglas Mawson was the leader of the Australasian Antarctic Expedition team that set up a meteorological station there in 1911, and of the British-Australian-New Zealand Antarctic Research Expedition scientists that made magnetic determinations and zoological observations there in 1930. In spite of the weather, he referred to Macquarie Island as “a wonder spot of the world”. The only spot of land for hundreds of kilometres in all directions, it is a platform for thousands of sea birds and seals. Hurd Point, at the southern end of the island, is home to the largest colony of royal penguins in the world, well in excess of half a million birds. It is one of just a few landing spots around the world for southern elephant seals, and it is there that significant advances in knowledge of the species specifically, and of diving mammals more generally, have been made.

SOUTHERN ELEPHANT SEALS

The annual cycle

Much of the knowledge revealed in the papers by Dick Laws was predicated on the assumption that his new method of ageing individual animals by examination of sections of the canine teeth was correct. The canine tooth grows continuously throughout life, the pulp cavity remains open and attrition is negligible. A cross-section of a tooth has an appearance somewhat similar to that of a tree, with a series of concentric dentinal rings around the pulp cavity. The columnar dentine deposited while seals are fasting ashore is very dense, whereas the marbled dentine deposited while they are feeding at sea is less dense, so the rings appear as alternating light and dark bands as seen with transmitted light. The deposition of these structurally different dentine types corresponds to different rates of deposition of dentine.

Growth of the root of the tooth is retarded during the terrestrial, fasting phases and accelerated during the aquatic, feeding phases of the annual cycle. Thus, ridges are formed on the outside of the root, that can be used to estimate the age of young animals, although the ridges often become covered by cementum in older animals and are therefore unreliable indicators of age. On the other hand, the light and dark bands in the dentine do permit estimations of age of individual animals of all ages to be made. Laws related the ridges and rings to the terrestrial and marine phases of the annual cycle, and estimated the age of individuals by counting them. Robert Carrick confirmed the method, which was published in 1952, subsequently, by examining sections of the teeth of a large number of animals whose ages were known precisely because they had been branded permanently at birth. A distinct natal ring is deposited in the teeth about the time of birth, from which subsequent rings can be read.

Mature males (bulls) begin to come ashore from their long winter marine sojourn in August, heavily laden with body reserves and particularly blubber. The presence of barnacles attached to the skin is evidence of their uninterrupted months at sea in many cases. Within a few days they space themselves along the beaches, jostling for sections of beach. Most of the competition for territory is settled vocally, but some drawn-out and vicious fights do occur at this stage. In September pregnant females (cows) begin coming ashore, also with large body reserves to carry them through the breeding season. Each female joins the nearest male as she comes ashore, and gradually harems develop. The harems vary greatly in size, the smallest being about six to ten females, the largest up to 1500 females. The average ratio of harem males to females is about 1:50; in the very large harems, there is a dominant or alpha male (which Carrick referred to as a beachmaster) and several beta males

(assistant beachmasters). Within two or three days of arriving in a harem, a cow gives birth to a single young (pup). Mothers remain with their pups throughout lactation, which lasts about three weeks (mean 23 days). Weaning is abrupt, when a cow abandons her pup and heads back into the sea. Weaned pups, which by the time of weaning have moulted or almost moulted their black natal fur, move to tussock grass areas above the beach, away from the harems where they spend the following six to eight weeks teaching themselves to swim and breath-hold. After finally going to sea, immatures return to land only for one or two brief "rests" during the winter months (the significance of these "rests" is not known), and they do not return to land for any length of time until mid November-early January of the following year, when they return to moult.

After returning to the sea, the cows, which have lost approximately 50% of their body mass during lactation, regain some weight before returning to land again in January-February to moult. The breeding bulls remain and hold their harems for most of the breeding season, so they are ashore for up to three months, during which time they fast. It is extremely energy demanding, as they must constantly defend their position against challenges from other bulls, and they also mate with each cow towards the end of her lactation (at about 18 days postpartum). As a result of the heavy energetic demands, bulls, like the cows, lose up to 50% of their body mass before they return to the sea. They return to the island to moult later than the cows, in March-April. All elephant seals remain ashore for an uninterrupted three to four weeks during the annual moult. The moult is a dramatic event in which the entire pelage is shed in sheets, along with and attached to the outer layers of the epidermis.

