THERIOGENOLOGY: COMPARATIVE ASPECTS ON EVOLUTION 
AND FUTURE OF THE DISCIPLINE

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INTRODUCTION

I extend my most sincere thanks to the American College of Theriogenologists (ACT) and the Society for Theriogenology (SFT) for the honor of being selected for the Bartlett award. The history of the theriogenology specialty in the United States and the role that Dr. Bartlett played in its birth make this award particularly prestigious. Considering who the previous award winners are, and the magnitude and quality of their contributions to ACT and SFT, makes me wonder if I really deserve to be a member of that illustrious group. The selection is certainly a sign of commitment to diversity, which has been a hallmark of both organizations for many years. Thus, the award is also a recognition of the outstanding institution in animal reproduction that provided my veterinary and post-graduate training—the Department of Obstetrics and Gynecology at the Royal Veterinary College in Stockholm, now the Faculty of Veterinary Medicine at the Swedish University of Agricultural Sciences in Uppsala.

The topic of the award presentation has been chosen to remind all of us about how the field of animal reproduction attained the status of an academic discipline and clinical specialty, while pointing out that sustaining, consolidating, and evolving this status will require continued innovations, hard work, and change. In the lecture, I am extending our horizons beyond those of North America in keeping with the vision expressed by David Bartlett in the first Bartlett lecture, 1984, when he said, "provincialism in theriogenology must be avoided."

SOME PERSONAL HISTORICAL NOTES

A cold, dark, wet, and windy evening in a small motorboat on Rainy Lake in Canada on the way to a faculty fishing retreat in May 1974, is a vivid memory of how I first got acquainted with my theriogenology colleagues at the University of Minnesota during a sabbatical leave with Bo Crabo and Ed Graham in the department of Animal Sciences. A practical joke (a benevolent interpretation!) masterminded by Bob Wescott and executed by Louis Archbald, caused Howard Whitmore and me severe anxiety when we were told that we were lost on the lake and might not find the retreat island that night, or any other accessible island for that matter. While this was a rough beginning, possible to cope with only thanks to the tranquilizing effect of the refreshing fluids that Louis et al. had been humane enough to bring, the continuation of the retreat, after reaching the island in question, began a great friendship and camaraderie that enabled me to feel at home in therio circles.

So, when Ed Mather, in mid 1975, called me in Sweden and asked whether I would be interested in a theriogenology position, I was happy to respond positively. I began as a faculty member on January 1, 1976, in a tenure-track professor position on a 3-year probation. I must admit that at that time I didn't understand exactly the nature of the tenure system, despite good attempts of Ed and Dale Sorensen, the department chair, to explain it to me. So, we sold our house in Sweden, transported our furniture and other belongings to St. Paul, rented a house, and later, after I magically had received "early" tenure as an exception to the rule, we built our own house.

The following three years were truly a great period in my career. I got to work with outstanding colleagues Ed Mather (section head), John Hurtgen, Shirley Johnston, Rolf Larsen, Patty Olson, Arun Phatak, Brad Seguin, Jack Tate, Howard Whitmore, and of course, Ray Zemjanis, then associate dean for research and
graduate education. I also was fortunate to enjoy an excellent relationship with colleagues in animal sciences (Crabo, Graham, et al.). Despite the fact that Zemjanis, who had developed the theriogenology program at Minnesota, and I had had the same mentor, Nils Lagerlof, the European flavor of my knowledge and experience was not always in line with that of my Minnesota colleagues. There was need for some modification, change, and improvement. I owe my colleagues many thanks for the caring and careful way they gave me supplemental knowledge in the art of theriogenology.

Ray Zemjanis was a forceful and effective leader at U of M. He became a great personal friend and a strong supporter of me personally. Because of my earlier experience in research and graduate education at our common alma mater, Ray expected me to take on a sizeable amount of graduate advising. So, I ended up with five graduate students, which required the juggling of clinical responsibilities (mainly in the field service) with commitments to graduate students. All five graduate students developed and conducted original research, four of them for a thesis, and all graduated. One of the five was Mushtaq Memon, who successfully defended his doctor's thesis in 1980.

