dition to traditional course work, opportunities have been established for student internships with pet food companies, animal shelters, and dog training centers. An annual field trip offers students direct exposure to career opportunities in companion animal management, training, and nutrition. Animal Sciences students that have training with companion animals have enjoyed enhanced experiences in veterinary medicine and opportunities for careers in occupations related to companion animals.

403 Research in companion animal biology: Topics of importance, current controversies, and opportunities. Gail Czarnecki-Maulden[1] and John Bauer*[2], [1]*Friskies,* [2]*Texas A&M University.*

Both fundamental and applied research initiatives in companion animal biology are available in university environments. Where Colleges of Agriculture and Veterinary Medicine co-exist on a single campus, interdisciplinary collaborations using clinical case materials provide unique opportunities for creative investigation. In the absence of such combined resources, opportunities for basic research also exist. Initiatives for companion animal research are generally more similar to those of human health rather than animal production and areas ranging from digestive physiology to genomics are of interest to several funding agency sources. Examples of funding sources, key meetings for interaction and development of mutual interests, and examples of several existing programs in companion animal biology focusing on nutrition will be described. Opportunities for developing key programs in other aspects of companion animal health are also ripe for exploration. As for industry, there is a considerable basic research effort in companion animal nutrition. This research is aimed at providing a point of difference vs competitor products and is often targeting visible differences rather than the more traditional indicators of nutritional adequacy used in the livestock industry. The non-invasive policies of most pet food companies also provide unique challenges to the researcher within industry. Career opportunities for animal scientists in the pet food industry and current research topics will be discussed.

404 Outreach efforts in companion animal science: Issues, controversies, and opportunities. Steven Zawistowski[1] and Tim Phillips*[2], [1]*American Society for Prevention of Cruelty to Animals,* [2]*Watt Publishing Co.*.

Well over half of all American homes have a companion animal, and the purchase and care of these animals is a multi-billion dollar business. In addition to direct expenditures associated with companion animals are the additional monies associated with enhanced health care when animals are employed as therapeutic partners or, conversely, the billion dollars in insurance claims made each year due to dog bites. Surveys of pet owners consistently show that a majority celebrate their pet#s birthday and buy gifts at holiday time. At the same time, millions of abandoned animals die in animal shelters each year. These contrasts are linked by a common theme. There is a lack of consistent high quality information on pet acquisition and care, and this is partly due to limited opportunities for education and training of specialists and professionals to participate in the field. Pet care businesses, animal shelters, and extension efforts all require individuals with a background in animal sciences that incorporate the most up-to-date information on nutrition, behavior and management skills. Opportunities in companion animal biology include positions at biomedical facilities, petfood companies, petfood industry suppliers, diagnostic laboratories, colleges, humane societies, animal control facilities, veterinary practices, drug companies, and the military. According to the American Veterinary Medical Association, the areas of greatest potential are molecular biology, toxicology, laboratory animal medicine, immunology, diagnostic pathology, environmental medicine and other specialties, including nutrition. Evidence of a strong interest in companion animal education can be found in the growth of Petfood Forum, an international symposium for those involved with the petfood industry. Since 1993, attendance has grown from 319 to over 1,000 people.

405 Role of animal science departments and the American Society of Animal Science (ASAS) in fostering companion animal programs. Maynard Hogberg*[1] and Ellen Bergfeld[2], [1]*Michigan State University,* [2]*American Society of Animal Science.*

Companion animal programs appear to be on the increase in animal sciences departments in the United States. The changing structure of animal agriculture has caused the traditional student pipeline from livestock farms to diminish greatly. As a result, departments are struggling to maintain enrollments and retain resources. It is critical that departments study and understand the implications that companion animal programs can have upon the following: departmental mission, student enrollment and student credit hours generated, type of students enrolled, departmental resources, fundamental research programs, relationship with Colleges of Veterinary Medicine and placement opportunities in the companion animal field. Companion animal programs can have a very positive impact on traditional animal science programs if properly planned and administered. As for ASAS, the companion animal area represents a vast opportunity for increasing membership and providing information to the public at large regarding animal science. The ASAS mission is "to discover, disseminate and apply knowledge for the sustainable use of animals for food and other human needs". Companionship of animals is a perceived need by many in today's society. ASAS membership and clientele demographics continue to change. A look forward suggests greater numbers of members with non-food animal interests and a shift from "food animal" to "animal". ASAS needs to recognize and embrace companion animal research and education as a legitimate component of animal science; foster greater collaboration with AVMA, veterinary medical colleges, and other related companion animal interest groups; develop educational materials for K-12 (K-life) distribution; and plan symposia, workshops, and other educational events that will be valued by both our members and the general public.