Estimating age from tooth rings

A great deal of information about the life history of an individual seal can be gained from examination of a tooth section. The most regular and constant feature of the annual cycle is the moult, when a broad and distinct dark dentinal band of approximately constant thickness is deposited. It is distinct in appearance from dark rings deposited during other terrestrial visits. Subsequently, by counting these moult rings, it is possible to estimate the age of an individual animal. After animals attain sexual maturity, they spend two protracted periods ashore per year, one for the breeding season and the other for the moult. Further, they no longer return for winter "rest" periods. It is possible, then, to distinguish immature animals (small dark bands representing winter "rests") from breeding ones (no rings during the winter marine phase). In breeding females a narrow dark line ("pupping line") represents the

breeding season, while the moult continues to be represented by a broader dark band. The two are separated by a narrow light lamina, deposited while the animal is at sea and feeding for the 2-3 months between the breeding season and the moult. The light lamina between the moult and the subsequent breeding season is broad, representing the longer period at sea (7 months) during winter. This pattern of a narrow dense band (breeding) and a broader dense band (moulting) is continued throughout the life of the seal, unless a pregnancy is missed. Therefore in females, examination of tooth sections can reveal absolute age, age when the first pup is born and the number of pregnancies throughout the life of the individual animal. Careful examination of the dentine adjacent to the pulp cavity, i.e. that deposited just before death, indicates the time of year the animal died. Armed with this knowledge, a few years ago I examined a large sample of canine teeth of elephant seals collected in Aboriginal middens in northwest Tasmania by Professor Rhys Jones.¹ We concluded that animals were killed (for food) throughout the year, and provided evidence of change in reproductive pattern over time, consistent with a response to predation pressure. The evidence pointed to the conclusion that Aboriginal hunters exterminated the population about 1300 years ago, through selective exploitation of smaller animals, which included significant numbers of breeding females. More recently, using a small number of crabeater seal teeth I had collected in the early 1970s, and a much larger number collected by Dick Laws many years before, we showed that the method was valid in that species as well.² We were thus able to examine the size and growth of crabeater seals³ as well as provide information about the breeding season and embryonic diapause.⁴

Growth and development

The speculations that Robert Carrick and I made on that day in January 1966, about the marine world of elephant seals, were based on the quite extensive knowledge amassed of their life on land. From Dick Laws' and Robert's work, we knew that early postnatal growth is extraordinary, and the anatomical studies I had been doing during the previous fourteen months at Macquarie enlarged on those pieces of knowledge and provided much of what we know today of the development of tissues and organs of seals. Pups born in the harems weigh about 40 kg, and they are suckled for an average of 23 days, during which time they treble or quadruple their birth weight. They maintain their birth weight, or even lose a little, during the first few days, but then increase weight at the remarkable rate of up to 8 kg or even 10 kg per day, the most rapid growth rate occurring during the last week of lactation. Much of the increase is fat, the majority of which is laid down as subcutaneous blubber, although there is significant increase in muscle and some

growth of bone and viscera. The composition of the milk changes as lactation progresses, particularly the fat component, which increases from about 8% at the beginning to about 50% toward the end of lactation. Growth during this period is critical, because the pups fast for several weeks after they are weaned, and a critical body mass must be attained by weaning to see them through that postweaning fast, until they go to sea as nutritionally independent individuals. Further, they require at least a minimum thickness of blubber to insulate them when they enter the icy waters of the Southern Ocean.⁵



Plate 2. Elephant seal pup, about 10 days old, drinking from its mother within a harem.

An aspect of early postnatal growth that interested me was the comparison of the rate of growth of elephant seals at Macquarie Island and South Georgia, because Carrick had shown that Macquarie Island seals grew more slowly and were slightly smaller at maturity than the South Georgia seals reported by Laws. I found a high incidence of extensive bruising and bone fractures in pups at Macquarie Island, which were due to being crushed by the large bulls as they charged through the

harem while driving off challenging males, and I believed that such injury would interfere with their normal growth. This was less likely at South Georgia, because the largest bulls were harvested for their oil, and there were fewer adult males and probably fewer challenges for harem control. I applied growth models to reach the conclusion that the elephant seals at Macquarie Island were permanently stunted, possibly because of retarded growth during the suckling period when, among other organs, almost 25% of postnatal growth of the brain occurs.⁶

I have made several references above to the large size of bulls. The sexual disparity in mature size of elephant seals is one of the greatest among mammals: breeding cows weigh in the vicinity of 450-500 kg, breeding males reach almost 4,000 kg in weight. Weighing the bulls was a major undertaking. With the help of most of the 19 men stationed at Macquarie Island, we strapped the immobilised animal in a cradle made from lengths of scaffolding, and raised it above the ground with a chain block and tackle to which scales reading to 6 tonnes was attached. We were the first to weigh adult elephant seals the previous work had expressed size in terms of body length.