My tenure as clinical department head at the University of Illinois from 1978-87 gave me opportunities to continue working relationships with great theriogenologists like Kathy Bretzlaif, Bruce Brodie, Ted Lock, Ken McIntee, Randy Ott, Bill Wagner, and Howard Whitmore. Through my "flying start" at Minnesota, I had ongoing research projects and other plans that I could continue at Illinois in cooperation with theriogenologists and other faculty. Projects included antibiotics in the genital tract, inflammatory mediators and nonsteroidal, anti-inflammatory agents in bovine mastitis, mastitis indicators and their relationship to the endocrine status of the animal, postpartum uterine infections and leukocyte function, and factors affecting uterine motility. The recruitment of my friend and coworker from Minnesota, Howard Whitmore, as food animal chief at Illinois in 1980 was crucial for getting much of this research going. Thanks to Howard's leadership and dedication as project director, we were able to conduct some very productive and clinically relevant research in all of the above areas. Also, I was faithful to my area of initial research, bull reproduction, by helping to bring Allan Bake, Honorary DACT, the major advisor for my doctoral program, to Illinois as a George A. Miller fellow to work with Randy Ott on sperm morphology in the bull. As you all know, this visiting professorship turned out to be very successful as evidenced by the outstanding reproductive studies in the bull that since have come out from Randy Ott's laboratory.

Soon after my arrival at Illinois, Bill Wagner signed me up for the 2nd Conference of North American Educators in Theriogenology, held in Arrowhead Lodge, Oklahoma, in September of 1978. Bill has earlier (in his Bartlett lecture in 1995) told the story about our lodging predicament at that meeting, which forced Bill to share the bridal suite with me. More important though (I think), I presented a paper on Minimum Standards of Didactic Teaching of Clinical Disciplines. The discussions that followed reinforced my interest in curriculum development—an area which I later got such a splendid opportunity to pursue as dean at Washington State University.

Helping host the International Congress on Animal Reproduction at Illinois in 1984 belongs to the highlights of my term at U of I. The fact that this was the first time the congress had been held outside Europe required some "behind the scene" work before an invitation had a chance to be accepted. The congress became a success under Bill Wagner's able leadership as congress secretary.

The remainder of my 22-year American career was spent at Washington State University as dean from 1988-98. I am sure you all know how difficult it is to maintain your own research in such a position. For me it was also difficult to keep up with everything else happening in my own discipline. Although it might have looked like I vanished from the therio scene, I maintained a keen interest in what all of you were doing. To be selected as an honorary ACT diplomate in 1992 was to me a strong indication that you recognized the value of my work at WSU.

A HISTORICAL PERSPECTIVE ON THE DISCIPLINE/SPECIALTY EVOLUTION

The desirability of establishing animal reproduction as a discipline/specialty that integrates physiology, pathology, diagnosis, health and disease control programs, and therapy is a common denominator for efforts in different parts of the world. In the days preceding the pioneers, W.L. Williams, W.W. Williams, and Nils
Lagerlof, the "veterinary field of animal reproduction and obstetrics was relatively amorphous and was incorporated under the disciplines of surgery, medicine, and animal husbandry or zoo technics" (cf. Roberts, Bartlett Lecture, 1985). In the European continent and in the Scandinavian countries the veterinary colleges began relatively early to create independent departments for obstetrics and breeding diseases later generally called Departments of Obstetrics and Gynecology.

Already in 1915, an independent professor chair was established at the Royal Veterinary College in Stockholm. A large, modern physical facility for the department was built in 1942-45. Independent professor chairs were established in most other European countries as well. While the department structure and function have undergone changes since then, the independent nature of the field of animal reproduction has remained strong. Thus, Nils Lagerlof's old department, now chaired by the world-renowned veterinary scientist Stig Einarsson, is a major influence in the European system. It is still called Obstetrics and Gynecology (OG) and has currently more than twenty faculty members. In addition to performing an excellent teaching program for veterinary students (including field service conducted by an Ambulatory Clinic), the department currently has twenty-three doctoral candidates and produces three to four Ph.D.'s per year.

