INTERNATIONAL SYMPOSIUM ON
HEALTH ASPECTS OF THE

INTERNATIONAL MOVEMENT OF ANIMALS

PAN AMERICAN HEALTH ORGANIZATION
Pan American Sanitary Bureau, Regional Office of the
WORLD HEALTH ORGANIZATION

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INTERNATIONAL SYMPOSIUM ON HEALTH ASPECTS OF THE INTERNATIONAL MOVEMENT OF ANIMALS

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Introductory Note

The Inter-American Symposium on Health Aspects of the International Movement of Animals, held in San Antonio, Texas, from 28 to 30 August 1968, was sponsored jointly by the Pan American Health Organization and the Conference of Public Health Veterinarians. More than 160 specialists from all parts of the Americas attended the meeting. The 32 technical papers presented are compiled in this volume, together with the introductory statements and the summary of the proceedings.

The Symposium was partially supported by grants from the U.S. Air Force Office of Scientific Research (OAR) (Grant AF-AFOSR-68-1530), and from the U.S. Army Medical Research and Development Command (Grant DADA 17-68-G-9272), to which sincere appreciation is expressed.

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PREFACE

Everything that leads to the creation or strengthening of the scientific and intellectual community of the Americas helps to forge the kind of future required by the peoples of the Hemisphere and agreed to by their Governments. This is how we view this Symposium and its importance to the Americas. Dire consequences have arisen from the isolation and misunderstood nationalism which until recently prevailed among our countries. Today we are witnessing the development of a more just society, and we hope that the present era will eventually become a true epoch in history. But it is essential that that time be preceded by the formulation of a set of common ideals and purposes, by an identity of thoughts and activities, by a generous exchange of knowledge and experience, and by a genuine decision to have the common welfare prevail over personal interest and to have progress prevail over conventionalism. The economic interdependence and integration we are currently preaching is only an instrument for improving the living conditions of the people and for expanding social mobility, thus multiplying the opportunities for human beings to realize themselves and to build their own destinies. Each stage of this complex process is merely a means, and the means must not overshadow the end, which is, ultimately, the betterment of the human being.

This is how we understand the significance of this Symposium and its importance to the Americas. Everything that will be analyzed here will, in addition to being useful to science and technology, be even more useful to health protection, the promotion of development, the avoidance of risks to the economy, and the establishment of welfare. Whether you speak of exotic and experimental animals or of food animals and animal products as carriers of pathogenic microorganisms, we find a single uniting thread of humanitarian purpose. This coincides with the doctrine of the Pan American Health Organization and the World Health Organization and explains our presence at this Symposium. It is no longer fitting for us to segregate the professions and their practitioners, either within countries or at the international level. There is no exclusive ownership of programs or functions. Both have acquired new dimensions, which are continent-wide in space, human in objective, and interdependent in action. Perhaps veterinary medicine is the science which best demonstrates the ecologic concept of health, that dynamic process which stems from the adaptation of living beings to their environment and its varied components. Health problems arising from that interaction—many of them brought about by man himself—can only be solved successfully in a multidisciplinary manner, on a single-program basis. Today's science and technology are pluralistic—that is to say, ever more diversified and universal—and their exercise requires the participation of various professions and their institutions. We must confess that we all have to learn how to perform this joint task and to act as a society of equals, animated by the same purpose. A glance at the agenda of this Symposium suffices to indicate this inescapable principle.

The recommendations which will result from your discussion of each topic will be useful to both Governments and international agencies. It is easy to foresee how their systematic application will contribute to the gradual reduction of that truly organized profusion of disease agents which play such havoc with the economy.

A Hemisphere with so much malnutrition cannot afford to waste the protein lost through foot-and-mouth disease, rabies, brucellosis, bovine tuberculosis, hydatidosis, and other parasitic diseases. Even a most conservative estimate shows that the equivalent of over 20 per cent of the available proteins are either not produced or are destroyed because of such diseases. In the meantime, more than 750,000 preventable deaths in children under five years of age occur each year in Latin America and the Caribbean area. And they die because malnutrition does not permit them to resist the attacks of the environment and to survive. Of those who do survive, we do not know how many will be mentally retarded as a result.

Of similar importance will be your recommendations for the establishment of quality control standards for industrialized food products of animal origin, for the improvement of laboratories, and for the establishment of reference laboratories to serve several countries. This is of particular importance to the common markets. In the case of Central America and Panama, a decision has already been reached by the Ministers of Health of those countries to implement methods that will include all these measures. The implications to the industry and to the manufacturers are self-evident.

Your recommendations on the international movement of experimental animals will be important to the production of attenuated live virus vaccines in tissue culture of primates or other species. The publication *First International Conference on Vaccines against Viral and Rickettsial Diseases of Man* is the result of a meeting sponsored by the Pan American Health Organization. It contains a wealth of information generously given to us by experts from all over the world. It fully justifies the subjects contained in your agenda.

The question of simian malaria, for those of us who pursue eradication of malaria in man, must be carefully studied. Although presence of the disease has been verified, up to the moment it would not seem to have an influence on the dynamics of malaria in the Americas.

In the world of today it seems difficult to define what is exotic. On occasion, it seems to be that which surrounds us rather than that which comes from strange and foreign lands. We are undergoing such violent changes in customs, attitudes, and purposes that serious difficulties arise in attempting a meeting of minds between generations. We shall leave the task of a definition up to the Symposium. We do appreciate the health risks involved in an exchange of species, as each paper presented at this Symposium indicates. The dissemination of these diseases will continue to increase and already calls for practical control measures.

Of no less importance will be your recommendations to the universities on their duties of teaching, research, and the enlightenment of statesmen and Governments. Many of them are still far removed from teaching modern veterinary medicine in keeping with the political, economic, and social realities of the Hemisphere. We seek a complete education to produce graduates with a holistic concept of life and its responsibilities—graduates who are endowed with a spirit of cooperation toward their own profession and others, all working

together toward the common good, graduates who will see beyond the limits of their duties conceptually and beyond the frontiers of their countries geographically, graduates who will track down and determine the true nature and dimension of each problem.

Our sponsorship of this Symposium indicates the interest of the Pan American Health Organization in these problems. Your conclusions will permeate our commitments of cooperation with the Governments of the Americas. We wish to express our appreciation to the universities and the departments and agencies of the Government of the United States of America, and to the industries and professional associations that have made this event possible. The most lasting impression of this Symposium will be a strengthening of that intellectual and scientific community previously referred to—a community this time centered around veterinarians on whom so largely depends the future welfare of the peoples of the Americas.

Dr. Abraham Horwitz
Director
Pan American Sanitary Bureau

REMARKS ON THE IMPORTANCE OF THE ANIMAL INDUSTRY TO THE AMERICAS

DR. GEORGE L. MEHREN*

In assessing the importance of an animal industry to the Americas, I believe we should begin with the most significant of several considerations—the matter of human values. What does animal industry mean to the people of our countries as individual human beings?

It means food and a better chance for health and vigor.

One of the most difficult problems to solve for the undernourished in the Americas is the provision of enough proteins of adequate quality to support good health and to prevent protein malnutrition.

Man has traditionally balanced his diet with proteins of animal origin—meat, milk, eggs, and fish—that provide essential amino acids as well as minerals, fats, and vitamins. Animal products also contribute desirable flavor and structure to otherwise bland and characterless diets. Provision of adequate quantities of animal products is generally conceded to be the ideal way to improve protein nutrition.

The proteins in meat, milk, and eggs are of high quality because they contain a balance of the nine amino acids essential to man, while most plant proteins lack one or more essential amino acids. For example, diets composed principally of corn, wheat, or rice are likely to be deficient in methionine, lysine, or tryptophan. Even oilseed proteins have relative deficiencies of certain amino acids. Only in some of the pulse crops does the protein approach that of animal products. Diets composed mainly of cereal grains must be supplemented with foods containing the essential amino acids to meet human dietary requirements and avoid protein malnutrition.

There is no shortage of animal protein in the world as a whole, and the potential for expansion is great. Current supplies are adequate to supply every person in the world with 20 grams per day. However, the problem is one of distribution. The average per capita consumption is 44 grams of animal protein per day in the developed countries of North America, Europe, Australia, and New Zealand but only 9 grams in the rest of the world, including Latin America and the developing countries.

Meeting the needs for quality proteins in the Americas is complicated by several factors. Low per capita buying power is a major barrier. The availability of meat substitutes at relatively low prices presents a question. As long as low-income groups can get grains for so much less, would they or *could* they buy meat at meat prices?

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Low-income nations are using land for cereal production. The general belief has been that they can neither afford to grow nor to import animal products. The magnitude of population—particularly in areas of Latin America—and the differences between preferences and availability mean that an immense potential market for the animal industry is closed by low incomes or, more plainly, by general poverty.

This is part of the theory that, in the long run, man cannot afford to eat meat. Animals eat the same grains that man needs for his diet. They devour more protein in the form of plant food than they can produce in the form of meat. The world's *total* protein supply is thus diminished. Eventually, as populations grow and the demand for protein rises, man will find it necessary to get his protein directly from plants, without interference from that "wasteful intermediary," the meat animal. For example, what will happen in South America in the coming year?

In 1950, the populations of North and South America were about equal, at 170 million each. But the United Nations projects the population of North America at about 300 million by the year 2000, and South America at about 600 million. Can South American countries afford to divert, for animal use, food that would otherwise be consumed directly by people? The thesis is that it is wasteful to feed animals because the yield in energy from the animal products is only 10 to 30 per cent as much as the energy consumed. Therefore, it would be better to let people consume the food directly.

This concept holds up only if the entire diet of the animal is composed of foods eaten by people. Farm animals, particularly the ruminants, have the ability to convert feeds other than cereals and oilseeds into protein for human consumption. These other feeds consist mostly of forage, by-products from the harvesting or processing of fruits and other food crops, by-products from the processing of animal products, other wastes, and nonprotein sources of nitrogen.

Forages are food resources not generally consumed directly by humans. But forages make up a large proportion of the rations of farm animals. About 70 per cent of the protein of the average dairy cow in the United States is from forages. An average beef steer gets 60 per cent of its protein from forages; sheep from 80 to 90 per cent. Swine and poultry, of course, use much less forage. In other countries of the world, producers make a much more efficient use of forage, and the percentage in the ration of livestock is much higher.

Whether or not grains suitable for human use are fed to livestock is mainly a question of the supply and demand for other uses and their cost. When grains are readily available at a low price, they are fed to livestock, sometimes in abundance. When they are not available at a low price, animals are provided other feedstuffs, which generally cannot be used directly as human food.

And then there is the expanded use of marginal land.

Over 60 per cent of the world's agricultural land is nonarable and suited only for grazing. Animals are the only practical means of utilizing this resource for human food production. In the United States, about 191 million hectares of permanent grassland pasture and range are either privately owned or owned by public agencies other than the Federal Government. The productivity of this land for crops is only one-fifth to one-sixth of the productivity of most cropland. However, this land is an important food source when converted into animal proteins by livestock.

In addition, there are 162 million hectares of federally owned grassland range

and of forests and woodland pasture and range owned federally and otherwise. The productivity of this land is only 3 to 4 per cent of that of average cropland. But it is also making a valuable contribution as a feed source for our animal industry.