Elephant seals when born are terrestrial animals in many respects, and develop their ability to cope with life in the water during their early postnatal growth. During movement on land, animals take the weight on their forelimbs (flippers), then flex the trunk and hitch the hind end of the body forward, straighten the trunk again and repeat the motion, so at least superficially the movement is caterpillar-like. The hind limbs are dragged passively. The muscles used for terrestrial locomotion, particularly those in the forelimbs and shoulders, and the abdominal muscles, are well developed at birth. Aquatic locomotion uses different sets of muscles, in particular those around the spinal column and also particular muscles of the hind flippers. Swimming involves lateral movements of the trunk that provide most of the power, and flexion of the hind flippers that provides the thrust. The muscles surrounding the vertebral column are massive, representing about 17% of total muscle mass in pups before they go to sea, and 24% of total muscle mass in adults, illustrating the point that muscles develop in response to functional demand.⁷ These observations, and the theory that arose from them that apply to animal production were developed further.⁸ In the 1960s we could only guess at how active elephant seals are in the water, but it was clear from the developmental patterns within the musculature that they became active swimmers soon after they left the island and they needed to be strong swimmers.



Plate 3 Weighing a large bull Elephant seal

Dr Gerald Lim was the expedition doctor at Macquarie Island in 1965, and took an interest in the blood of elephant seals. We measured the blood volume of adults and noted that it was great, representing more than twice the relative blood volume of terrestrial mammals. If the large amount of fat (up to 50% body weight in seals) is discounted, the ratio of blood volume to lean body weight is more than three times that of terrestrial mammals. Further, the erythrocytes are large, and haematocrit is variable but up to 60% and even 65% in some individuals. This is not the situation in neonatal seals, whose blood values do not differ greatly from those of terrestrial mammals. So like the musculature, the cardiovascular system develops in response to functional demand. We noted further that the spleen is unusually large in elephant seals, and we speculated that it might be particularly important in the diving animal to store erythrocytes, and that this might account for the variation in haematocrit that we had observed.

Based on these findings, we further speculated that elephant seals are deep divers, and possibly dive and feed at greater depth than other seals.⁹ About 15 years ago, Dr Paul Ponganis and Professor Gerald Kooyman showed that the spleen of seals does indeed function as a major store for erythrocytes. Using modern imaging techniques and simulated diving in their laboratory at the Scripps Institution of Oceanography in California, the spleen was revealed to increase in size many-fold during simulated deep dives, such that the organ occupied space in the abdominal cavity equivalent to that of the uterus in the last days of pregnancy. The inordinately large and appealing eyes of elephant seals, we believed, might further support the assumption that they are exceptionally deep divers, being capable of detecting very dim light (possibly emanating from prey) in the total darkness of the deep ocean.

Other fascinating observations of early postnatal life of elephant seals have been made since those earlier studies. As part of his PhD studies at Macquarie Island, David Griffiths looked at the hypophysis, and observed that the somatotroph is the predominant cell at, and for the weeks following, birth, suggesting that secretion of growth hormone is a major function of the gland during the rapid growth of the pup.¹⁰ Later, Gerald Little showed in his PhD thesis that the thyroid gland shows ultrastructural evidence of high activity at and soon after birth, and the thyroid hormones tri-iodothyronine and thyroxine present in the circulating blood at birth rise rapidly within two hours and remain high for approximately the first week postpartum. Their decline coincides with the deposition of the layer of blubber, when metabolic rate probably declines also¹¹.

As a consequence of joining the Department of Veterinary Anatomy in 1970, where Professor Rex Butterfield had been recognised internationally for the excellence of his work on growth and development of meat animals, I put together a review of growth and development of marine mammals¹² in which I could point to possible insights that could be gained in future studies of the subject in domesticated species.

Thermoregulation

Elephant seals have sufficient thermal insulation from the blubber to allow them to maintain body temperature in the cold southern seas. The blubber layer is the major component of thermal insulation in members of the family to which elephant seals belong; the pelage is relatively sparse and provides no protection against heat loss in water, and little on land.¹³ However the question arises: how do they dissipate body heat during times of vigorous activity at sea?

More importantly, how do they dissipate heat on land, where heat loss by radiation, conduction or convection is significantly less than in the water, and where on occasions they experience temperatures many degrees higher than the sea temperature?