Totally, this OG department has produced 55 Ph.D. theses since Lagerlof himself received his doctoral training at the Karolinska Institute in the 1930s. At that time, the Royal Veterinary College did not have the right to grant a doctoral (Ph.D.) degree and Lagerlof's thesis, "Morphologische Untersuchungen über Veränderungen im Spermabild und in den Hoden bei bullen mit Verminderter oder aufgehobener Fertilität," was sponsored by and published from the Karolinska Institute-one of the most prestigious medical schools in the world. While this was the first work on bull reproduction in the Karolinska, it was not the last scientific cooperation in reproduction between OG and Karolinska-not even the last bull work. An example is the Ph.D. thesis by Bart Gledhill, DACT, a joint project with OG and Karolinska. (Studies on the DNA content, nuclear protein, and dry mass of bull spermatids and spermatozoal heads with aspects on fertility). The Royal Veterinary College received "disputation rights" in 1935. My own doctors thesis (1966), "Luminal Contents of the Bovine Epididymis Under Conditions of Reduced Spermatogenesis, Luminal Blockage, and Certain Sperm Abnormalities," is number 14 in the series of 56 theses beginning with Lagerlof in 1934. A steady increase in the number of Ph.D. theses per year during the past 30 years is a strong indication that maintaining animal reproduction as a focus in a school of veterinary medicine enhances the development and productivity of the discipline.

While other European veterinary schools may not have enjoyed the same magnitude of discipline development as Sweden, generally the discipline has grown steadily and independent chairs or sections for animal reproduction have been maintained, most commonly called obstetrics and gynecology. Due to changes in the livestock industry and the need for increased attention to population medicine/epidemiology, some schools (e.g., Gent and Utrecht) have created units/departments for reproduction and herd health or reproduction and population medicine.

Some European schools responding to the varying needs of different animal industries are currently planning species based sections/departments (e.g., equine, small animal, food animal) each including education and service in animal reproduction. From a development aspect of a discipline there are divided opinions on the wisdom of such changes. Adding animal reproduction as a part of a larger species based unit will, in the view of several leaders, not be conducive to creating the resources and emphasis that are needed for continued development of reproduction as a discipline. Some regard such a structure a step backward to times when reproduction was an "appendix" to another discipline. The history shows that the strongest development has occurred where the discipline has been well-defined and had a certain degree of independence. However, considering the need for population-based orientation, especially in the food-animal sector, the future success will be dependent on an appropriate integration of this orientation (often called production medicine) within the discipline.

In a paper, "Modern Veterinary Education in Animal Reproduction," published in a South American journal in 1970, Lagerlof gave an interesting perspective of the discipline development (or lack of!) in the United States. Stating that the U.S. veterinary schools had been slow in developing teaching and research
in reproduction, he attributed the circumstance that the U.S. veterinary schools did not take charge of artificial insemination to the lack of independent departments for reproduction. While recognizing the great efforts made by the animal and husbandry sciences departments in the USA, he maintained that reproductive problems must be looked upon in an integrated fashion (physiology, pathology, diagnosis, treatment). He linked artificial insemination with herd-health programs at that time called "sexual health control." The two shall not be separated.

Lagerlof's view, which he had preached widely during the 1950s and 1960s, had an impact on the United Nations Food and Agriculture Organization (FAO). Thus, FAO expert panels in 1961 and 1965, resolved that "the different aspects of teaching, training, and research should be dealt with within a special department in each veterinary school. Where animal reproduction is incorporated into other clinical departments such as surgery, this arrangement should be discontinued as soon as possible, and a separate department of animal reproduction be established." A special concern existed about how to advance animal production in developing countries—many of which required focused efforts by veterinarians well-trained in both physiology and in the clinical/pathological aspects of reproduction (Looks like a Theriogenologist!). Interestingly, Lagerlof sometimes gave the impression that he included the United States among the less developed countries in this regard until he finally, with great satisfaction, saw the development that Ray Zemjanis had accomplished at Minnesota. Increasingly, his "sermons" then included the phrase, "things should soon change in the United States."

