known to contain Kentucky swine) were placed under strict surveillance. It should be pointed out that all of these imported swine were automatically quarantined to the premises for thirty (30) days after arrival.

On August 26th, one of the eight imported herds revealed a positive fluorescent antibody test for hog cholera. Depopulation was completed on August 28th.

By utilizing trained epidemiologists, trained diagnosticians, appraisal teams, depopulation teams, and cleaning and disinfection teams, they were able to eradicate hog cholera from Ohio. This outbreak involved a total of seven counties, 26 premises, 6986 hogs and $101,926.56 in indemnity. It could have been far more devastating to our industry if the proper epidemiological approaches had not been put into regulatory usage.

Bovine brucellosis and bovine tuberculosis eradication efforts depend almost entirely upon traceback epidemiological effort. The days of down-the-road testing for these two diseases have become too costly in overall economics to be practical. In the initial phases of these two important programs, testing of each herd was necessary. However, with the state becoming certified "bovine brucellosis free" and modified tuberculosis accredited, the down-the-road testing was not economically practical. Regulatory officials then developed diagnostic programs in conjunction with meat inspection, with epidemiological traceback programs to the source herd. This type of program has proven most successful in revealing that high risk animals are the last reservoir of infection for these two diseases. It should be pointed out that in utilizing this approach, animal identification is a must. Extreme care must be used in the packing plants to (a) maintain identification of the animals, and (2) to be certain that the diagnosis of the lesions or test results incriminate the proper animals.

Animal identification is the key to any regulatory program. Regulatory officials in the past have utilized ear tags, tattoos, neck chains, and other means of identification. Each of these methods present problems of removal, tampering, or problems of restraint for ease in identification.

We, in regulatory programs involving animal health and consumer protection programs, are most impressed with the research involving electronic methods of identification. We have been exposed to and have witnessed demonstrations involving implanted transmitters that can electronically transmit to a receiver the identification of individual animals. When the cost of such a program is practical, we are of the opinion that identification of animals will take on an entirely new perspective.

Bovine practitioners are in dire need of more practical and efficient methods of identification. Preventive medicine programs involving bovine practitioners, such as vaccination for regulatory diseases, need proper animal identification. Pre-conditioning programs involving vaccination for such diseases as blackleg, leptospirosis, the influenza viral diseases, as well as those programs involving internal and external parasite control need proper identification so that pre-conditioned animals can be easily identified. This proper identity is the prerequisite to demand a higher premium for the owner's effort and for the veterinary fee involved in providing a meaningful preconditioned feeder animal.

In recent years, our profession has experienced the tremendous impact of Venzuelan equine encephalomyelitis and Asiatic Newcastle disease. In utilizing all the tools of regulatory medicine with total involvment of veterinary epidemiology, these two diseases have been eradicated. The nation has enjoyed two years of hog-cholera-free status.

In summary, we have attempted to indicate that veterinary epidemiology is preventive and regulatory medicine.

When regulatory officials, as well as practicing veterinarians, are cognizant of the where, when, how and how much disease occurs, the livestock industry of this nation is properly served.

International Movement of Bovine Genes: Current Status of Importation and Exportation Regulations

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Despite the fact that the title-subject may be of immediate interest to only a limited number of bovine practitioners, its implication to this country's cattle population and to the cattle industry has been/will continue to be of major significance.

Numerous factors, influences, and interests–scientific, economic, and business, mostly business–have been woven together to create, presently, an importance to international movement of cattle genes that is without precedent. Live animals for reproduction

and production and frozen semen for insemination of indigenous females are principally involved. Intercontinental transport of implanted fertilized ova, representing desired genes, carried within the uteri of indifferent, recipient females, is being accomplished. Scientists are actively researching improvement of techniques for the preservation by freezing of fertilized bovine eggs.