I was fortunate enough to be appointed Reader in Anatomy in the University of Queensland in 1973, and began fruitful collaborative research with the head of department, Professor Geoff Molyneux. He had been working on microcirculation, and particularly the structure and function of arteriovenous anastomoses, for several years. They are normal precapillary structures that connect the arterial and venous sides of the circulation and allow arterial blood to enter the venous circulation without passing through the capillary bed. They occur in almost all-important organs of most mammals and some other vertebrates. We published a review of their structure and function.¹⁴ Contrary to what the physiologists had been saying about these structures in superficial organs, they are involved in dissipation, not conservation, of heat. The role of cutaneous arteriovenous anastomoses depends on the large volume of blood they can convey from arteries or arterioles to superficial veins or venules. The rate of perfusion of the skin by blood at body temperature is considerably increased when these vessels open, resulting in greater heat loss from the skin surface. The magnitude of change in rate of blood flow when arteriovenous anastomoses open is illustrated by Poiseuille's equation, which has been applied with reasonable accuracy to the flow of blood in living vessels. An arteriovenous anastomosis ten times greater in diameter (100_μm) than a capillary (10_μm) would have a blood flow rate 10,000 times greater than a capillary, per unit of length. Based on normal capillary pressures, 1 ml of blood requires about six hours to flow through a capillary, while an anastomosis 100_μm in diameter would pass the same volume of blood in about two seconds. We reported extraordinarily high densities of arteriovenous anastomoses in the superficial layer of the dermis over the entire body of the Weddell seal¹⁵ and later in the elephant seal.¹⁶ The very high density over the body surface and their superficial position in the skin led us to conclude that these structures permit rapid dissipation of heat from the skin surface during vigorous activity in water, and perhaps more importantly when the animal is on land and heat embarrassment is potentially a problem.



Plate 4. Although highly thigmotactic on land, particularly when moulting, Elephant seals are solitary at sea

It has been known for many years that the pineal gland of polar animals is large. In the mid 1970s PhD student Ray Tedman made the observation (unrelated to his thesis work) that the pineal gland of the newborn Weddell seal is inordinately large, and significantly larger than in the adult. Subsequently David Griffiths made a similar observation in elephant seals during his PhD research, and showed a seasonal variation in size and activity of the gland in adults. We examined the pineal of elephant seal pups in detail, and found that as well as being large, it is also highly active. Although ultrastructurally the pinealocytes appear relatively immature¹⁷ the gland contains 50 to 100 times more of them in pups than in adults. Assays of the primary pineal hormone melatonin in pups revealed mean concentrations of about 12,000-15,000 picomoles per litre (pM/l), and in some individuals exceeding 60,000 pM/l, which contrasts with concentrations in adults of 100-300 pM/l.¹⁸ We suggested that the very high concentrations of melatonin might be related to the maintenance of the normal body temperature of 37°C in newborn pups, which have

little physical thermal protection, but subsequent work cast doubt on that suggestion. In 1992, I had the opportunity to carry out a more detailed study of pineal function in the closely related northern elephant seal at Año Nuevo Island, off the coast of California just north of Monterey Bay. The hypothesis was that, if the primary function of the very large and active pineal of neonatal elephant seals is thermogenesis, the gland should be smaller and less active in the northern elephant seal because the climatic conditions where it is born are very much milder than at subantarctic Macquarie Island. The results did not support the hypothesis: although daytime melatonin concentrations of northern elephant seals were a little lower than those in southern elephant seals, they were very high compared with other species. Further, a circadian cycle of plasma melatonin concentration was present from birth, with levels of 3000-5000 pM/l during the day, rising to more than 10,000 pM/l at night. Soon after weaning, daytime and night time concentrations were 60-100 pM/l and 100-400 pM/l respectively. It was suggested that the very active pineal gland might contribute to energy conservation by lowering metabolic rate, particularly at night. When physical insulation is acquired by the deposition of blubber, the mechanism is no longer necessary and melatonin falls to adult levels.¹⁹

When Mark Hindell joined my research group in Queensland as a PhD student, he had already done some work with elephant seals, and with the co-operation of our collective contacts with research workers in the Australian Antarctic Division in Hobart, planned to use developing technology to study ranging and foraging in elephant seals. During Mark's PhD research, and subsequent work at the University of Tasmania (where he is now an Associate Professor), he has revealed much of what is currently known about this fascinating subject.

Divers or surfacers?