Unfortunately, Lagerlof did not live long enough (he died in 1970) to see the enormous development in the United States that followed the First Conference of North American Educators in Animal Reproduction, organized by his disciple Ray Zemjanis and held in Brainerd, Minnesota, in 1970. David Bartlett has eloquently put this conference in the context of the theriogenology discipline evolution in the first Bartlett lecture in 1984 (Theriogenology: From Concept to Actuality). Reading Bartlett's conference summary, it is obvious that animal reproduction as a discipline in the United States was born at that time.

OUTLOOK FOR THE TWENTY-FIRST CENTURY

Parallel with the evolution of theriogenology as a clinical specialty and academic discipline, the society and the consumers of veterinary services have undergone greater changes in structure and function than perhaps any time period before. The changes have prompted veterinary educators to look at the consequences for veterinary education. In the United States much work has been devoted to modernizing the veterinary curriculum particularly following the challenge issued by the Pew National Veterinary Education Program (PNVEP) in 1988 through the publication of "Future Directions for Veterinary Medicine (Report of the PNVEP, Durham, N.C., 1988)." The European counterpart of the Pew report, "Reflections on the Future of Undergraduate Veterinary Education in Europe," issued by the European Association of Establishments for Veterinary Education (EAEVE), verifies that the problems facing veterinary education in the 21st century are universal as are the proposed solutions.

While the PNVEP in the United States and the EAEVE report in Europe have resulted in important changes in the veterinary curriculum, at this time greater in the United States than in Europe, the postgraduate programs leading to advanced degrees and specialization have not received the same attention. Especially in Europe, the work to develop a system for specialist education is in its formative years.

Thus, while the field of animal reproduction had evolved as a strong academic discipline earlier than in North America, the coordination between schools of veterinary medicine and the link between the academic discipline and those representing the discipline in clinical and public practice are much less developed. However, the formation of the European Union (EU) has initiated efforts to harmonize veterinary issues in the union. Veterinary Education including specialist education is being addressed by the EU Advisory Committee on Veterinary Training (ACVT), the European Association of Establishments for Veterinary Education (EAEVE), and the Federation of Veterinarians in Europe (FVE). The European Board of Veterinary Specialization (EBVS) was formed in 1993. Its structure and purpose have since been approved by the EU-ACVT.

Work to harmonize criteria and training levels for the different veterinary specialties is currently in focus
for the interest. Like in the United States, it will in all likelihood be up to the profession itself to develop agreements and working solutions to be endorsed by the EU-ACVT. Since the European veterinary community is in this formative stage of clinical specialties and the theriogenology community in North America is in an educational renewal process, a cooperation between the two "blocks" would, in my opinion, be beneficial.

Currently, the European theriogenologists are organized in two societies, the European Society of Domestic Animal Reproduction (ESDAR) and the European Veterinary Society for Small Animal Reproduction (EVSSAR). Drs. Aart de Kruijf of Belgium and Stig Einarsson of Sweden are president and vice president respectively, of ESDAR. Drs. John Verstegen of Belgium and Martine Lemozo of France are president, respective vice president of EVSSAR. The establishment of a European College of Animal Reproduction is the goal of both these organizations. While some have promoted the formation of a separate college for small-animal reproduction, discussion between the two organizations are likely to result in a proposal to EVBS to form one college representing all domestic species (Einarsson, 1998).

In the United States, leaders in veterinary education are generally aware of the need for change in postgraduate education and training programs to meet the needs of a rapidly changing society. In theriogenology, several of the previous Bartlett lecturers have noted weaknesses in the current specialist training programs and made suggestions for improvements. Two of the most outspoken statements came from Bob Kenney (1991) and Bill Wagner (1995) addressing the urgency of increasing emphasis on the development of research competency for specialists (clinical investigators) aiming at an academic career making them more capable of helping advance the frontiers in clinical sciences. Bill Wagner had earlier addressed similar issues from a general postgraduate training perspective (JAVMA, 1992, 201:544-546). Looking back at the Bartlett lectures since 1984, one will find that all, in one way or another, showed concern about the continued existence of theriogenology as a discipline and clinical specialty. Most concerns refer to education and training programs. It is generally agreed that the specialty organizations (ACT and SFT) do have the main responsibility for developing ideas and proposals for change.