The productivity of grazing lands in the Americas can be improved greatly when modern forage and range management techniques are utilized. Even land classified as arable will, under certain conditions, produce a more valuable human food resource through the production of certain high-yielding forages, such as alfalfa or Sudan grass, for use as livestock feeds rather than when it is used to produce cereal grains for consumption by people. The application of modern range management techniques also promises to convert some of the lands now considered to be waste lands into valuable producers of forages.

As the need for food becomes increasingly more urgent, there will be a great temptation to put these marginal or waste lands into production. If they are forced into crop production, the losses in soil productivity and fertility could be disastrous to the needs of future generations. But if converted to grasslands and properly managed as such, these lands would form the foundation of an animal agriculture, both the best kind of conservation and the best kind of productive farming.

Animal agriculture provides a means of sound diversification in areas that are too concentrated in one-crop farming. The growth of livestock production in the southern part of the United States is a graphic illustration of this point. Row-crop farming has been wearing out the land for many generations. And as the land became poorer, so did the farmers. Now, wherever livestock farming has been introduced into a diversified system, the agriculture of our South has been strengthened, along with the economic stability of producers and the community.

In countries like Brazil, where the attempt is being made to move away from the heavy concentration upon coffee production, there is an opportunity to introduce more livestock production—an opportunity to provide for better diets and a stronger agriculture.

In addition to its benefits to the health of the people and to the soundness of diversified agriculture based on conservation of resources, animal industry is of significant economic importance.

Let us look at the United States, for example.

In the United States, consumers spend $33 billion a year—or about 49 per cent of their food dollar—for livestock products.

Producers receive about $17 billion a year from the sale of livestock and livestock products.

The livestock industry, including production, processing, marketing, and the production of supplies for livestock farms, provides employment for 6 million people.

Livestock and livestock products provide profitable exports.

This is the level of economic contribution an animal industry can provide under relatively efficient operation, such as we find in Canada and the United States.

In Latin America, livestock production is much more varied in the quality and quantity of output and in the productive use of grass and pastureland. For example, in Argentina, the country's exchange position in international trade is almost totally dependent upon livestock. In other areas of Latin America, low productivity per animal unit limits the value of animal industry on all counts.

Recent (1964) figures from the Food and Agriculture Organization of the United Nations showed the following levels of productivity:

In North America, 114.7 million head of cattle were producing 74.8 kilograms of beef and veal and 570.7 kilograms of milk.

In Latin America, 213.4 million head of cattle were producing 27.5 kilograms of beef and veal and 102.7 kilograms of milk.

And so, we see one of the problems is productivity.

Latin America has an abundance of resources for livestock production. Its agricultural land area approximates that of the United States, although a much larger proportion—over 80 per cent—is grazing land. There are more than twice as many livestock units in Latin America as in the United States and Canada. Livestock numbers increased rapidly from 1953 to 1963, although increases in production per animal did not keep pace with the increase in the United States and Canada. Only one-half as much meat, about one-third as much milk, and one-fourth as many eggs are produced in Latin America as in North America.

What do we need to do to improve this lag in productivity and the total animal industry throughout the Americas for the future?

First of all, we are faced with an interlocking chain of requirements. Unless we can increase efficiency of production of livestock and livestock products, the industry cannot be economically sound. If we produce efficiently on the land and have *not* the methods of transportation, marketing, and handling to bring animals and products to market, the production efforts are wasted. If we bring high-quality products to market and there are no buyers, the whole system crashes into ruin.

Beginning at the market place, we are again confronted with the two-pronged question. On the other hand, there is the belief that you must have basic economic development—a balanced economic development—to have a market for an animal industry.

In the United States, as I have said, with a high level of economic development and a relatively high average income, consumers spend 49 per cent of the food dollar for meat and livestock products. People have a preference for meat products, and, when they can afford them, they buy.

In Latin America, there are no religious or cultural barriers to a preference for livestock products. The principal barrier is low income. Therefore, one of the important steps we need to take is to strengthen basic economies in those countries where an animal industry is not supported because consumers cannot afford to buy what they want. We must build a market for livestock products—domestically and in foreign trade—by developing a strong national economy.

On the other hand, the second part of the question is the belief that building a strong animal industry is an active step in developing the basic economy. By increasing the value of a farmer's output from grain to livestock, by creating more jobs in systems of transportation, processing, handling, and marketing, we are strengthening the total national economy.

The logic is clear: We must do both. We must strengthen economic development generally in low-income countries, and a more efficient and productive animal industry is an essential part of that development.

That brings us back to the beginning of what we must do to increase efficiency of livestock production. The main reason that livestock are unproductive is the

failure to use scientific principles of breeding, feeding, and management, including disease control. If modern principles of genetics, nutrition, range and forage management, animal husbandry, and disease control were adapted to local conditions and applied, and if farmers were appropriately supported by suppliers and processors, animal production in American countries would be increased greatly without wastefully competing with people for food.

In other words, the solution to efficiency of production lies in management know-how and appropriate public policies. If young farmers in low-income countries receive a good primary education, they can learn and apply the large store of management information already available. The crucial first step is to acquaint the farmer with important basic principles that have been tested and proved by farmers with efficient animal industries.

A good beginning has been made in Latin America toward spreading these basic principles to producers. We must make every effort to increase and expand the training of agricultural leaders in animal agriculture so that they may adapt the principles to specific conditions, particularly in tropical climates.

The innate abilities of native cattle must be tested. Then breeding programs should model native livestock to local conditions and markets. Finally, foreign cattle lines should be introduced to improve the best native lines.

Livestock diseases and parasites are a severe limitation to efficiency of production throughout the Americas. Aftosa—foot-and-mouth disease—is one of the most debilitating diseases of ruminants and swine. In North America we have established the policy of eradication whenever this disease has appeared. In most of South America, the most hopeful approach for the immediate future is to control aftosa wherever it exists and to keep it from spreading.

We have continuing battles with such diseases as anaplasmosis, anthrax, brucellosis, bovine tuberculosis, hog cholera, tick fever, and a host of other parasites and diseases. Our goal for the future must be to continue and increase our efforts until we can make a significant reduction in the losses from these pests and diseases.

We must make improvements in the productivity of pastures to improve livestock nutrition, particularly in the tropics.

All these needs for the future that I am outlining take capital investment on the part of producers. It would be highly impractical to expect new and underutilized land to be opened to animal agriculture for the first time, to expect producers who are raising scrub cattle to an average weight of 200 pounds at six years of age to upgrade their operation to full efficiency of production, or to expect any low-income or poverty-ridden farmer to jump into a relatively expensive livestock production operation without support. That means the national economy must be able to develop credit systems to allow producers to invest carefully under expert guidance.

There must be means of providing breeding stock, fertilizers, and tools at more reasonable prices. Electrification systems must be extended so that livestock producers can take advantage of automation.

Public policies must be established to encourage a more efficient animal industry, policies such as land-tax reforms, provisions for importing livestock and equipment, and differential pricing policies to broaden consumption.

There are transportation problems. We must build roads to get the livestock to nearby terminal markets. We must provide wheels to move the animals in order to keep from walking the meat off their bones before they reach slaughtering

plants. We must provide refrigeration and improved sanitation in processing and handling livestock products to ensure the safety and wholesomeness of meat products.

So far, I have been touching on some of the needs for the future that we can see now with the knowledge we already have at hand. But we know that we can expect rapidly changing conditions in our countries, in our Hemisphere, and in the world. We must continue research in the various fields of animal industry so as to be ready for the requirements that we cannot yet see—or, at least, cannot yet fully understand.

We must conduct research to develop more efficient methods of production, including greater use of automation in order to meet increasing needs of growing populations, to lower costs, and to reduce risks. We must improve biological efficiency and enhance product quality. We must find more effective ways to reduce losses from diseases, parasites, and insect pests. We must develop new and improved livestock products and processing technology. We must learn more about the role of livestock products in meeting nutritional needs and in providing preferred eating qualities.

In fulfilling all our needs for the future, we will find increasing value in cooperation. We must work together to reach a better understanding of the trading patterns in livestock products in and among the Americas and with other nations. With better understanding, we can evolve a more mutually beneficial system of trade.

Within nations, we should be able to strengthen the ties of cooperation between national, local, and private institutions concerned with livestock. We can continue and improve our informal cooperation between our nations. And we have an excellent opportunity to work more closely within the framework of the several regional organizations of the Americas concerned with economic growth, livestock health, production, and marketing.

Through such efforts as these, I am sure we can continue to enhance the importance of animal industry to the Americas.

Summary

HEALTH ASPECTS OF THE INTERNATIONAL MOVEMENT OF ANIMALS

SUMMARY

LEONARD M. SCHUMAN, M.D.*

Eleven years ago a symposium on Animal Diseases and Human Health was of sufficient significance in the eyes of the public to merit an editorial in the *New York Times*. That symposium, which dealt almost exclusively with animal diseases transmissible to man, was considered a ten-year progress report on the zoonoses. Clarifying many complex problems then extant and defining the areas of unsolved problems, it made no excuses for its deficiencies, subject-matter-wise, in the wide-ranging spectrum of the interrelationships of animals and man in the sphere of health. Thus it is not only fitting that a decade later another symposium dealing with animal, and hence human, health should be held, but that it should, in view of the global proportions which all problems have increasingly been assuming, be sponsored jointly by the Pan American Health Organization and the Conference of Public Health Veterinarians. These organizations, which serve as our hosts, are to be commended for their judicious selection of a theme which is so relevant to the greater problems besetting us today—problems of exploding populations, poverty, and social upheavals with their very relevant impacts on our food supply and the health maintenance both of the animal sources of that supply and of man.

In the relative microcosm of a single country the health problems posed by the movement of food animals and their products can at times appear insurmountable. What then can be said of the macrocosm of a Hemisphere, which involves not only a greater diversity of types of problems but also inequalities in the magnitudes of these problems in terms of supply, quality, demands, and the ability to achieve these demands? The importance of this Symposium has been ably pointed out by the Director of the Pan American Sanitary Bureau, Dr. Abraham Horwitz. The importance of the industry created by the ingenuity of man in response to his vital needs has been succinctly expressed by Dr. George Mehren. The addresses of these two men very properly determine both the theme and the mood of this Symposium.

Dr. Horwitz, in drawing a parallel between the isolationism of nations and that of the professions, warned against the dire consequences of such isolation and pleaded for a recognition by the health professions of the economic interdependence and integration which is being attempted to improve the living conditions of all of mankind. He reiterated the belatedly unfolding concept that no single agency, no single profession, has the "exclusive ownership of programs or functions." Science and technology have become pluralistic. The complexity of our problems dictates complex solutions and demands multidisciplin-

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ary approaches with interdisciplinary cooperation. It was his hope that, our ultimate goal being the well-being of man, the discussions at this Symposium would lead to a communion of ideals and purposes and an exchange of knowledge and experiences that would be of value to individual governments, to international agencies, to industries, and to universities where the duties of research and the teaching of a modern medicine, both human and veterinary, in line with a holistic concept of life, are becoming more a social obligation than a privilege.