In his early studies Mark attached time-and-depth recorders to elephant seals at Macquarie Island and revealed just how remarkable those animals are. Elephant seals are indeed the deepest divers of all seals; Mark recorded dives of up to 1600 metres in depth, and up to 2 hours in duration. Another remarkable thing about the elephant seals is that, when ashore they do little other than lie about (except during the breeding season), and they are highly thigmotactic, but at sea their level of activity almost defies belief. The recorders attached to the seals revealed much about the profiles of the dives. During transit from Macquarie Island to their feeding grounds, they travel long distances and seem to be active for many hours or days at a time without a break. The profiles of dives during this time do not change, they are U-shaped, suggesting that the animal dives and surfaces while swimming

continuously for days at a time. We considered the physiological implications of continuous, prolonged and deep dives,²⁰ and showed that some dives were longer than the theoretical aerobic dive limit of the individual. We suggested that elephant seals might increase the aerobic capacity of dives by lowering their metabolism to approximately 40% of the resting metabolic rate on long dives. The dive profiles showed that cows tend to dive deeper than bulls, and led to the suggestion that bulls forage mainly at the sea floor, approximately 500 metres depth, over the Antarctic continental shelf (some 1,000 km south of Macquarie Island), whereas cows forage in deeper water north of the shelf. Some dive profiles indicated that after surfacing an animal dives to 100 metres or so, then appears to drift down to about 500 metres over a period of up to 15 or 20 minutes. These dives are believed to be rest or sleep dives. The ratio of time spent below the surface to that spent at the surface was very great: whereas the average dive duration during transit and foraging was more than 20 minutes, seals remained at the surface for 1 to 2 minutes between dives. This made us realise that elephant seals spend the vast majority of their time at sea beneath the surface, and surface for just enough time to take a few breaths, so they are really surfacing mammals, rather than diving mammals.

In recent years Mark has incorporated heart rate monitors in the time-depth recorders, to measure energy output and metabolic rate during diving. Further, the attachment of satellite trackers has provided a vast amount of fascinating information about the lives of elephant seals at sea. It has extended the earlier work, and shows that elephant seals cover vast areas of the Southern Ocean, and are seemingly boundless in their ability to meet the severe challenges for a mammal of living in freezing water and having to breath-hold for long periods while diving to great depth for food. He has shown that some elephant seals make the journey from Macquarie Island to the Ross Sea, a distance of some 2,000 km, in just a few days, and apparently without a break.

It gives me a great feeling of satisfaction to have been in this field of endeavour long enough to see revealed the amazing feats of elephant seals, and the wonder of their lives. What a pity it is that Robert Carrick, whose insight was so incisive, did not live to witness these things.

EPILOGUE

I am often asked how and why I got into this field of endeavour, which in the early 1960s was unusual for a veterinary graduate. While an undergraduate at the University of Queensland, I was stimulated to read a fair bit about Antarctica after my father visited the frozen continent one summer and sent descriptions of his

experiences in his weekly letter from Tasmania. Never really grabbed by clinical work, I decided after a couple of years of working in Tasmania to approach the Australian Antarctic Division (AAD) to see whether they would take on a veterinary graduate. It was fortunate for me that Antarctic biology was in its infancy in Australia at the time, and few graduates were interested in carrying out research in those remote parts. Dr Philip Law was Director of AAD, and accepted me as only the second honours graduate in a biological science to be willing to develop a research project on southern seals. I followed Dr John Ling, who had almost completed his stint as a biologist, working on the skin and moulting of elephant seals at Macquarie Island. His work was a PhD project supervised at the Australian National University. Philip Law put me in touch with Robert Carrick, who suggested I seek a PhD supervisor in a university of my choice and work up a project. The faith in me was remarkable, in that I had no zoological training, other than a pass in first year Zoology in the University of Tasmania, and everyone knows that one is certainly no Zoologist after just one year. However with application and hard work, it is possible to develop the necessary knowledge to build a research capability in the field. Another piece of good luck for me was that I had previously done some work with Professor Rex Butterfield, whose internationally-recognised research involved anatomical dissection in the study of growth and development of meat-producing animals. Rex encouraged me when I told him I would like to apply the techniques he had developed to an animal that was born on land, but spent much of its life in the sea. Terry Robinson was unhesitating in accepting me as a research student in his developing Department of Animal Husbandry in Sydney, and Dr Fred Jacka and Mr Phil Sulzberger, the senior scientists in the AAD, were more supportive than I could ever have hoped or expected. After a year of preparation I was off to Macquarie Island for 16 months and the rest, as they say, is history.

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Victorian Government Veterinarians in Western Victoria in the Early Twentieth Century

Dr Robert P Knight, 7100 Glenormiston RSD, TERANG 3264

The establishment of modern veterinary practice in southwest Victoria has been reported in the Australian Veterinary History Record (number 45—March 2006). It may be of interest to also list the personnel involved in the establishment of District Veterinary Offices by the Victorian Department of Agriculture.