There can be no doubt that the rational and vigorous application of firmly established principles of genetics can contribute materially to increasing the world supply of animal protein. (1) More milk from genetically improved dairy cattle, (2) more lean meat from genetically improved beef cattle that grow faster and convert feed more efficiently, (3) higher fertility at crossbreeding, (4) higher fertility of F_1 females, and (5) higher livability of crossbred progeny, are, individually, well demonstrated goals achievable through rational genetic selections and manipulations.

It seems evident that whenever custom and tradition are combined with provincialism, firmly vested interests, and nationalism, cattle have been characteristically plateaued at sub-maximal levels of production. Reaction to the foregoing influences seems to be the basis for the recent international scramble extant for North American dairy genes in Europe and for European beef genes in North America. Past advances of science, typically, stood naked and ignored until development of new economic pressures.

In today's exciting pursuit to achieve–or give the appearance of pursuing to achieve–the important, potential gains from exploiting established genetic principles, it must not be forgotten that numerous undesirable animal disease entities–some almost eliminated, some controlled, some never present in discrete populations of livestock–if introduced or reintroduced into susceptible livestock populations concomitant with the desirable genes, can act to negate any potential genetic advances within the newly disease-affected population. Especially, the etiological agents of foot and mouth disease, rinderpest, contagious pleuropneumonia, blue tongue are unacceptable companions to the most highly desirable of bovine genes.

Fortunately, in these mid-1970's, technical capabilities of veterinary medicine have evolved to the status where it is possible–trained and competent personnel, facilities, money, enlightened and effective management available–to so handle gametes, with or without their supporting and accompanying somatic cells, so as to assure freedom from specific pathogens. It follows that it may even be well to verbalize that unless the vast past and present public expenditures for animal disease research can be justified through applications, when the need arises, of useful facts that have been established on the basis of anticipation, then it logically follows that animal disease research has been/will be a poor investment of public funds.

Since it is obviously impossible to evaluate the merit of individual females genotypically, as can be done for bulls through measurement of the performance of their offspring through progeny testing, why not exploit the genetic fact that by fourth generation a cow herd can be/will be comprised of 87.5% bull-transmitted genes from a succession of genotypically evaluated progeny-proven bulls? Surely, it is more directly effective to assemble and maintain a stable population of a few progeny-proven bulls under precise environmental control in respect to disease and from them draw upon desired genes for breeding the indigenous females of an importing nation. A genotypically evaluated bull in his mature lifetime can sire as many as several hundred thousand offspring, while an imported female can produce but a few offspring in her entire lifetime.

It would seem that the assembling and transporting internationally of groups of females entails for an importing nation the maximum risk of importing concomitant disease and the minimum potential for genetic advance at the greatest possible cost. Also, there is an inherent risk of loss of imported bovines, *per se,* especially in areas where encountering severe environmental stress is inevitable. Could custom, impatience, high visability, and/or opportunity for exorbitant speculative profits be the dominant considerations in live animal exportations and importations?

Regulations:

If one should consider collectively all the assembled, published regulations of the various countries located upon the several continents and compare and contrast their composition, one finds them highly inconsistent, individualistic, and regionalistic. Some examples can be cited that have permitted–if not encouraged–development of orderly, and apparently, mutually satisfactory international trade. On the other hand, some regulations are so written as to leave no choice other than compliance through expediency in an attitude of abject cynicism. Instances can be found among the collected regulations that seem to be scientifically incorrect and/or highly political. One finds examples of poor balance, there being emphasis upon single factors while overlooking equally important other factors. Instances are evident where emphasis is upon "officialness" of statements, certifications, and endorsements rather than upon authentication of hard technical data.

Poorly written regulations seem, sometimes, to favor scientific naivete and/or irresponsibility over competence and professional integrity.

One perhaps might reasonably surmise that some regulations were written to preclude importation of germ plasm–at any rate, to so restrict importations for political or commercial reasons that importations would he highly infrequent and that any importations when accomplished would constitute *cause célèbre.* Inordinate expense, time inputs inconsistent with

value of product, red tape, risks that can't be anticipated or controlled, and paper documents by the kilogram are too often involved.