Dr. Mehren, concerning himself basically with food needs and the balanced nutrition of man, the *raison d'être* of the animal industry, very edifyingly pinpointed the problems of today: no shortage of animal protein in the world, but a problem in its distribution and purchasability; no problem of food animals overconsuming foods eaten by man, but a problem in having man understand that animals with a human food potential can produce protein for human consumption with feeds other than cereals and oilseeds and with forages not used by man; no shortage of suitable grazing lands, but a need to expand the use of marginal lands and improve the productivity of grazing lands with known proven methods; no shortage of marginal lands, but a problem in adapting them properly to grazing, as opposed to their attempted use for crop production with greater loss of fertility; no shortage of cattle in Latin America, but a problem of beef, veal, and milk productivity. Mehren pinpointed these problems and indicated the need for a two-pronged attack for their solution: (1) joint strengthening of economic development through credit systems for breeding stock, for fertilizers, and for tools and electrification for automation, and (2) the application of scientific approaches to breeding, feeding, and management with vitalized disease control, which is the main concern of us all.

MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

Associated Disease Problems

Since countries do vary in the size of their human populations and hence food requirements, in levels of economic development, in crop as opposed to grazing land acreage, in quality of breeding stock, in health status of food animals, and hence in productivity, there will be varying levels and degrees of self-sufficiency for a long time to come, thus making necessary the movements of food animals and animal products between nations. From time immemorial both man and his domestic animals have migrated for reasons having to do with the essential of life. Whereas such movement of animals in the distant past was a matter of the owner seeking new grazing lands or a new locale for a livelihood, today man's domestic stock and animal products move far without him, posing problems of the introduction of animal diseases into new areas. Cognizant of the enlarging sphere of influence of such hazards, Dr. Robert J. Anderson outlined the objectives of quarantine and inspection procedures and the extent to which they are applied to both imported and exported animals, animal products, and animal-associated materials to prevent the introduction or exportation of disease agents. He noted that the ultimate goal is not only the protection of our own inhabitants but those of other countries that rely upon our export

regulations and the integrity of their enforcement. Continuing research in disease control must be maintained in order that the most efficient and least oppressive methods may be applied.

Dr. José da Faria, expressing the same concern over the growing potentialities of disease dissemination and underlining the role of rapid air transport in potentiating this danger, outlined for us the activities of the international organizations of the Pan American Health Organization/World Health Organization, the Food and Agriculture Organization, and the International Office of Epizootic Diseases (OIE) in their search for unified principles, criteria, and standards in health protection of animals in international movement. He cited the International Zoosanitary Regulations of OIE pending approval and felt that for animal health goals to be acheived in the Americas each government will need (1) an adequate veterinary service for implementation of the sanitary measures and (2) an orientation of technical personnel toward an understanding of the goals and methods of such sanitary control through training, refresher courses, and seminars. Dr. da Faria singled out several specific control measures for special comment. These included (1) improvement of epizootiologic records by improvement of reporting procedures for animal diseases and increasing the tempo of research, (2) standardization of antigens and diagnostic tests for disease detection, and (3) standardization of sanitary requirements in the shipment of animals and animal products. He called for stricter sanitary controls with particular reference to exotic diseases, citing the Brazilian studies on detection of the carrier state of type C foot-and-mouth disease in cattle for export from Brazil to Venezuela. He called for increased governmental financing of the development of animal husbandry with part of such resources earmarked for improved activities related to international shipment.

Dr. Kenneth Wells of the Canadian Department of Agriculture related the impressive example of the 1952 introduction of foot-and-mouth disease to Canadian cattle, which virtually cut off Canadian livestock and livestock product exports, cost $1 million for eradication, and resulted in a loss of $900 million in exports, in livestock value depreciation, and in government support of meat prices. Two methods of control are possible—total prohibition of import or the application of import requirements controlling entry. But even a highly organized and qualified veterinary service does not necessarily ensure that anything less than total prohibition will be successful or feasible. Dr. Wells, concerned about the multiplicity of existing diagnostic tests for export and import and the apparent rarity of an animal truly "free of disease," does not, however, foresee an answer to these problems except through greater international cooperation in the development of uniform test standards, quarantine requirements, and disease reporting. He also feels that a much greater danger of introduction of animal and human disease agents lies in the importation of meats and suggests a reconsideration of updating current meat inspection operations with respect, for example, to pesticide residues. The replacement of inactivated vaccines and simple bacterins with live attenuated products also increases the risk of accidental spread of disease agents where production methods fall short of minimal safety. Dr. Wells also expressed the concern of other speakers over the dissemination of disease via the meat parcels carried by airline passengers or sent through the mails.

Dr. Miguel Villegas Delgado delineated the factors which have increased the complexities of the health problems arising from international movement of

animals and animal products. Citing such factors as increase in herd size, geographic concentration of herds, close living relationships of members of the herd accentuated by the application of modern technology of livestock production, cross-breeding of animals from different areas, the food demands of growing human populations, and the extraordinary growth of extremely rapid transportation, he emphasized not only the inherently explosive nature of the situation with regard to animal and human disease transmission but the extremely adverse effects of such disease transmission on the food supply for a growing human population.

Pointing to the disastrous Venezuelan experiences with the importation of foot-and-mouth disease, the enormous economic drain which it has produced and continues to produce, the impact of its spread to neighboring countries, and its return from newly established endemic foci, Dr. Villegas Delgado pleaded for international control of import and export of animals and animal products through properly enforced legislation, surveillance and inspection services, and a centralized international information service that would provide information on a periodic basis. Also noteworthy was his admonition that the effectiveness of a country's capability of working in disease control on an international scale would be measured by its effectiveness in operating in this area in its own country.

Problems of Producers and Processors

To the scientist and teacher one of life's greatest rewards is the application of his teachings to life's problems. In this regard I am sure that all participants in this Symposium will agree that it was gratifying to have the representatives of trade associations set forth in bold language not only their concern over the entry of disease agents into their herds and processing plants but their acceptance of the methods and procedures necessary for safeguarding against such entry. With their concerns ranging from foot-and-mouth disease to the need for adequate and even mandatory reporting of animal diseases, the trade associations have certainly qualified as partners in society's efforts toward animal disease control. Mr. C. W. McMillan of the American National Cattlemen's Association voiced these concerns and felt that continued close liaison with other nations will be a major factor in resolving the problems of animal and animal product movement. He urged that restrictions be based on need, not economics.

Señor Octavio Ochoa y Ochoa, President of the Inter-American Livestock Producers Association, in his comprehensive dissertation on the problems confronting producers and marketers, emphasized problems involving movement of cattle and outlined several recommendations derived from his insight into these problems. Indicating that the control of animal disease is the proper concern of all governments and international and regional health agencies of the Hemisphere, he proposed that cattlemen be provided the opportunity for greater involvement in governmental programs. He appealed for the application of sanitary regulations through readily understandable, simple control systems, for the drawing up of an inventory of animal health legislation in the Hemisphere, for the development of uniform international health certificates, for the use of innocuous vaccines without risk of contamination, for disinfection and disinsectization under the control of veterinarians, and for the establishment of veterinary inspection services at airports.

Dr. Ruben Lombardo of the Pan American Foot-and-Mouth Disease Center in Brazil reiterated the disease hazard involved in the international and interregional movement of animals and animal products. With respect to the geographic locale of endemic foot-and-mouth disease, he delineated three regions: (1) North and Central America, the Caribbean islands, Guyana, French Guiana, and Surinam—free of foot-and-mouth disease; (2) Venezuela, Colombia, and Ecuador—two viral types present; and (3) all the rest of South America—an endemic region for all three types of virus. Dr. Lombardo looks upon the situation as a problem of compartmental or regional epidemiology; with the drive for economic interdependence and integration and with the attendent expansion of rail and highway systems, Latin America is experiencing a great change in the factors that favor herd displacement and the spread of this disease. He feels that control of the interregional spread is dependent, first, on national campaigns of control coordinated at multinational levels and then on: bilateral agreements for coordination of border actions, sanitary legislation on an interregional basis, research on carriers of this agent and others and on food technology to assure food safety, establishment of more quarantine stations and border posts, reinforcement of measures to prevent introduction of such agents, and intensification in the training of personnel in the diagnosis of exotic diseases.

Dr. J. W. Cunkelman of the American Meat Institute described a survey made of representatives of processing concerns through the mechanism of meetings in preparation for this Symposium. Processing plant representatives, asked directly about their problems in relation to the international movement of food animals and animal products, identified several areas of concern. Port processors are looking toward more efficient control and even eradication of trichinosis through new methods being tested; their anxiety over the possibility of the decimation of their hog supply by outbreaks of hog cholera is engendered by the fact that less than 30 per cent of the entire hog population could have been vaccinated with the vaccine distributed. Without assurrances of such control, the international market for swine products cannot be expected to increase. Processors are also concerned about our current lack of a system for identifying the origin of all meat animals for proper tracing and correction of disease problems on the farm. Dr. Cunkelman recognized the difficulties inherent in the adoption of such a system without an educational program among livestock raisers directed toward an appreciation of ultimate benefits of the system.

The lack of uniformity of interpretation and application of the regulations governing meat inspection at local levels was scored by the processors. Furthermore, they could not understand why countries that accept U.S. Department of Agriculture inspection do so with exceptions that vary from country to country. Their greatest distress in international movement of processed meat is caused by the excessive, unnecessary, and expensive labeling requirements and changes and the holding up of shipments for long periods because of the time required for translation and notarization of certificates acceptable to both countries. This again highlights the need for a uniform certification system wherever possible.

In the open discussion which followed there was an expression of a need for a central agency to which an exporter or importer could turn for information in preparation for international transport of animals and animal products without costly errors and delays. Though such an agency is desirable, it was pointed out

that up-to-date information on changes in regulations among the several nations would be a prerequisite for the success of such a system and that presently the most reliable approach is by communication with the national authorities involved, either directly or via their consulates.

In the discussion the point was made that business interests in animal and animal product importations have a serious commercial stake in animal health protection and that it is important to explore the extent to which industry can and should protect its investments through the control of animal disease.

Public Health Implications

In the introductory presentations of the Symposium attention was directed not only to the transmission of disease to hitherto uninfected animals through the import-export activities of international trade but to the human health implications of the spread of such animal diseases. Although virtually all the participants expressed an obvious concern over these implications for man in terms of zoonotic infections and a wholesome food supply, several of the speakers addressed themselves more particularly to the public health implications of the international movement of food animals and animal products.

Dr. Robert K. Somers of the Consumer Protection Office of the U.S. Department of Agriculture—noting that the free movement of both fresh and frozen meats between countries is not regulated entirely by the laws of supply and demand but quite frequently by the necessity for ensuring that the consumer's food supply is wholesome, healthful, and otherwise fit for consumption—indicated that reciprocal trade in meat and poultry would be immeasurably enhanced if there were reliable assurance that the products were derived from healthy animals, that they were produced under sanitary standards, and were unadulterated and truthfully labeled. He felt that if each country conducted its own inspection program (including antemortem, postmortem, and preventive "in-plant" meat inspections) and, more in the modern vein, monitored meats for residues of the pesticides that have become so vital in crop production, then meat products offered for export would need only minimal inspection in the countries importing them. At the present time the U.S. Department of Agriculture obtains this assurance in part by the use of foreign program officers—veterinarians who visit exporting plants in other countries and report on the effectiveness of those countries' meat and poultry inspection programs.