The first District Veterinary Officer appointed for the Western district was Stanley Mountjoy in 1928 following two years with the department in Melbourne. Stan had graduated L.V.Sc from Melbourne University in 1911 and practiced in Kerang in northern Victoria until he enlisted in the AIF in 1914 in the Australian Army Veterinary Corps. He served with some distinction as Veterinary Officer in the 8th Mobile Veterinary Section and was promoted Major as Veterinary Officer in the 3rd Light Horse Regiment in Egypt and Palestine. Following active service he resumed practice in Kerang until 1926 when he joined the department. He remained the DVO until his retirement in 1954 and passed away in Warrnambool in 1973 aged 84 years.

Stan was replaced by David Fitzpatrick (BVSc Syd 1952) who was employed by the department from 1953 until his retirement in 1982 having served his professional life there and still a resident of the district. David's other claim to fame was his involvement for many years in amateur theatricals, particularly Gilbert and Sullivan.

In Geelong, Robert Wardle (BVSc Melbourne 1916) was appointed DVO in 1926 holding that position until 1939 when he was appointed Director of Veterinary Hygiene in the Commonwealth Department of Health, in Canberra. Robert had a record similar to Stan Mountjoy having served in the AIF in the Middle East and having been in private practice in Geelong from 1919 to 1926.

In Colac, Daniel M, Flynn (BVSc Sydney 1942) was appointed DVO in 1943 remaining in that position until 1952 when he transferred to head office where he became a distinguished administrator. He was followed in Colac by Bruce Paine (BVSc Sydney 1950) 1953-1955 leaving there by moving to Queensland, then David Leaver (BVSc Sydney 1955) 1956 who left the department to subsequently accept a position in 1969 as senior lecturer in the newly formed school of Agriculture at Latrobe University. Ian Hart (BVSc Sydney 1957) was next 1958-

1959, Andrew Turner (BVSc Sydney 1963) 1964-1966 then Peter Jackson (BVSc Sydney 1966) in 1967. Andrew Turner moved to laboratory interests in Melbourne and later studied virology to gain a PhD degree eventually becoming Chief Veterinary Officer of the department.

In Camperdown, the first DVO appointed was William Pryor (BVSc Sydney 1950) in February 1951 who remained in this position until July 1956 when he accepted a position with Nicholas. He later studied Animal Husbandry to achieve a PhD degree and was involved with teaching at Brisbane and Massey Veterinary schools. After a gap of some years Wally White (BVSc Sydney 1963) was appointed to Camperdown in 1964 remaining until 1966. He also studied further for a PhD degree and was later involved in departmental administration. Next to appear was Douglas Harris (BVSc Sydney 1965) who remained there for many years. In Hamilton, Albert Engel (BVSc Sydney 1938) was appointed DVO in 1948 having served time in the RAAF followed by a year or so in practice in Adelaide and remained for eleven years until 1958. He had a flair for showmanship, was a competent pianist, and was successful in extension. He left to accept a position as Senior Extension Officer in the South Australian Department of Agriculture. Albert passed away in 1982. Albert was succeeded in succession by John Armstrong (BVSc Sydney 1954), Bruce Christie (BVSc Sydney 1957) who also left the department to further studies achieving a PhD degree, then Ralph Salisbury (BVSc Sydney 1964) who was the incumbent 1965-1970. He was followed by Neil Twaddle and later Dennis Naphthine.

In Ballarat, Charles Pope (BVSc Sydney 1937) had spent time as DVO broken by time spent involved in the second world war. He resigned from the position to begin veterinary practice in that city. Jack Eccles (BVSc Sydney 1945) was appointed to Ballarat and remained from 1946 until his death in 1969.

During the late thirties when R.J.deC.Talbot was chief Veterinary Surgeon in the Department of Agriculture a scheme of appointing cadets was initiated. Applicants were paid a stipend plus their education fees and following their education were bound to the employ of the department for a contracted period. This system has survived for many years and has provided ever so many capable graduates to the department and to the profession in Victoria. Over the years many of these cadets bought their way out of the departmental bond to accept other veterinary positions. Many drifted into veterinary practice reducing the shortages of graduates in that sphere. Great credit is due to the system for the quality of the graduates who settled into the state.

The Western Australian Veterinary Act, 1911 and the Veterinary Surgeons Act Amendment Act, 1923.

Dr William T Clark
51 Henry Bull Drive Bull Creek WA 6149

At the end of the 19th and beginning of the 20th century the population of Western Australia was growing rapidly (Table 1). A major factor in the strong growth in the economy at this time was the discovery of gold in the Kimberley region in 1885, at Coolgardie in 1892 and Kalgoorlie in 1893. In addition the forestry and farming industries were also contributing to the expanding economy.