The changes in the consumer sector and in perceptions and attitudes of the general public concerning the use of animals require knowledge that the traditional training programs often do not provide. In my discussions with our European colleagues, the perceptions have been reinforced that the survival of animal reproduction (theriogenology) as a veterinary discipline is at stake. As the broadest field in veterinary medicine (Roberts, 1985), theriogenology is, in my opinion, in a special need to continuously consider how to adequately respond to changes in the environments. I agree with previous Bartlett lecturers that training programs are the key to creating the professional identity. Thus, we need to take a hard look at how we educate future specialists. In doing that, it is advisable to take advantage of ongoing efforts to create criteria and develop training programs in other parts of the world. I would even go so far as to suggest a formal liaison with our European counterparts in developing a model that will sustain animal reproduction as an academic discipline for the foreseeable future. Such a development would be in keeping with the wise words of David Bartlett (1984): "provincialism in theriogenology must be avoided." The international aspects have been prominently featured also by others (e.g., recently by Willis Parker in part of his 1996 Bartlett lecture (International Contacts: A Mutual Growth Opportunity). To further stimulate change, I would like to quote a statement from Lloyd Faulkner's Bartlett lecture in 1988: "no matter how long a thing has been done a certain way, there's always a better way. Look at the things not as they are, but as they can be. Don't be stuck with what is; visualize what can be done in the future"

FUTURE TRAINING OF ACT DIPLOMATE CANDIDATES

To precisely determine how the present training programs should be changed to meet the current and future needs is beyond the scope of this lecture. However, I would like to briefly address some issues that need increased attention when designing the education of future theriogenologists.

ACT and SFT are increasingly devoting time to discussions of possible improvements in the training programs. Examples are surveys conducted (e.g., Patricia Olson's survey of ACT diplomates, presented at the 1995 Educators Forum) and committee work directed toward training issues. The ACT Food-Animal
Committee has devoted considerable time to discuss the possibility of combining specialty training with training in production medicine/health economics for those who primarily will be species specialists in practice (Howard Whitmore personal communication). Zemjanis in his Bartlett Lecture (1987) pointed in the same direction, i.e., the need for redefining the role of veterinarians in reproductive management systems. To provide adequate species emphasis parallel with an adequate depth of discipline expertise is a key question for training programs both here and in Europe.

Other issues currently in training focus are those related to the need for incorporating new, emerging fields of interest to veterinary medicine. The "new" areas are, to a large extent, the same as those highlighted in the reform of the D.V.M. curriculum, e.g., animal well-being, environmental health, aquatic animal health, international veterinary medicine, genetic disease, wildlife health management. For ACT candidates who plan to embark on an academic career, the educational programs must be designed to develop research competency in traditional as well as emerging areas.

In connection with the Educators Forum in 1995, I presented an analysis of the job market for ACT diplomates based on employment as listed in the ACT Roster of Members. Also, the results were presented of a limited survey of ACT diplomates concerning their perceptions of current and future markets and of the adequacy of the current training programs. Table 1 shows the percent ACT diplomates employed in different field from 1983-97.

Table 1. ACT Diplomates-- Percent Employed in Different Fields from 1983-97(From the ACT Roster of Members)

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<tr>
<td>Teaching/Research (TR)</td>
<td>71.3</td>
<td>66.7</td>
<td>62.2</td>
<td>55.0</td>
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<tr>
<td>Private Practice (PP)</td>
<td>18.9</td>
<td>24.8</td>
<td>25.8</td>
<td>33.0</td>
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<tr>
<td>Industry/Consultation/Misc. Organizations (ICO)</td>
<td>8.3</td>
<td>6.5</td>
<td>9.1</td>
<td>9.5</td>
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<tr>
<td>Government (G)</td>
<td>1.5</td>
<td>2.0</td>
<td>2.9</td>
<td>2.5</td>
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The data show that we still have an overwhelmingly large percent employed in the two major markets (TR and PP), i.e., 88 percent in 1997 compared to 90.2 percent in 1983. A shift has occurred within the two markets with an increasing percent employed in private practice. It is obvious that training programs would need to continue an emphasis on these two markets and equally obvious that training of a specialist for practice must be a high priority.