In addition to hazards from livestock and meat products, hazards to human health, through direct contact or indirectly by contamination of domestic animal environments, exist in the importation of animal products not intended as human food. Wool and hair, dired-milk products, bones and bone meal, hides and skins, and other nonfood products equal or exceed our importation of meat and meat products. Dr. Benjamin Blood of the Office of International Health of the U.S. Public Health Service outlined the hazards of importation of rinderpest, foot-and-mouth disease, fowl pest, Newcastle disease, African swine fever, and anthrax and described the procedures for, and restrictions on, importation of the nonfood items that readily serve as sources of contamination and infection. Particularly delicate problems are frequently posed by the presence aboard entering foreign vessels and aircraft of prohibited animals carried for food or as pets and of meat scraps in ships' garbage. Though the measures utilzed to

prevent importation and exportation of disease agents in animal products have been extremely effective, the concern was expressed that with the shrinkage of travel between countries and the increase in trade, defensive measures will become more and more difficult to maintain. Dr. Blood suggested (and the writer wholeheartedly agrees) that the time is now at hand to supplement current defensive practices with prevention at the source—the elimination of animal diseases wherever they exist—a feat which will require greater international cooperation than ever before.

Dr. Blood was not the only speaker expressing concern for the potential diminution of effectiveness of defensive measures against the importation of disease agents by increased trade and speed of transport. Dr. Boris Szyfres of the Pan American Zoonoses Center in Argentina voiced his concern over the ease of introduction of exotic diseases and the reintroduction of previously epidemic and endemic diseases. Only island communities can hope to maintain reliable animal transit controls. Countries with large land frontiers have particularly difficult problems and need to develop international collaborative programs of control and eradication. Dr. Szyfres cited as examples of the need for such collaboration the reintroduction of rabies into Uruguay and the introduction and spread of Newcastle disease among the newly developing poultry industries of Brazil and Argentina while diplomatic temporization repeatedly postponed a vital conference planned to adopt legislation for protection against this disease. He called for the expansion of regionalization of area control programs and concerted efforts in eradicating animal diseases at their geographic sources. He emphasized the need for a proliferation of the type of accords which provide for cooperative efforts between nations, citing the experience of Mexico and the United States in eradicating foot-and-mouth disease in Mexico, thus preventing its entrance into the U.S., and also the canine rabies control program along the Mexican-U.S. border. For effective control programs, proper diagnosis of infection and effective antigens are extremely vital. A Pan American agreement to standardize antigens and diagnostic tests for the most important zoonoses is urgently needed as is the expansion of training of epidemiologists and diagnosticians.

In a challenging paper, Dr. Enrique Mora of the University of Chile utilized the situation in Chile, which is not atypical of that prevailing in other Latin American countries. He expressed the all too frequently overlooked fact that partial approaches to health problems are meaningless unless they are considered within the over-all context of the socioeconomic development of countries. Chile still finds itself in the complex situation of consuming less meat than the goal set by the National Health Service in striving for improved nutrition and of producing an insufficient amount of animal protein; this requires the importation of meat and other foodstuffs in an amount equal to 20 per cent of Chile's total foreign exchange, and this in turn reduces purchasing power and renders most persons incapable of obtaining an adequate meat supply. Dr. Mora cited the inadequacies of animal and other food production by the landowners, all of whom possess little or no social awareness of their role in community development. Governmental price-fixing, rather than producing incentives, binds the producers and leads to low productivity. Furthermore, the lack of refrigeration facilities does not permit storage and the creation of stocks for regulating the market. Imports of cattle on the hoof are thus necessary (processed products would result in unemployment), and these create the hazard of introducing disease

agents into the grossly inadequate herds. Because of this chain of problems, Dr. Mora recommended for consideration: (1) that agreements be made with countries exporting animals and their products to establish standards of identity, of composition and purity, of wrapping materials and containers, of labels and names of products, as well as standards for detection of contaminants and other standards consistent with safety and wholesomeness of the food, and (2) that regional centers be established to provide advisory services on regulation of international trade in foodstuffs, to conduct research on animal products, to study and review standards, and to train specialized personnel in sanitary quality of foodstuffs; regional centers would also serve as reference centers for control of quality and for the collection and dissemination of information on production, on international trade in foodstuffs, on prevalence of animal diseases, on incidence of human disease arising from animal foods, and on current developments in food technology.

The subsequent discussion revealed that considerable delay is occurring and is likely to continue in many Latin American countries in the early processing of fresh imported meats. In light of the general lack of adequate refrigeration, the question of hastening movement of such materials is valid but is presently not realizable because most nations are currently reluctant to accept regualtions which override their own.

MOVEMENT OF EXPERIMENTAL ANIMALS

Not only does the international movement of food animals pose hazards to the health of indigenous animals and man, but the growing traffic in selected animal species for experimental purposes provided a distinct threat which, though of lesser magnitude numbers-wise, is complicated by the existence of poorly understood exotic diseases.

Keynoting this section of the program were Dr. William H. Stewart, Surgeon General of the U.S. Public Health Service, and Dr. Pedro Daniel Martínez, Undersecretary of Public Health, Mexican Ministry of Health. Dr. Stewart, noting that man's destiny and his health have been interwoven with his fellow creatures since before the dawn of history, indicated that animals for research have become a very important item in international trade and as such carry a potential threat of disease. As both numbers and species involved in international movement increase, the threat increases proportionately. There are over 1,200,000 species of animals, so that the reservoir of species and diseases is virtually inexhaustible. Dr. Stewart, noting that technological advance brings with it new hazards or the threat thereof, outlined approaches which migh minimize these hazards and enhance contributions to health: maintenance of high standards of laboratory sanitation, precautionary laboratory procedures, control at the source, inspection enroute, responsible handling, and cooperation with conservationists to ensure against the destruction of species. Domestic breeding of exotic species would certainly reduce the drain on nature, improve stock quality, reduce transport costs, and decrease the transmission of disease.

Dr. Martínez keynoted the problem by emphasizing that the public health hazards deriving from international transit of animals depend more on national health conditions than on the ordinances and dispositions established to regulate international transit. Citing the collaboration between Mexico and the United

States, in matters of international health, he welcomed the enthusiastic and efficient cooperation of the Pan American Health Organization in problems which affect all the Americas. He noted that the complexities of the health implications of the movement of animals between nations with varying levels of disease status require coordinated systematic study and planning and the organization and execution of programs by well-trained veterinary public health personnel. Dr. Martínez felt that the most important conclusion to be reached by this meeting is the assurance of continued, permanent discussions between professionals interested in these problems.

All too often the establishment of primate colonies for biomedical research has been undertaken with little insight into the hazards to human contacts and, for that matter, into the impact on the health of the simians themselves, of capture, crowding, transport, and abnormal environments. Research is desperately needed in this area, particularly longitudinal studies for the determination of cross-infectivity, rate of spread, and impact of environmental change and stress. A significant beginning has been made by Dr. S. Kalter and his associates, who have not only demonstrated that human agents (from the entero-, myxo,- adeno-, reo-, arbo-, pox-, herpes- and miscellaneous virus groups, as well as rickettsia, diverse bacteria, fungi, and protozoa) infect simians, with obvious implications for the health of such colonies, but have also found evidence that simian agents of the several virus groups infect man. Changes in the rate of enterovirus excretion attending transportation of simians were also described; its significance as a result of crowding or stress, or both, is not as yet understood, but at least has been called to the urgent research needed in this area.

In the same vein, the problem of simian malaria due to several simian species of *Plasmodium* has been of concern for at least five decades. Experimental transmissions to man via inoculations of parasitized blood have been performed for the past 35 years. Since 1960 experimental mosquito-induced transmissions have been demonstrated, but it was not until 1965 that the first naturally acquired case of simian malaria to be recorded graced the literature. The following year an additional case was documented. Although the probability of the intrahuman transmission of simian malaria would depend upon such factors as gametocyte adaptation to anthropophilic mosquitoes, Dr. Phillip Conran in a review paper pointed out that *Anopheles leucosphyrus*, a group with vectors for simian plasmodia, contains members important as vectors for human plasmodia and that these latter, given the opportunity, will bite simians as well. Dr. Conran did not exaggerate the importance of simian malaria, but he did pose it as a hazard for humans working with primate colonies and suggested procedures for minimizing this hazard.

Dr. William Greer of the Gulf South Research Institute of Louisiana, involved in many aspects of the problems of procurement and transport of healthy nonhuman primate stocks for research laboratories, systematically categorized these problems. A major problem is the difficulty of communicating to the trapper of primates the need for high-quality healthy stocks. The number of importers with financial capability to go to the source and supervise this aspect of the operation is very small. The education of personnel at the trapping end of the operation, though highly indicated, is certainly far from feasible at the present time. Dr. Greer pointed out that the advent of high-speed transport has automatically solved many of the problems which led to high morbidity and mortality during transport, but even here at times new problems arise for which

responsibility is not too readily fixed on the air carrier. Dr. Greer, like so many others in this Symposium, drew attention to the impact on the phenomenon of disease importation made by today's high-speed transport. The problem of disease in primate stocks is twofold: diseases affecting only the animals and those of human health significance. Although not jeopardizing the livestock industry to the extent that importation of exotic ruminants and ungulates do, primate movement may introduce disease to its own and to human populations. Dr. Greer illustrated the potential and real hazards in the home and in the laboratory from such diseases of primates as tuberculosis, shigella dysentery, monkey B virus, green monkey disease, and viral hepatitis. These hazards are always potentially explosive, and the recognition of their presence is a prerequisite to their control.

Craig E. Pinkus, after discussing the human morbidity and mortality derived from agents spead by nonhuman primates and the high mortality rates among the primates themselves when shipped to other countries for research, for exhibit in zoological gardens, or as pets, assayed existing federal jurisdiction over primate importation and disease control only to find it a confused mass of overlapping authorities with little insight into enforcement, even of existing inadequate regulations. The inadequacies are gross and prevent any intelligent appraisal of the extent, nature, and origin of diseases leading to primate mortality and human hazard. The primate mortality rates are so excessive and the demand for these animals so increasingly great that extermination of species is not beyond probability. Mr. Pinkus, in an excellently documented proposal, outlined the content, mechanism, and administration of a federal regulation of primate importation and disease control, which appears sound and feasible. The regulation is based on individual animal certification as to species and microlocale of origin, on transport in individual cages for more rational inspection and identification, on certification of receipt, and on notification of illness and death after receipt, all centered in a computerized data collection system. The proposal merits serious consideration in behalf of research and a growing industry, and for the sake of humane treatment of the subject material as well.

The considerable floor discussion that ensued involved control of animal disease at the source. There was a feeling that surveillance systems based upon identification of animals as individuals and by source would be a great advantage in control. Furthermore, it was proposed that importers should buy from exporting dealers who comply with such requirements. Some disagreement as to the feasibility of such procedures was expressed, but the general consensus seemed to be in favor of a surveillance system, even though the agency to be involved in surveillance was not clearly designated.