Table 1. Population of Western Australia at census dates 1891-1933

Date	1891	1901	1911	1921	1933
Population	49,782	184,124	282,114	332,732	438,852

Horses were extensively used in mining, forestry, transport and farming and numbers grew quickly between 1890 and 1920. Food requirements for the expanding population and demand for wool encouraged land clearing for farming and a sharp increase in the numbers of farm animals. (Table 2)

Table 2. Farming data: 1890-1930

Year	1890	1900	1910	1920	1930
Horses (thousands)	44	68	134	179	137
Cattle (thousands)	131	339	825	850	813
Sheep (thousands)	2525	2434	5159	6533	9883
Pigs (thousands) ²⁹	62	58	61	101	
Cropping acres (thousands)	70	201	855	1805	4792

Veterinary Act 1911

An act “to regulate the Practice of Veterinary Surgery, and for other relative purposes” was introduced to the Parliament of Western Australia in November

1911.

Practice of veterinary surgery prior to 1912

It is difficult to determine who was carrying out diagnosis and treatment of animal diseases in the late 19th century and the first decade of the 20th as there was no requirement to keep statistics. The Post Office Directory of 1911 lists 17 names under the heading Veterinary Surgeons. Only three of the persons listed had formal veterinary training and two subsequently registered as veterinary surgeons under the Act. Ten of the remaining men on the list successfully applied to be registered as veterinary practitioners following approval by the new veterinary board. In addition, from reading parliamentary debates on the Veterinary Act, it is clear that in country areas pharmacists and farriers commonly provided veterinary services.

During discussion on the Act in the Western Australian parliament, the Colonial Secretary said that there were six men in the State who had veterinary diplomas. Using information from several sources it appears that five of these six were based in Perth: three were in practice, two worked for the Stock Department and one was Director of the Zoological Gardens.

It should be noted that during debate in parliament and subsequently in the veterinary board, veterinary surgeons were always assumed to be male. The name of the first female veterinary surgeon was added to the register in 1947.

Reasons for the Act of 1911

When the Colonial Secretary moved the reading of the bill for the Act in Council he said;

“Hitherto the State has taken no action in the direction of providing safeguards against an important section of the field of science being invaded by quacks who travel round the country falsely representing themselves as veterinary surgeons, but who are not possessed of the qualifications.”

When the bill was introduced to the Assembly by the Minister for Lands he stated that

“Hon. Members who have any knowledge of the country districts in Western Australia will know that for some time past there have been repeated complaints as to the practice of veterinary surgery by incompetent persons. Speaking from my personal experience I know settlers who can ill afford the loss which they have undoubtedly sustained through the fact of persons posing as veterinary surgeons and attending their stock without requisite knowledge to qualify them for that particular calling.”

The bill produced extensive and sometimes heated debate in both houses of parliament. The main issues which concerned members were the requirements for registration including examinations, the role for those men who provided veterinary

services although they had no formal qualifications, the provision of veterinary services in country areas, concerns that the new veterinary board might be too restrictive in granting registration and the composition and cost of the board.

Requirements for registration as a veterinary surgeon

The Act, as originally proposed, stated that every person shall be entitled to be registered under the Act if he had attained the age of 21 years, was a person of good fame and character and held a diploma of competency as a veterinary surgeon from the Royal College of Veterinary Surgeons of Great Britain or from some other college or institution recognised by the board. A person who had no formal qualifications but had been practising as a veterinary surgeon for seven years could also be registered provided he passed an examination prescribed by the board. There was little disagreement about the age, character and diploma requirements but there was heated discussion about the proposed treatment of the men without diplomas who provided veterinary services.

Examinations

There was some debate in parliament about whether the examination should be written, oral or practical, which subjects should be examined and what the standard should be. At the end of the debate the issue was largely left to the veterinary board, for the Act says a person may be registered as a veterinary surgeon if he has passed a prescribed examination to the satisfaction of the board.

Mr Dwyer MLA pointed out that there was no provision in the bill for training veterinary surgeons and suggested that the new university (University of Western Australia), which was in the planning stage, might have some role in training and examining veterinary surgeons.

Role of veterinary practitioners who had no formal training

There were several difficult issues here as it was recognised that few would be able to pass an examination and there was considerable sympathy for existing practitioners who would lose their livelihood if they were not allowed to register.

Hon. V Hamersley MLC expressed the view that:

“We have to recognise, also, that although we want fully qualified men, we have at the present time men who are fairly competent in veterinary surgery without actually having diplomas and who are more successful in the cases they treat than some of the men with diplomas of whom we have had experience. It would be a hardship to have the business they have built up in the last few years taken away from them.”