Future U.S. Swine Industry

406 The U. S. Swine Industry: Where we are & how we got here. R. L. Plain*, *University of Missouri-Columbia.*

Hog prices fell below the cost of production in November of 1997 and stayed there until February 2000. During this unprecedented period, hog producers lost over $4 billion. Producers responded to the record red ink as they always have, by reducing hog numbers. Only this time, the liquidation was less than history would have predicted. Structural change has given us a hog industry that is geared for growth and reluctant to downsize itself. Ten trends are shaping the U.S. swine industry: 1. Improved herd performance: Over the last 20 years, the nation's hog farms have produced 3% more pork per breeding animal per year. 2. Fewer & Bigger Hog Farms: The number of U.S. hog farms has declined from over 1 million farms in 1967 to only 85,760 in 2000 with 235 operations owning 52% of the hogs. 3. Specialization: In 1920, 75% of all U.S. farms raised hogs. Today, only 5% have hogs. 4. Fewer & Bigger Packing Plants: Just as hog farms have become fewer and bigger, so have hog slaughter plants. The concentration ratio for the top four firms increased from 33% in 1980 to 56.2% in 1999. 5. Geographic Shift in Production: Unlike the past, recent growth in production has been in grain deficit regions. 6. Integration of Production & Packing: Four major packers are on the list of the nation's 6 largest hog producers. Packers currently own 25% of the nation's hogs. 7. Integration of Packing & Processing: Packers are rapidly expanding their ability to further process and brand their pork. 8. Contracting: Over 32% of hogs were finished under production contracts in 1999. In January 2001, only 17% of hogs were purchased on the spot market. 9. Globalization: World trade in pork is increasing by about 8% per year. Last year, we exported over 6% of U.S. pork production. 10. Not In My Back Yard: There is growing community aversion to hog production and packing.

Key Words: Swine, Economics

407 The view from an integrated system. J.D. Lehenbauer*, *America's Best Pork®, Farmland Foods, Inc., Kansas City, MO.*

Three key factors will be the primary drivers of future change in the pork industry: 1) customer demands for specific pork quality characteristics; 2) reduction of food safety risks; and 3) the ability to coordinate and trace the identity of market hog deliveries that satisfy pork quality and food safety requirements. To address these changing dynamics in the pork industry, Farmland Foods developed America's Best Pork®

("ABP"), a vertically coordinated pork production system. ABP consists of three primary components: 1) proprietary Triumph genetics; 2) a USDA-approved process verification program; and 3) market hog purchase agreements. Within two years, producer participation in ABP has grown to more than 230,000 sows, which represents more than 55% of Farmland Foods' total processing capacity. From an industry perspective, independent producers will have less and less control in the future over major production decisions such as genetics, nutrition, and production practices as pork processors compete to satisfy customers' demands for quality, food safety, and price.

Key Words: Integrated system, Pork, Process verification

Genetics of Carcass Merit and Meat Quality

408 Genetic prediction for time to finish end points in beef cattle. B. L. Golden*[1], [1]*Colorado State University*.

In national beef cattle genetic evaluation programs recent attention has been given to the development of genetic predictions that are more useful for determining the effects on profit and risk of alternative selection and mating decisions. This is in part due to the fact that many current national beef cattle evaluation programs contain EPD for indicator traits. It has been shown that considering EPD for indicator traits, especially when EPD for the economically relevant traits are available, will actually decrease the accuracy of prediction associated with a selection decision. Because properly formed EPD for economically relevant traits should consider the contribution of the indicator trait, using indicator trait EPD results in a redundancy that increases prediction error and confusion among cattle breeders. A precept has resulted from this renewed understanding that has been termed the principle of economically relevant traits. Using this principle it is possible to identify appropriate traits for inclusion in national beef cattle evaluation programs. The principle has lead to an especially interesting set of recommendations for traits of carcass quality and yield. This is in part because of dogma and in part because carcasses are often valued based on traits that indicate a different desirable characteristic (e.g., marbling score versus tenderness, or subcutaneous fat thickness versus yield). Other livestock industries such as the swine industry have overcome these problems by using genetic predictions for amount of time to achieve finish endpoints. Work has begun to develop genetic predictions using random regression models for time to finish endpoints in beef cattle for weight, subcutaneous fat thickness, and quality grade. Having these three finish endpoint EPD will allow producers to not only predict the relative values of alternative selection decisions, but will also allow producers to predict appropriate finishing management programs for groups of slaughter cattle.

Key Words: Beef Cattle, Genetics, Prediction

409 Genetic influences on carcass merit of sheep. N. E. Cockett*[1] and G. D. Snowder[2], [1]*Utah State University, Logan, UT*, [2]*USDA, ARS U.S. Sheep Experiment Station, Dubois, ID*.