A note of concern for conservation was also expressed, particularly for the endangered species. Preconditioning centers were proposed for acclimatization to captivity prior to shipment as one step to reduce excessive losses in some species. However, conservation principles alone will not be adequate to control human hazards of disease importation; they should be part of a multidisciplinary approach to such control.

Carrying the concept of humane and healthful treatment of primates beyond the transport stage to the colonial management stage, Dr. Robert Hummer, Director of Animal Resources and Facilities at the Southwest Foundation for Research and Education, Texas, outlined the essentials of the construction and operation of primate colony facilities. Recognizing our deficiencies in scientifi-

cally established environmental and design criteria for housing and caging of primates, he urged that the guides drawn by experienced veterinarians and other scientists with experience with primates be utilized as minimum standards until more widely established criteria are available.

The growing interest in primates for biomedical research should not overshadow the problems remaining in the international shipment of other laboratory animals. In the shipment of small laboratory rodents the health status of the animals is obviously of importance. Inspection of a group of animals may be unrealistic in determining their state of health. Dr. Henry Foster of the Charles River Breeding Laboratories, Massachusetts, believes that laboratory techniques are available and feasible to determine bacterial, viral, and parasitic profiles of the animals to be shipped. He also believes that certification of the general health status of the colony, with a report of absence of clinical signs by a laboratory animal medicine specialist, is a feasible first step in this direction.

In a review of the statutory responsibilities of the U.S. Public Health Service in the protection of the United States against the importation of certain diseases, Dr. John Richardson of the National Communicable Disease Center described the functions and activities of the Center's foreign quarantine program with particular reference to the importation of selected species for research purposes. The preponderance of nonhuman primates, both in relation to all imports of quarantinable species and to species imported for research purposes only, was immediately apparent. Dr. Richardson drew attention to the fact that such diseases of the primates as tuberculosis, enteric diseases, B virus, and nematode and protozoon infestations have been recognized as distinct hazards to man for many decades. He bore testimony to earlier comments that our knowledge of simian diseases potentially transmissible to man could stand considerably greater insight and cataloging, citing such recently discovered entities as Yaba virus, contagious pox disease of monkeys, and the African green monkey disease, highly fatal to man, as examples of the rapidly emerging hazards. In this last disease the problem is confounded by the inapparent infection state in the *Cercopithecus* species. Dr. Richardson suggested that, if all feral animals captured for experimental purposes were handled as if infected with virulent microorgananisms, risk to man would be reduced. In any event control procedures should include postentry quarantine, screening for disease, physical examination, and necropsies of all deaths.

The responsibility of the Animal Health Division of the U.S. Department of Agriculture in regulating the importation and interstate movement of animal-disease-producing agents for research purposes was outlined by Dr. John Jeffries of that agency. The basic purpose of the agency's regulations is the prevention of entry of agents of animal disease not present in the country or of more virulent strains of disease agents already present and the prevention of their spread to livestock and poultry. Included in these goals is the minimization of the possibility of inadvertent entry of exotic disease agents as contaminants of relatively innocuous cultures as well as surveillance for outbreaks of unusual diseases which may have their origin in escape of agents from research or commercial laboratories. The regulations were described as protective rather than restrictive. Only one agent is *absolutely* prohibited—foot-and-mouth disease virus. For a few other agents the Department does not issue permits: rinderpest, African swine fever, horsesickness virus, and the *Mycoplasma* of bovine pleuropneu-

monia. Interstate movement permits are not required for agents normally present in the country, except for those for which eradication programs are being executed. The granting of permits is based on the qualifications of the scientist requesting importation, the adequacy of the laboratory and animal facilities, and the characteristics of the agent in question.

The overlapping of jurisdiction, alluded to earlier, by the U.S. Department of Agriculture and the U.S. Department of Health, Education, and Welfare (jurisdictional complexities involve the Department of Interior as well) stems obviously from the overlap inherent in the ecosystem of man in an environment of animals and the ecosystem of animals in an environment of man. The common ground of the two ecosystems is occupied by the zoonoses. Dr. Jeffries pointed out that the early recognition of this obvious overlap led to a long-standing cooperative liaison between the Public Health Service and the Department of Agriculture for the issuance of a single permit with a minimum of delay for the entry of an agent hazardous to both animals and man.

The floor discussion that followed dealt with a number of problems, not the least of which was the quality of port of entry inspections. "Would not a few ports of entry for animals for experimental purposes with highly qualified inspection facilities be better than all ports with thinly spread facilities?" was a question repeated several times during the discussion of the day's papers. The need for international health certificates for animals, like those that exist for man, was also expressed. An appeal was also made for the updating of lists of diseases considered a threat to a country, especially when such a disease has become rare or no longer constitutes a threat.

Some concern was expressed about the cost of elaborate quarantine facilities, but Dr. Hummer pointed out the great range of quarantine quarters that are adequate but not expensive and are suitable for the holding of many animals safely.

Questions also revealed concerns for measures now employed to exclude arthropod vectors readily and rapidly transported and for measures other than veterinary inspection required for export to the United States. The hazards of the introduction of echinococcosis were described, and the lack of a prior permit system to guard against such diseases as African equine fever was pointed out.

MOVEMENT OF EXOTIC ANIMALS

What could be more appropriate than that the last day of the Symposium should deal with an activity which derives from the need to satisfy a very important aspect of human health—man's mental well-being. The international movement of exotic animals to satisfy man's quest for knowledge and relaxation (expressed in the form of hobbies, visits to zoological gardens, the keeping of pets, or the hunting of game) brings with it potential hazards not only to his physical health directly but to his indigenous animal food supply as well.

Dr. Harold Vagtborg, keynoting this segment of the Symposium, aptly expressed the problem in terms of a disruption of an indigenous, balanced ecology and more specifically in terms of the introduction of exotic disease agents into a highly susceptible, virginal population. He stressed the constant vigilance necessary to prevent the introduction of such agents.

Importations of wild animals for zoological parks have been highly successful, and the disease experience associated with such importations has been extremely minimal. Dr. Leonard Goss of the Cleveland, Ohio, Zoological Park described the relatively few incidents of disease among such imports, deriving his information from the sparse literature and from a questionnaire submitted to members of the American Association of Zoo Veterinarians. The epidemiology of nonoccurrence of disease can frequently be as revealing as that of disease outbreaks and can provide clues for the control of disease. Dr. Goss suggested that the paucity of disease occurrences in imported animals is dependent on a great number of factors: the strict quarantine by the U.S. Department of Agriculture of all imported wild ruminants, swine, and birds; the surveillance of zoonoses by the Public Health Service; the small sizes of the single shipments of animals; the holding of such relatively smaller shipments in quarantine and domestic holding compounds, which leads to acclimatization and conditioning; the costliness of such importations and the insistence of zoos on sound healthy animals before acceptance, so that exporters guarantee against personal loss by more careful selection for export; the regard of zoo keepers for their collections and the application of prophylactic measures; the species barriers against spread of disease agents, coupled with the small size of species populations. All these factors may operate in maintaining a low disease incidence, as compared with the incidence of disease among the huge numbers of mammals and birds imported for the commercial pet shop trade. Of interest in the floor discussions was the reference to the transmission of avain malaria from imported birds to penguin flocks in zoos.

Dr. Frank Hayes, Director of the Southeastern Cooperative Wildlife Disease Study, University of Georgia, agreed that, although the introduction of an exotic animal disease or its vector could devastate our domestic and wildlife populations, rigid inspection procedures and adequate quarantine facilities do minimize the risks associated with movement of wild animals to extremely small levels. The price for such security is constant vigilance, for even with such measures two extremely hazardous exotic vectors were relatively recently introduced: the tick vectors of equine and bovine piroplasmosis into Florida and the tick vector of heartwater disease into the Virgin Islands. Dr. Hayes believes that the importation of wildlife species should never be permitted to exceed a nation's financial capability of guarding against disease introduction and that governmental agencies should never yield to minority pressure groups in behalf of such hazardous importations.

Dr. Hayes emphasized two far greater hazards: first, the introduction of accidental foreign disease due to increased military and civilian travel and demands for imported meats and animal products and, secondly, the purposeful introduction of highly lethal pathogens. The danger to our native wild fauna particularly calls for action, since our nation's game animal resources are in the multibillion dollar category. In recognition of this danger not only to the wild fauna but, because of wildlife expansions in many regions, to domestic livestock as well, surveillance systems for early detection of exotic disease introductions were indicated. In the southeastern United States the Association of Game and Fish Commissioners in cooperation with the Animal Health Division of the Department of Agriculture set up a foreign and emergency disease surveillance training program for the earliest possible detection of foreign disease introductions to, for example, white-tailed deer and feral swine. Hayes regrets

only that such activities are restricted thus far to the southeastern United States.

The presentation by Dr. Manuel Moro, Director of the Veterinary Institute for Tropical and High Altitude Research of Peru, all the more interesting because it dealt with a species exotic to us in North America but indigenous to South American countries, emphasized the extreme importance of animal health and management to the economy of a country. The Auchenidae, indigenous primarily to Peru, Bolivia, and Chile, domesticated for their wool and, in the case of the alpaca, for its food value, are subject to a number of diseases of economic importance, with intrafamilial differences in resistance and with suggestions of varying susceptibility to some diseases on the basis of altitude—an example of a species domesticated for over 2,200 years yet only recently maintained with modern methods.

The work of Dr. Paul Arnstein at the Hooper Foundation with the Psittaciformes is a prime example of the need for intensive research in animal disease for the national application of proper methods of handling the importation of exotic species with safety. The example of psittacosis is a prime one for illustrating the results of potential misapplication of quarantine procedures. The stresses of crowding during a prolonged holding period without antibiotic prophylaxis actually increases the prevalence of infection. Were psittacosis the only disease of concern in importation of these exotic avian species and if shipment quickly after assembly could be assured, prophylaxis would not be necessary. However the threat of Newcastle disease virus importation with these species makes a longer (45-day) holding period necessary. With antibiotic prophylaxis and this quarantine period, the important hazards in importation are eliminated.

The hazards of international movement of exotic animals are obviously and unfortunately not limited to the presence of overt disease among them but may, for many disease agents, be greatest when the agents produce greater proportions of inapparent or latent infections or prolonged convalescent carrier states. When to these disease characteristics are added ignorance of wild species' susceptibilities and responses to infection, as well as the rapidity of air transport (more rapid even than the incubation periods of overt cases-to-be), it is obvious that the great unknown becomes greater and the risks more perilous. Inspection for illness is useless in such situations. The inapparent infection of cattle with foot-and-mouth disease virus for months after exposure and the latent infection of hedgehogs with that virus through hibernation, the inapparent infections with rinderpest virus in the hippopotamus and Thompson's gazelle, latent viremic infections of African swine fever in healthy bush pigs and wart hogs, experimental infection without illness of many wild mammal species with pseudorabies virus—these are but a few examples of inapparent infection hazards. Add to this the broad range of hosts for these agents and the gross deficiencies of information for many exotic species, and the implications are clear. In presenting this premise of hazard in the international movement of large wild mammals, Dr. Lars Karstad of the University of Guelph in Ontario presented his plea for a two-pronged approach: surveys for evidence of wildlife infections in areas where the agents exist and studies of experimentally induced infections. Only in this way can information be accumulated rapidly on host range and infectious responses, and the hazard quantitatively assessed.