When one takes a more objective viewpoint of the published regulations of the various nations, it is possible, sometimes, to see them in a more tolerant way. Fundamentally, it does remain the prerogative of any nation to express its interests, concerns, and responsibilities to the health of its livestock as ever it sees fit. Frequently, regulations seem to be an overt expression of national personality.

It is indeed unfortunate that international communication within the veterinary profession is found so frequently not to have occurred or is so slow to occur, and that political and economic considerations so often seem to overlay or underlay scientific and professional matters. Is it not axiomatic that solutions to politically and economically induced regulatory barriers, which are in effect trade barriers, will never be found within veterinary science?

Regulations - Frozen Semen:

It is clearly apparent that regulations in respect to frozen semen have usually been written by regulators familiar, mostly, with regulating movement of live animals. The very fundamental biological and time frame differences between live animals and frozen semen as potential carriers of disease are too often overlooked. Obviously, a given live animal is usually the subject of an exporation/importation only once in its lifetime; health test data, obviously, must be contemporaneous with the date of exportation/importation. On the other hand, semen when frozen is static; health test data, to be meaningful, must be contemporaneous with the bull's health status on the date of semen collection. Health test data of the bull surrounding the date of exportation/importation of the semen may be meaningless, especially if the semen concerned has been in frozen storage for several years.

Almost consistently, regulators have failed to exploit their unique opportunity to effectively employ the safeguards afforded by both pre-collection and postcollection health test data made possible by the "time stopping" characteristics of frozen semen.

For example, requiring a single tuberculin test (or most any other single test) within 30 days preceding semen collection is unsound. It is generally recognized that tuberculin tests should not be administered routinely at intervals of less than six months. It follows, therefore, that semen from a bull subjected to programmed, routine, twice-yearly testing for tuberculosis within a stable population of bulls maintained exclusively for production of semen for use in AI, is eligible for importation only two months each year. On the other hand, under a thirty-day requirement, semen from a bull never tuberculin tested before in his lifetime is eligible for importation for thirty days after an initial, single test.

Obviously, the intents of an importing nation are best served when it is required that health test data be submitted for each bull and for each disease, with test dates that both precede and follow date of semen collection. Further, they would be well advised to obtain truly meaningful data upon which to make sound judgments by requiring, as available, the complete by-disease, by-test history of each bull from which semen is to be exported/imported. Semen producing organizations, if stable and reliable and committed to programmed bull health surveillance, will have no difficulty in documenting before semen collection and after semen collection health test data and in providing complete health test histories during tenure on their premises.

Poor regulations have the potential of being counterproductive, sometimes incorporating the potential of favoring the fly-by-night, one-shot operators and penalizing stable, knowledgeable, responsible organizations.

Technical Considerations:

It is a reasonable generalization that pathogenic microbiological forms–bacteria, fungi, protozoa, molds, viruses, etc.–that find their way in any manner into bovine semen and/or semen extender, pre-freezing, will survive the semen freezing processing, frozen storage, and subsequent thawing approximately as well as sperm cells. Inadvertent intrauterine delivery of most pathogens incident to uterine placement of semen can result in transmission and development of disease processes.

There is no choice whatsoever other than total acceptance of the necessity for regulations (1) that declare and/or recognize the enzootic nature of certain specific, highly contagious diseases in discrete geographical areas and (2) that either establish highly efficacious rigid procedures for, or preclude absolutely, importation of animals or animal products into disease free countries from infected countries. Just as North American countries carry the responsibility to protect their livestock populations against importation of foot and mouth virus, so must Australia and New Zealand protect their livestock populations against viruses of foot and mouth disease and blue tongue. Rinderpest and contagious pleuropneumonia are, likewise, examples of diseases dealt with, necessarily, on a national basis. Only recently have new and highly sophisticated veterinary technologies, major commitments in governmentally employed professional manpower, and large sums of risk capital been combined to accomplish movement of live cattle and/or genes from countries of disease presence or of potential disease presence to importing disease-free countries.