Sheep numbers have decreased from nearly 30 million head in the early 1960s to 7 million head in 2000. Total production of lamb and mutton has not declined as sharply because of an increase in lamb carcass weight. From 1960 to 2000, the average lamb carcass increased from 22 kg to 31 kg. This change in carcass size is in part the result of improved feed management and an increase in mature size due to direct genetic selection and the use of large terminal sire breeds. Also, lambs are now frequently over-finished because the profit margin often favors larger animals and packers discount only extremely heavy lambs. Heavier carcasses have resulted in increased fat thickness, with the average carcass now exceeding recommendations by the American Sheep Producer Council's Consumer Acceptability Task Force for fat depth. It is possible to produce heavier carcasses with lean lamb characteristics using later maturing breeds, but current production systems have not capitalized on this opportunity. The proportion of lean meat cuts has remained constant in heavier carcasses, except in callipyge and Carwell animals. Lambs expressing these phenotypes have 30 and 8% increases in lean meat, respectively, with associated decreases in fat of 8 and 0%, respectively. However, almost all studies have found decreased tenderness of the callipyge loin. A similar effect on tenderness has not been reported for Carwell carcasses. Consumer consumption of lamb continues to fall, with annual per capita consumption of lamb and mutton dropping from 2.3 to 0.5 kg over the 1960 to 1997 time period. Studies of consumer preference indicate a lamb product with reduced fat and less intense flavor would be more appealing. These changes can be achieved through genetic selection and the choice of breeds. Identification of QTL for carcass merit will also aid in these improvements.

Key Words: Ovine, Carcass, Genetics

410 First generation of QTL searches for carcass traits in beef cattle. R. T. Stone*, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE*.

Microsatellite-based linkage maps were developed with the expectation of being able to identify quantitative trait loci (QTL) emphasizing those traits for which phenotypic data were sex limited, expensive, or difficult to obtain. Currently, the publically available results for QTL searches for carcass traits are based on a few large half-sib families; five sires and approximately 1,000 offspring. Seven of these QTL are genome-wide significant (one false positive per 20 scans) while more than 20 are considered suggestive (one false positive per scan). Significant QTL affecting rib bone, carcass weight, dressing percentage (BTA5), predicted retail product yield (BTA2), marbling (BTA3), hot carcass weight (BTA4), and fat thickness (BTA8) have been reported. Of those QTL at the suggestive level of significance, some are for correlated traits at the same position or present in multiple families, indirectly suggesting that they are real. The first generation of QTL searches have demonstrated: 1) QTL with modest effects (0.5 standard deviations) can be detected, 2) the need for a much broader sampling of genetic variance, and 3) the need for sampling and statistical methods to detect interacting alleles. The second generation of QTL searches will likely be based on single nucleotide polymorphism (SNP) haplotypes because of their power in determining identity-by-decent and their suitability for high-throughput genotyping technology. The most logical resource populations will be half-sib families, many of which are small or have a limited number of off-spring with phenotypic data. Thus, the power to determine identity-by-decent is critical for both QTL and candidate gene analysis. Recently, 120,000 bovine expressed sequence tags (EST) have been assembled into about 20,000 clusters. Thus, an emerging EST or gene-based genetic map will coalesce into the functional and comparative genomics of humans and model organisms. Undoubtably, developments in genomics and genotyping technology will greatly impact future QTL studies in livestock and their utility in breeding programs.

Key Words: QTL Mapping, Carcass Traits

411 Dissecting the genetic control of carcass merit and meat quality in the pig. Max Rothschild*, *Iowa State University*.

Modern molecular biology and the science of genomics have opened up new and exciting possibilities to dissect complex phenotypic traits such as meat quality. To date over 4000 genes and markers have been added to the gene map of the pig. In addition to identifying and mapping genes and markers, animal geneticists have begun to search for the individual genes that affect meat and muscle quality in the pig. Meat and muscle quality traits are complex traits and some are often measured in a subjective manner. Measurement of these traits usually includes assessing backfat, intramuscular fat (marbling), loin eye area, pH, color, tenderness, juiciness, water holding capacity and flavor. For many of these traits heritabilities are moderate to high. While it is clear that these traits are likely to be controlled by many genes some individual genes may have large effects. To find these genes three approaches have been employed. The first has been to find or observe that "major" genes such HAL and RN are segregating in a population. The second approach is the "genomic scan" method which uses specialized crossbred resource families and random genetic markers to scan regions of the genome which are associated with meat quality traits. This approach has yielded many regions of the porcine genome associated with traits of carcass merit and meat quality. The final approach is the candidate gene approach and uses genes that by their very nature are expected to be associated with certain physiological functions. The purpose of this paper is to review