Mr Mitchell MLA pointed out that:-

“It is desirable that those who practice veterinary surgery should be limited to those with some knowledge of the profession but the owners of stock should be protected

also. If veterinary surgery were limited to the number we now have I fear the greatest portion of the State would be underserved.”

This part of the bill generated considerable discussion until members looked at precedents in Great Britain, Victoria and Queensland where the acts allowed registration on the basis of previous service. Parliament then decided to have two sections in the register. The first section would contain the names of veterinary surgeons i.e. those persons who held a recognised diploma or had passed an examination set by the board. The second section would contain the names of veterinary practitioners, registered on account of having practised for five years prior to 1912. There was no provision in the Act for examinations to allow men to register as veterinary practitioners.

Concerns that the board might be too restrictive in granting registration.

Some members were concerned that a small board comprised only of veterinary surgeons would make registration difficult in order to protect their own interests by restricting registration of existing veterinary practitioners or qualified veterinary surgeons from elsewhere. Mr Thomas MLA asked,

“What are the fees going to be?” and then stated, “They will not look at a horse under a guinea. If a person has an animal of little value such as a cat or a dog, he could not possibly requisition the services of a veterinary surgeon because he would charge five times the value of the animal merely to look at it.”

Composition and cost of the veterinary board

The number of board members and their qualifications were discussed at some length. It was agreed that if the board was to set examinations it would need a number of members with veterinary qualifications. Several members of parliament felt that stock owners’ interests should also be represented. It was pointed out that there were very few qualified veterinary surgeons available for the board so it was agreed that the government should nominate three veterinary surgeons and two members who had knowledge of stock and that the appointments should be renewed annually.

The Colonial Secretary reassured Council that board appointments would be honorary but that members would be reimbursed for rail fares to attend meetings.

Assent

Parliament passed the bill on the thirty-first of December 1911 and it came into effect on first of January 1912.

Veterinary Surgeons Act Amendment Act 1923

By 1923 there were only nine names in the register under the category veterinary surgeon. There was concern about the difficulties in obtaining veterinary services in the country areas so, in November 1923, a short bill was introduced to parliament

to amend the original Act in order to permit unqualified persons to practice in areas which were 30 miles distant from where a veterinary surgeon worked

When the Minister for Agriculture introduced the bill in the Assembly he said

“The proposed amendment of the parent act is to enable the Veterinary Board to permit persons who may prove on examination to be qualified or fitted to attend to ailing animals throughout our scattered country districts, to do so where no registered veterinary practitioners are available. It will overcome the difficulty expressed in country districts at present.”

In the Council debate the Minister for Agriculture stated:-

“Experience has shown that the services of qualified veterinary surgeons are very much needed in outlying country districts. There are men capable of treating ailing animals residing in these outlying districts, and the bill is brought in to enable something to be done to enable them to receive fees for the services they render.”

There was no disagreement about the need to provide better services in the country but the 30 mile radius from an established veterinary surgeon generated debate and two amendments to reduce the distance to 20 or 15 miles. The Hon. W Carrol said:-

“With regard to the radius of 30 miles proposed by this clause, we have to bear in mind the scarcity of veterinary surgeons in this state. I believe there is not one between Kellerberrin and Kalgoorlie; I know there is not one between Kellerberrin and Northam. The cost of transporting a veterinary surgeon, frequently by car, represents a very heavy expense. Very often the sickness of an animal can be cured by a handy man, without the intervention of a veterinary surgeon.”

Both amendments were lost and the 30 mile limit confirmed.

As a result of this Act a third group of names was added to the register. These men were known as “permit holders” and there were no restrictions on the type of veterinary work they could do provided it was performed outside the 30 mile limit from the residence of a veterinary surgeon.

Amendment to conditions for registering veterinary practitioners

During the debate on the bill an amendment was moved to allow the board to register as a veterinary practitioner

“...any reputable person who, prior to the Great War, had undergone not less than three year’s training in a veterinary hospital in this State...and who subsequently served abroad with the Australian Imperial Forces.”

This amendment received wide support and appears to have been inserted with a specific individual in mind. One additional name was added to the list of veterinary practitioners in 1924.

Parliament assented to the Act on 22nd December 1923.

Acknowledgements

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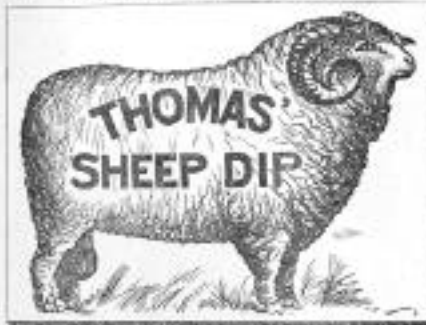
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