The importation of small feral animals, particularly for microbiological research, has increased tremendously in the past two to three decades, and the

hunt for new laboratory animals continues. Dr. Merle Kuns of the Pan American Zoonoses Center in Buenos Aires raised several questions with regard to the increased traffic in such animals. Among these were questions of potential human health hazards, the effectiveness of physical examination for detection of agents of high pathogenicity for man, and the need for new regulatory measures for minimization of these hazards. Citing experiences with the arthropod-borne virus group, he noted that although in rodents these viruses produce a fleeting viremia followed by persistence of immunity to reinfection, the course of such infections in other small mammals is poorly understood. The persistent shedding of virulent hemorrhagic fever virus from asymptomatic infection of wild rodents is an example of the hazards posed by importation. The Machupo viruria of the species *Calomys* is another case in point. All in all, as the field of virology continues to unfold and new species of agents from more and more exotic species of mammals are isolated, the need for ever more information on host range, infectivity, and response to infection will increase in explosive fashion. The urgent need will be for practical methods of detection if we are to exercise control against the importations of exotic diseases.

To round out the Symposium, Dr. Claude Smith of the Animal Health Division of the U.S. Department of Agriculture discussed the import-export requirements for the movement of exotic animals from philosophic and practical standpoints. The unity of purpose among all groups, from the owner-seller (or hunter, trapper, or collector) to the consignee at destination and conservation and preservation organizations, focuses upon the delivery and receipt of an animal free of disease and therefore not a threat to the new environment. Humane handling must also be a prerequisite to the transfer. Smith stressed the fact that, though economic factors are obviously important from the monetary interest of the sellers, through the profit interest of the buyers and shippers, to the monetary interest of the consignee, they must not become the controlling factors where animal disease and humane handling are concerned. If the owner-sellers and buyer-shippers of animals realized the relationship of freedom from disease and humane handling to continued growth of commerce, they would make every effort to provide healthy animals, thereby making the work of health officials in the countries of origin and destination that much easier and hence less costly. Dr. Smith furthermore emphasized the need for close cooperation between the animal health officials of the countries of origin and destination in order to assure that minimum export and import requirements have been met. The importance of the avoidance on the part of the transporting carrier of such undesirable and dangerous practices as bonus payments for the crowding in of extra animals was also stressed. It was not clear, however, what measures other than loss claims could be utilized as leverage for proper transport practice.

The import-export of exotic animals will not for too long remain associated primarily with zoological gardens and research laboratories, for with our exploding populations new species as sources of animal protein will have to be exploited and this will increase our problems manyfold.

In conclusion, I should like to return to the opening sentence of Dr. Horwitz's address: "Everything that leads to the creation or strengthening of the scientific and intellectual community of the Americas helps to forge the kind of future required by the peoples of the Hemisphere." From this vantage point, I believe that this Symposium has made a highly significant contribution to the health of this future to which we all aspire. The fact that members of several disciplines

have sat down together is an auspicious beginning for a continuous dialogue among the Americas and, hopefully, among other nations of the world. Those of us who for decades have raised the banners of prevention know full well the meaning of "an ounce of prevention" for, if even the advantaged nations can no longer afford the pound of cure with its mounting costs, then what can be said of other countries of the world?

It is my sincere hope that my pleasure in this Symposium reflects the feelings of all of you. I know that I am taking away with me more than I brought, for I leave with a much more acute awareness of the ecology of man in the macrocosm which is our life together.

Part I

INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

DISEASE PROBLEMS ASSOCIATED WITH THE IMPORTATION AND EXPORTATION OF FOOD ANIMALS AND ANIMAL PRODUCTS

1. THE U.S. VIEWPOINT

ROBERT J. ANDERSON, D.V.M.*

Our discussion today concerns a problem that has plagued man throughout recorded history: how to prevent contagious animal diseases from spreading into new areas along travel and trade routes. The risk of contaminating other environments is as real in the Space Age as it was in the time of Marco Polo.

We have made a lot of progress, but we still do not have all the answers. And until we do, we will have to live with restrictions on international travel and commerce.

These restrictions are relatively new in our history. Noah, for instance, had no particular problems when he discharged his animal passengers on Mount Ararat. But since those animals were the only ones in existence at the time, inspection and quarantine were not issues!

Growing commerce between communities and nations, however, turned livestock diseases from local into national and international problems. Hitchhiking disease agents and vectors traveled thousands of miles—often across deserts and over water—to infect animals in areas where trade relationships were becoming established.

This situation still confronts us. And the advent of air freight service at jet speeds has compounded the difficulty.

Until recently, extended sea voyages generally allowed time for disease symptoms to show up before the animals arrived at the destination country. Today, most of the animals imported into the United States are shipped by air. This means that a newly infected animal can arrive at its destination before visible disease symptoms develop.

Speedy shipment has many advantages, but it eliminates the benefit of a quarantine period while in transit.

Import and export restrictions, therefore, have become a fact of life. Here in the United States, they are a vital part of a general effort to accomplish three things. First, we try to keep out all diseases and parasites of livestock and poultry. Second, we try to control those which are endemic. Finally, we take steps to eradicate diseases and pests that are real or potential economic threats.

When we impose agricultural quarantines on animals or products entering or leaving the United States, we try to do it on a scientific and highly selective basis. Control measures may range from refusal to permit entry of a single suspicious animal to a complete embargo on certain animals from areas where a particular disease exists. Our policy

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is to impose *only* the degree of control necessary—no more and no less—to keep out or contain any given disease or parasite.

We do not intend to impose any unnecessary hardships on travelers or shippers. Nor do we intend to make or enforce any regulations that would unnecessarily curtail trade between our countries. Regarding international commerce, I might point out that the United States Department of Agriculture has always resisted any pressure to use quarantine laws or regulations as trade controls.

Our system of adequate safeguards, administered by the Animal Health Division of the Department's Agricultural Research Service, has paid off at home. American consumers have available to them an abundance of wholesome meat, eggs, milk, and other farm products. It is our aim to insure that agricultural products are as wholesome as our technology and inspection procedures can make them.

American meat products are certified as "U.S. Inspected and Passed by the United States Department of Agriculture." This certification, given by the Department's Consumer and Marketing Service, is designed to protect the consumer, either here in this country or abroad.

We demand strict compliance with official procedures for exporting livestock, since we intend that only healthy animals be exported. We require, too, that the animals be handled humanely and transported safely—so that they will arrive at their destination in good condition.

Obviously, we do this to help maintain and expand our position in foreign trade. But we also recognize that we must provide protection for other countries that rely heavily upon our export regulations and the integrity of their enforcement.

As noted previously, we try to adapt our procedures scientifically to fit any given situation. But certain general routines are followed in checking all animals destined for shipment outside the United States.

Prior to shipment from the farm of origin, the animals are inspected by an accredited veterinarian to verify that no evidence of communicable disease or exposure is present. Required tests are conducted under supervision. Our Department veterinarians reinspect the animals at ports of departure and determine that they are properly loaded aboard vessels and planes.

Any animals shipped are considered to be in international commerce when they leave the farm of origin.

This thoroughness in checking animals and animal products before export is matched by an equally thorough scrutiny of imports. Our objective is to prevent importation of agents that would cause disease in our livestock or poultry. We also look for external parasites such as ticks that might be vectors of disease.

Basic to our entire system of inspection and quarantine is the concept that it is better to prevent a disease from entering than it is to fight it when an outbreak occurs. Our experience with the most dreaded and rapidly spreading animal disease of all—foot-and-mouth disease—appears to bear out the validity of this concept.

We had to contend with six different foot-and-mouth outbreaks between 1902 and 1929. These were stamped out by enforcing strict regulatory procedures, including slaughter of infected and exposed animals. Although slaughter is a difficult procedure, it is the only effective way known for eradicating the disease.

We know that stamping out procedures are effective because the United States has been free of foot-and-mouth disease for the past 38 years. The same approach was used following appearance of the disease in Mexico in 1946, in Canada in 1952, and in Great Britian during the past year.

Since 1930, we have been operating under

legislation that prohibits importation of domestic ruminants and swine, and fresh, chilled, or frozen meat from countries where foot-and-mouth disease exists.

An earlier successful campaign in the United States—and the first which called for concerted Federal action—involved contagious bovine pleuropneumonia. This disease reached the United States in 1843, when a New York milkman innocently bought an ailing cow from a British ship captain. This "bargain" cow started an epidemic that spread through several herds. Later outbreaks in other areas of our country were likewise caused by cattle imported from Europe.

The situation deteriorated progressively until the early 1880's. By this time, even European countries were refusing to buy our cattle for fear of further spreading the disease. An organized Federal campaign wiped out the disease in this country, but only after five years of work and at a cost of more than a million dollars.

It turned out to be time and money well spent: our livestock producers have never again had to contend with the disease.

A few of the other devastating diseases that we have kept out are rinderpest, East Coast fever, African swine fever, and African horse sickness.

This job has not been an easy one. To begin with, it is complicated by the many different pathways that animal diseases take in moving from area to area and from country to country.

Perhaps the most common route is through a "carrier" animal that shows no outward signs or symptoms of the disease it is carrying. Other ways are even more insidious. Infectious disease agents or vectors may hide in shipments of meat, hides, and other animal by-products. Or they may be concealed in meat scraps from ship and airplane garbage, as well as in food and litter from infected animals.

In still other cases, they may be present in such food products as home-canned, partially cured, or improperly cooked meat. These items are often sent through the mails or are carried by travelers in their luggage.

To make sure that none of these things get past us, we inspect and impose quarantine restrictions on imported animals, poultry, animal products, and animal-associated materials. Our inspectors also check the baggage of travelers entering the United States, particularly those from areas where certain devastating animal diseases are known to exist. This work is conducted at all principal coastal cities and international airports and at all principal ports of entry along the Canadian and Mexican borders.

We refuse entry of any animals or animal products that are specifically prohibited. And we require further processing at approved establishments or confiscate and dispose of other restricted animal products or materials.

Animals that show no evidence of a communicable disease during the first inspection may be quarantined for a predetermined minimum period of time. While under quarantine, they are held in strict isolation. Our veterinarians treat them for external parasites as a precautionary measure and subject them to various tests. If no communicable disease appears during the quarantine period, the animals are released without further restriction.

As I mentioned previously, the degree of control that we apply to any imported animal is determined scientifically after all the circumstances have been considered. Relatively simple tests, for example, exist for dourine, glanders, tuberculosis, and brucellosis. If other diseases are suspected, more complicated tests may be required, or animals may be inoculated.

Sometimes stricter measures are called for. In these cases, we combine the tests with still other quarantine procedures. Zoological

specimens from foot-and-mouth or rinderpest-infested countries are subject to these more stringent measures. So are horses from areas where African horse sickness exists.