Notable examples of such are:

1. Importation of bovines into Canada and subsequently of these same animals or of bull semen into the USA from countries of western continental Europe when principal concern was foot and mouth virus.
2. Importation into New Zealand from England of Jersey cows pregnant with purebred Simmental or

Charolais fetuses implanted as very early embryos when principal concern was foot and mouth virus.
3. Importation of bovine semen into USA from countries of western continental Europe via "third countries" i.e., Japan or Scandanavian countries, when principal concern was foot and mouth virus.
4. Importation of bovine semen into Australia and New Zealand from Canada when principal concern was blue tongue virus.

There are other less-feared but very important diseases of cattle for which surveillance is imperative, especially when bovine semen is concerned, because of the large number of herds potentially affected should bovine semen be infectious. *Mycobacterium bovis, Mycobacterium paratuberculosis, Brucella abortus, Trichomonas foetus, Vibrio fetus* var. *venerealis, Leptospira spp* are pathogens associated with well defined bovine health hazards. For dealing with these entities there are adequate, well established procedures and methodologies which must be incorporated into the semen producing practices to avoid semen-borne disease. Presently, the potential of IBR/IPV-IBP is being recognized and defined. The possible importance of the virus of bovine leukemia is yet to be clarified. The role of Chlamydia and of Mycoplasma are not clearly established. There is no present evidence that the non-specific, ubiquitous, opportunistic pathogens, i.e., corynebacterium, pseudomonas, staphylococci, streptococci, commonly present within or about the preputial cavity, are of significant importance, except in instances of gross contamination.

Routes Toward Resolution

The technical problems of international movement of livestock and semen have been the subject of study and statements by the Food and Agriculture Organization of the United Nations. Meetings have been sponsored and a summary of their deliberations has been published.

Also, the subject of international movement of semen has been studied by Working Group 5, "Artificial Insemination of Animals," Subcommittee I, "Methods of Reproduction," Technical Committee 34, "Agricultural Food-Stuffs" of the International Standards Organization. This group has functioned under a USSR Secretariate, with eastern and western European composition. The USA was first represented in 1974.

In the USA, the subcommittee on AI of the Committee on Infectious Diseases of Cattle, U.S. Animal Health Association, has endeavored to aid the Animal and Plant Health Inspection Service of USDA toward developing an interstate regulation governing the movement of bovine semen. This effort has been provided with continuous support and endorsement of the Sire Health Committee of the National Association of Animal Breeders and of the Association's Board of Directors. The American Association of Veterinary Laboratory Diagnosticians has provided an excellent statement of recommended technical procedures for tests and testing.

Regrettably, this worthy project has been unsuccessful, having been progressively frustrated over the past six years by a succession of factors. Presently, shortage of USDA funds seems to be precluding implementation of a satisfactory regulation.

Although certain key staff veterinarians of USDA have worked hard and well toward developing a practical and effective regulation, USDA's administrative inability to conclude this prolonged effort by enactment of the proposed regulation has served to perpetuate a long existing vacuum. In the absence of the essential, effective leadership, initiative has been irretrievably lost. **USDA's failure to have established a domestic USA standard renders impossible the clear expression of a U.S. export standard.**

Presently employing joint USDA Foreign Agriculture Service funds, and National Association of Animal Breeders funds, three teams, each comprised of a USDA veterinarian, an NAAB veterinarian and an NAAB geneticist have/will visit western European nations, eastern European nations, and Central/South American nations for purposes of direct, technical communication and, hopefully, resolution of some differences.

In the final analysis, it appears that early resolution of the problems of international movement of bovine genes is not probable, the critical impediment being more frequently functions of regulators and regulations rather than of technology or veterinary science.

Nevertheless, more communication through professional channels of scientific facts might be helpful.

In the meanwhile, bilateral agreements and understandings developed between individual countries appear to be essential with the national economies and the live cattle or bull semen sellers and buyers paying the inordinately and unnecessarily high costs of conducting business in such an environment.