The "non-traditional" employment category (ICOG) reached 12.0 percent in 1995-97, an increase from 9.8 percent in 1983 and 8.5 percent in 1989. The relatively low employment rate in this category requires, in my opinion, increased attention. Do we provide the diplomates with qualifications that are attractive to employers in these "nontraditional" areas? Do diplomates market themselves adequately in these employment fields? The survey of advertisements in JAVMA, 1990-94 by Craig Smith, which I presented at the Educators Forum in 1995, indicates that these two questions may have to be answered by no. Namely, of the 395 advertised positions by government, state, industry, and miscellaneous organizations, roughly 20 percent (in the estimation of Craig Smith) could have been filled by ACT diplomates creating more than 15 new positions per year.

I believe these "non-traditional" areas constitute a very important future employment opportunity not only for theriogenologists, but for veterinary medicine overall. To successfully pursue these opportunities the diplomate candidates must be provided additional training emphasis in areas of needs or perceived future needs. We must realize, however, that some of these "non-traditional" opportunities will not open up for veterinarians unless the new graduate or the specialist have adequate knowledge and competency allowing the person to market himself/herself. In the limited survey I conducted in 1995, several ACT respondents
emphasized the importance for the individual theriogenologist to market his/her own skills. The ACT diplomats surveyed in 1995 for the Educators Forum suggested a number of areas that need more emphasis in ACT diplomate education. I have summarized the major points in Table 2.

Table 2. Areas to emphasize more in ACT diplomate education (From a survey of ACT diplomats, 1995).
- Research-Graduate Education
- Production Medicine; Epidemiology; Information Management; Health Economics
- Broader Training Providing a Multi-skilled Practitioner (e.g. medicine, surgery, nutrition)
- Marketing of Skills; Communication/People Skills
- Animal Production Systems (e.g. Economics of Production; Impact on Animal Well-Being; Animal Selection and Breeding Techniques; Environmental Concerns and Issues)

- "Large Issues" of profound Impact on the Entire Veterinary Profession:
  - Animal issues of concern to society (e.g. animal well-being science, population control, animal behavior)
  - Environmental/Ecosystems Health
  - Public Health/Food Safety/Drug Residues
  - Global Aspects on Animal Health and Veterinary Services (Legislation; Health
  - Surveillance System; Identification; and Reporting etc.)
  - Ethics (e.g. modern biotechnology)
  - Economical, Ethical, and Legal Considerations in Veterinary Practice and Research

- Aquatic Animal Health
- Zoo/Wildlife/Endangered Species

Table 2 certainly represents a large and diverse agenda. To incorporate selected areas into the theriogenology education and training programs requires substantial innovations and new thinking. Some of the issues have been discussed at ACT/SFT meetings. As thought provoking examples, I would like to mention Randy Ott's article, "Animal Welfare Issues in Theriogenology," which included aspects on animal selection and breeding techniques and Bob Kenney's Bartlett Lecture (e.g., environmental health, genetic disease). These are examples of areas where we need to convert rhetoric to action.

CONCLUSIONS:
Conclusions: Following a successful evolution of animal reproduction as a veterinary specialty and academic discipline, the future calls for an educational renewal process to preserve the discipline in the changing environments of the twenty-first century. Professional organizations (SFT and ACT in the United States and ESDAR and EVSSAR in Europe) have the responsibility to initiate work on educational reform as a joint venture with educational institutions. The main issue at hand is the development of relevant competency for various career options (academia, clinical practice, industry, public practice, etc.). There are several related questions. For example, can we produce a theriogenologist with sufficient species competency in one species while providing an adequate depth of training in the primary discipline? How do we best incorporate new, emerging fields of interest in the training programs providing opportunities for the ACT candidates to market themselves in a particular area?

Since maintaining and strengthening animal reproduction (theriogenology) as an academic discipline and clinical specialty is a common goal for the United States and the European Union, a cooperative approach is suggested for redesigning the training programs. Such a cooperation would not only help harmonize the educational standards between North America and Europe but would also provide opportunities for an international exchange of training programs in specific areas of expertise/emphasis that do not exist in every institution/country.
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