Our inspectors have been and are doing a commendable job in maintaining surveillance. But we are witnessing a boom in world travel and trade that taxes the ability of animal disease control agencies to continue this excellent performance. Constant emphasis is being placed on streamlining some of our present quarantine procedures, so that our country can be properly protected without unnecessarily inconveniencing or delaying travelers.

For example, a pilot study was recently inaugurated that permits us to check most passengers at one location instead of at several check points. We are, however, still looking for ways to anticipate the arrival of potentially dangerous materials so that we can make a more thorough and expeditious check of the travelers most likely to be carrying them.

Attempts to improve these procedures are closely tied to the results of our research studies. More than 80 years have elapsed since we first teamed animal disease research with regulatory work, and they have proved to be an ideal team.

Each serves the other. Research, for example, is often directed toward specific disease-control problems. In turn, disease-control field operations provide practical tests for research and point the way for new investigations. Our regulatory workers, including quarantine inspectors, are often the first to use research results.

One of the facilities that provides us with this information is our Plum Island Animal Disease Laboratory. Located on a small island in Long Island Sound, this Laboratory is devoted to studying a variety of exotic diseases. Scientists there constantly furnish us with new data on the characteristics of these diseases and with information on how a carrier can be detected, what kind of preventive measures are possible and practical, and how the disease agent or vector can be destroyed.

Such information gives us many of the tools we need to prevent, control, or eradicate animal diseases. Our success so far proves that it can be done. The question is: Are we willing to encourage using these tools on a world-wise basis?

The answer, of course, has to be "Yes" if any kind of international program is to succeed. We must be willing to pay the cost and undergo the inconveniences that characterize such an undertaking, including quarantines and restricted movement of animals, animal products, poultry, poultry products, and related materials that might transmit diseases of animals or poultry.

Even more than this, we must have the understanding and cooperation of everyone concerned if we are to reach the solutions we are seeking.

DISEASE PROBLEMS ASSOCIATED WITH THE IMPORTATION AND EXPORTATION OF FOOD ANIMALS AND ANIMAL PRODUCTS

2. THE BRAZILIAN VIEWPOINT

JOSÉ DA FARIA, D.V.M.*

The international movement of animals, animal by-products, biological products, and pathological products† is gradually becoming increasingly important to the social, economic, and sanitary structures of all countries.

At present, the facilities, fast means of transportation, and the intensification in the movement of animals and animal by-products contribute to the risk of dissemination of pathogenic agents and animal diseases, making possible their accidental or intentional infiltration into the importing countries. From the sanitarian point of view geographic and political boundaries are becoming less important.

This situation has caused every nation to adopt measures of common agreement, as uniform as possible, to prevent the spreading of animal diseases and of pathogenic agents from one country or continent to another, for they may affect not only the preservation and expansion of cattle raising and its related industries, but also—in cases of transmission of zoonoses—human health.

Consequently, permanent sanitary control of those operations has become a source of constant concern to governmental authorities, specialized international organizations, such as Pan American Health Organization/World Health Organization, Food and Agriculture Organization, and International Office of Epizootic Diseases (OIE), to regional organizations in several continents, and even to economic communities.

The above-mentioned institutions are trying, by international agreement, to harmonize principles, criteria, norms, and measures by means of the International Sanitary Regulations, applicable to men (World Health Organization), and the International Zoosanitary Regulations, applicable to animals, animal by-products, and biological or pathological by-products (OIE). That includes the standardized utilization of international health certificates.

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† According to the International Office of Epizootic Diseases, *animals* applies to all mammals (except sea mammals) or birds of wild or domestic species; *animal by-products* refers to meats, fish, and animal products for human consumption, animal consumption, and industrial and pharmaceutical utilization; *biological by-products* refers to (1) biological reactives utilized for the diagnosis of certain diseases, (2) sera which may be utilized in preventive action and treatment and, eventually, in vaccination sera for certain diseases, and (3) vaccines, inactive or modified, which may be utilized in preventive vaccination for certain diseases; *pathological by-products* refers to samples of infection agents and collections of infectious or parasitic material made by an official veterinarian on a living animal, as well as excreta and tissue samples and organs from a corpse to be remitted to a specialized or reference laboratory accredited by the International Office of Epizootic Diseases, the World Health Organization, etc.

Concerning the International Zoosanitary Regulations, which are pending approval, Dr. R. Vittoz, the Director of the OIE, stated: "The measures contained therein are not intended to hamper national or international trade. On the contrary, their purpose is to normalize, as far as possible, zoonsanitary conditions. This would insure an appreciable degree of medium and long-term security and continuity to trade."

Concerning the American countries, especially the developing ones, given the peculiarities of their geographic, social, and economic characteristics, a great deal of effort has been and should be invested in the establishment of an effective zoosanitary policy in the best common interest, on the national, regional, or international level. That policy should have its own legislation and rely on updated veterinary services operating on a technical-scientific level which would be compatible with present requirements (*1*). Forceful examples are the International Regional Organization for Health in Agriculture and Livestock (OIRSA), of Central America and Panama, and the Regional Technical Commission on Animal Health of South America, instituted by the Inter-American Agreement on Animal Health, which has also created a subcommittee on transit and quarantine. The subcommittee's resolutions and recommendations, originated at its meetings, have resulted in effective cooperation on the commerical exchange of animals and biological by-products in particular, among the member countries, and have created and updated transit and quarantine regulations and standardized the interpretation of results of biological tests.

If the goals sought are to be reached in the Americas, it is the responsibility of each government to ensure (a) that there is an adequate setup of veterinary services, responsible for the implementation of sanitary measures, with improved technical and material means and (b) that the technical personnel in charge of sanitary controls are oriented by means of training and refresher courses and seminars to be held in the appropriate national or international centers, such as the Pan American Zoonoses Center and the Pan American Foot-and-Mouth Disease Center. This concern caused the Ninth Regional Conference of the Food and Agriculture Organization for Latin America (Punta del Este, Uruguay, 1966) to promulgate a recommendation which reads as follows: "To promote the institution of a training center designed to teach and train veterinarians, specialized in biostatistics, epizootiological information and the control of the import and export of animals and animal by-products."

Regarding the specific sanitary controls on the shipping of animals, animal by-products, biological products, and pathological products for import and export, the various countries must necessarily take the following into account, on the national or multinational level:

1. The improvement of epizootiological records by intensifying the reporting procedures on the incidence of transmissible diseases of animals as well as a stepping-up of current research and zoosanitary campaigns;

2. The standardization of tests for diagnosis of diseases as regards the antigenic and allergenic agents employed and methods adopted, including collection of samples and interpretation of results.

3. The standardization of sanitary measures and formalities required in the shipping of animals, eggs, semen, or pathological animal by-products, taking into account:

The point of departure and the locale and time of shipping;

The movement from the point of departure in the exporting country to the point of arrival in the importing country;

Entry into the importing country;

The quarantine and controls required in quarantine stations or installations;

Ports, airports, and border posts for entrance or departure in both countries;

Terms and requirements for land, water, air, and postal shipping;

Disinfection and extermination of insects and rodents on the carriers;

Conditions for the preservation of by-products to be shipped, especially those which require freezing.

Although the International Zoosanitary Regulations established by the OIE already contain policies regulating a good portion the above items, it would be timely to consider some areas which, due to their peculiarities, deserve special attention:

1. The fifth edition of the International Rules and Recommendations, Annex 9 of the International Civil Aviation Conference, fails to discuss the competence of the various animal sanitary defense services and the specific measures applicable to animals and animal by-products, biological or pathogenic, when in transit. This is a serious gap which deserves due consideration in view of the consequences it may entail. To remedy this flaw, Brazil submitted to the Seventh Session of the Division of Facilitations, convened by the International Civil Aviation Council in Montreal, Canada, on 14 May 1968 Working Paper Number 31.

2. For many countries, parcel post (*colis postaux*) represents an opening for the introduction of pathogenic agents and diseases into the countries of destination, since at present no sanitary controls are required for remittances as long as they comply with the rules of the Universal Postal Conference, approved in Vienna, 1964. Since postal services especially air mail, are fast, that, coupled with variable degrees of respect for the privacy of postal remittances, make for particularly favorable conditions for the infiltration of pathogenic agents and diseases into remote areas. Consequently, it became necessary to advocate, at the Universal Postal Union in Bern, Switzerland, the adoption of principles and measures which would enable the implementation of better sanitary controls on parcel post.

3. Special attention and consideration should be given to baggage enjoying privileged treatment.

4. Regarding the specific area of shipment of animal by-products for human consumption, animal consumption, and industrial or pharmaceutical utilization, the importing countries should also take into account the health-sanitary conditions prevailing during their handling and packaging, so as to insure their total wholesomeness. In this way the risk of infiltration of pathogenic agents, diseases, or toxicants to men or animals is eliminated. Such precautions, incidentially, should be preceded by familiarization with technical and health-sanitary requirements for the operation of organizations handling the products and with the norms for sanitary inspections and technological processes employed, including those for final premarketing controls.

5. Another very important aspect, in view of the modern technological methods for research, is that of animals which have been carrying certain serious diseases for much longer periods of time than had hitherto been known, a fact that argues for more strict sanitary controls, particularly on exotic diseases from certain countries or continents.

An example of strict sanitary criteria are the controls adopted by mutual agreement by Venezuela and Brazil for the export of Brazilian zebu studs to the former country. Since virus type C (Waldmann) or foot-and-mouth disease is nonexistant in Venezuela, special emphasis was given to the question of possible carriers of virus, over and above the zoonsanitary inspection for various

diseases. The operation was carried out under strict sanitary guarantees, and the testing of 164 animals for foot-and-mouth disease virus was subject to technical supervision by the Brazilian authorities with the valuable cooperation of the Pan American Foot-and-Mouth Disease Center. Control tests were made on pharynx-esophagus tissue samples from each animal to be exported, utilizing lactant mice and cell cultures BHK–21 and C13 for virus detection.

As a result of those four months of work, two virus C carriers were segregated from the lot to be exported, along with some carriers of type Anand type O virus of foot-and-mouth disease which are common in Brazil and Venezuela. Besides these controls, Brazil is adopting identical procedures for animals newly arrived in the country. Thus, the risk of introduction of an exotic virus of foot-and-mouth disease into the importing country is considerably reduced.

More strict controls should be imposed on the import of animals and animal by-products coming from continents where exotic nosological entities are present, in view of the natural immunologic implications involved.

In this instance, there is the case of the cattle plague or rinderpest, which is nonexistent in the Americas. Should it be introduced here by an incidental carrier, it could result in an economic and sanitary catastrophe of unforeseeable magnitude. For this reason, Brazilian legislation and that of other Latin American countries prohibits the import of zebuines, gibbous animals, and other susceptible animals from the country or continent where that virosis is present.

Concerning the import and export of animals, animal by-products, and other related material, Brazilian sanitary legislation has been subject to continuous updating. The health authorities, both in the national interest and pursuant to the requirements of the importing countries, exercise a highly effective control on those operations. To that end, many legal dispositions regulating sanitary matters have been reformulated and have brought about an improvement in health services and have provided training for technical personnel responsible for the implementation of sanitary measures. Similar criteria have been adopted by the member countries of the Inter-American Treaty on Animal Health and by other countries of the Hemisphere.

Given the importance of this subject, emphasis should be placed on the need for adequate governmental resources, including credit from international financing institutions, to be invested with priority on the development of animal raising. This is the spirit of the recommendation promulgated by the Ninth Regional Conference of the Food and Agriculture Organization for Latin America. Part of those governmental resources should be earmarked for an improvement of the activities related to international shipping of animals and animal by-products, biological products, and pathological products in the best interest of the American countries and the other continents.

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DISEASE PROBLEMS ASSOCIATED WITH THE IMPORTATION AND EXPORTATION OF FOOD ANIMALS AND ANIMAL PRODUCTS

3. THE CANADIAN VIEWPOINT

KENNETH F. WELLS, D.V.M.*

The international movement of livestock and livestock products is a necessity from the viewpoint of both trade and a more equitable distribution of the world's protein resources. But such movement, uncontrolled, leads inevitably to the dissemination of animal diseases. The regulatory veterinarian, in most countries, must bear the responsibility for preventing this dissemination or, more realistically, the introduction of diseases into his country.

There are, broadly speaking, two weapons that can be used; these are the total prohibition of imports and the use of import requirements which control the entry of products capable of carrying disease agents.

When dealing with a country having a well organized and recognized national veterinary service and a high level of animal health, the choice is an easy one. In such cases realistic veterinary requirements can be readily laid down with the full expectation that they will be met.

The foregoing circumstance is not the rule and, therefore, one of our most difficult problems in this area is that of obtaining adequate and accurate knowledge of both animal disease and meat inspection control procedures along with the disease situation and the control programs in the country.

An example of the application of such knowledge is the importation by Canada—a country free of foot-and-mouth disease—of cattle from certain European countries not traditionally free of foot-and-mouth. This movement is possible as a result of a thorough knowledge of the veterinary services and the foot-and-mouth programs of the exporting countries. The foot-and-mouth programs in these countries do not as yet keep them free of the disease but an accurate knowledge of the control measures in force makes it possible for Canada to develop safe import procedures.

Similarly in meat and meat products importations, a realistic approach can only be developed if well-organized, high-standard meat inspection systems up to acceptable international levels are established.

World veterinary organizations have done much and are continually working to raise the level of veterinary services and establish international animal and animal product certification standards, but increased knowledge and confidence in foreign veterinary services will go a long way toward reducing unreasonable veterinary health requirements.

In spite of the foregoing, the opening up of international livestock and meat trade with countries where serious epizootic animal diseases exist involves a very great risk for countries free of such diseases and dependent

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upon export of similar products. Canada's 1952 outbreak of foot-and-mouth disease provides a very good illustration of the extent of this risk. As a result of this outbreak, Canada's exports of livestock products were practically cut off. The cost of eradicating the outbreak was $1 million. However, the economic costs, including loss of export markets, depreciation of livestock values and government support of meat prices to provide a reasonable return to livestock producers, approached the $900 million level.

These staggering losses are not readily understood by countries endemically infected with foot-and-mouth or other serious diseases because they have not experienced the overnight closing of markets which had been open to them for many years.

Importing countries quite rightly reserve the right to exercise the greatest care in importing animals and meat products because, even though a disease may be established in a country, there is no justification for importing more. However, we are becoming concerned by the multiplicity of tests being both required by Canada and required of Canada. Whereas a few years ago we tested for tuberculosis and brucellosis, we are now being asked to test for leptospirosis, up to 10 serotypes, leukosis, Johne's disease, vibriosis, trichomoniasis, and blue tongue. Often the requests for certain tests produce serious problems because the tests required are not suitable for individual certification but were really intended as herd tests (e.g., vibriosis). With increased knowledge of biological and serological testing we can expect even this list to increase. Add to this the problems of certifying freedom from pesticide, antibiotic, and estrogen residues and we have a fair investment in a cattle beast before she leaves the farm. Add again the general phrase "free of disease." This is an excellent safeguard against importing any disease—except that such a beast must be quite rare.

I hasten to add that we do not have the answer to these problems. Perhaps it lies in greater international cooperation in establishing uniform test standards; as an example, Common Market countries require 30 international units or less for a negative brucellosis test, while the North American countries have been able to virtually eliminate brucellosis by testing to only 50 IU.

Touching briefly upon the problems of quarantine, we can and do provide excellent quarantine facilities for domestic livestock, dogs, and certain exotic animals, but we are ill equipped to handle the larger, more difficult and delicate animals for zoos as well as the ever increasing numbers of laboratory animals and exotic pets. The majority of zoos and research laboratories do not have adequate quarantine facilities and we, as the national veterinary service, must become involved in this problem.

So far I have spoken mainly of animal problems and the safeguards of quarantine and testing of animals, but we believe there is a much greater danger of introducing foreign diseases through meats. Again, by regulation, we can and do accept only cooked meats from countries that have serious epizootic diseases but have what we consider to be a good meat inspection service. But the justifiable demands of the public health needs both at home and in international trade require a reconsideration of our present meat inspection operations. Our concern with residue problems, both domestic and international, is opening new chapters in meat inspection. The old standards of antemorten and postmortem inspection and sanitation are no longer sufficient.

The increased flow and the more complex nature of biological products is demanding more and closer serutiny. The simple bacterins and inactivated vaccines are being replaced by live attenuated products pro-

duced in living cells, thus increasing the chances of accidental disease transmission. Fortunately production methods in this field have advanced rapidly toward safer products but there is still an increased effort required to be certain that these products do not introduce unwanted disease.

Finally, I cannot leave the area of problems without mention of what we consider to be the most dangerous of all problems from a disease dissemination point of view—the small (and sometimes large) meat parcels brought to our country through the mails and by airplane passengers. We maintain staff at all Canadian international airports to assist our customs officials in baggage examination. We also have staff at international mail-sorting depots. When one considers that it is not uncommon to take up to 50 to 60 pounds of foreign meats from the passengers of one aircraft from a foot-and-mouth infected country, the wonder is that we have not already had serious introduction of diseases. I might add that just before last Christmas we were collecting hundreds of pounds of foreign meats, including such things as jars of bovine and porcine blood from the international mails.

When we look ahead and see greater international movement of frozen semen along with the movement in fertilized ovum, which is surely coming, we can be sure our problems will not lessen.

What can be done? We do not have the answer, for we in Canada are probably just as careful and cautious as others. But I do see the need for greater international agreement between countries with livestock of similar health status along with the possibility of greater reliance on our neighbors' veterinary services. This would give relief to some of our problems but I fear will not eliminate them.

The following are some possibilities for assisting the international movement of livestock and still reduce the danger of spreading disease.

1. The collection and publication of accurate information on the occurrence of diseases throughout the world.
2. Agreement on quarantine requirements as to facilities and duration.
3. Agreement on diseases requiring special tests.
4. Agreement on standardization of test procedures and tests which provide meaningful information when applied to the movement of animals.

DISEASE PROBLEMS ASSOCIATED WITH THE IMPORTATION AND EXPORTATION OF FOOD ANIMALS AND ANIMAL PRODUCTS

4. THE VENEZUELAN VIEWPOINT

MIGUEL VILLEGAS DELGADO, D.V.M.*

The problems arising from animal diseases have changed considerably since the end of World War II, particularly in the last two decades. Despite the progress achieved in the years following the discoveries by Pasteur and his colleagues, there is no doubt that a number of factors such as those already mentioned have presented the animal health services with extremely complex circumstances and conditions.

Among these factors the most important are the substantial increase in the size of the herds; the concentration of livestock in increasingly larger ranches; the application of technological standards of livestock production and breeding which involve, in many cases, a close living relationship, as well as the cross-breeding of animals from different areas; the needs of a constantly growing human population (which fosters a large trade in livestock and animal products); and, finally, the extraordinarily rapid progress in transportation, particularly by air, which makes it possible to move animals and their by-products over large distances in only a few hours. This last factor, the rapidity and ease of air transportation, is applicable also to man as an active or passive element in the transmission of animal diseases.

Faster transport is emphasized as the factor that makes possible the large-scale international movement in animals and animal products arising from nutritional, technological, and commercial demand.

The carrying capacity, range and speed of aircraft in the jet era has made possible an increasing trade between nations and even continents. For example, the development of the merging countries in Africa, formerly isolated and far removed, is creating new sources of livestock or raw materials from that continent, which poses the risk of the possible spread of diseases considered "exotic" in other regions or continents.

Without a doubt, the most serious threat to the interest of the cattle and poultry raisers is that posed by animal diseases, especially communicable diseases, whether infectious or parasitic, owing to the substantial economic losses they inflict.

On the other hand, these diseases are also highly important from the standpoint of human health, not only because of the serious problems presented by those which are common to man and animal, about which there is increasing knowledge and concern, but also because the loss of cattle or underproduction caused by such diseases

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has a direct and extremely adverse effect on the food supply of a constantly growing human population.

Recognizing the importance of the public health and socioeconomic aspects and the importance of the conditions created by the factors cited above, we who are responsible for animal health services in our countries or in the specialized international organizations are faced with a difficult and complex challenge to which we must find a reply. To me it is obvious that we are definitely at a disadvantage in trying to meet this challenge, a disadvantage arising essentially, in most cases, from the shortage of manpower and material resources, from the failure to give the problem adequate priority on the administrative scale, and from problems of communication and coordination between our countries. All this is quite apart from the technical complexities involved in these problems.

I am optimistic, however; the essential awakening to these problems has progressed gradually in our continent and has finally found concrete expression in this Inter-American Symposium, which is doubtless the most important effort so far made in the Hemisphere to quicken, coordinate, and define the activities aimed at finding an adequate response to the challenge.

We must make the best possible use of the experience and conclusions contributed by this meeting if we are to put into actual practice the improved methods and systems that will raise the effectiveness of the services to the highest attainable levels.

EPIZOOTICS AS A CONSEQUENCE OF THE MOVEMENT OF ANIMALS; CONTROL OF ANIMAL TRAFFIC

An important characteristic of the epizootiology of diseases that can be transmitted by animals is the very frequent appearance and development of epizootic foci as a result of the movement of animals. This is a common occurrence in our countries as a result of domestic movements and, to a lesser extent—though posing an even greater threat—is the cause of the spread of disease to other countries or regions.

Since the basic principles of modern veterinary medicine postulate the prevention of communicable diseases as the essential means of fighting those diseases, the proper control of movements of cattle and livestock products, both on a national and international scale, is regarded as a top priority task.

It is not necessary to dwell here at any length on the basic role played by the domestic control of animal movements as a means of protecting the national interests of each country. We do wish to emphasize, however, that the effectiveness of the work done in this by each country is the measure of its capacity to operate in this field on an international scale.

The quarantine services controlling the import and export of livestock and animal products are designed to prevent the entry of infectious or parasitic agents into a country and to ensure that all shipments of animals or animal products out of the country will meet the requirements imposed by the animal health authorities of the country of destination.

To achieve these objectives we must take the following instruments into account:

1. *Legislation.* Appropriate, complete, and enforced.

2. *Services.* At the ports, airports, and other points of entry or departure; trained personnel in sufficient numbers; suitable facilities and equipment.

3. *Information.* International in scope, and centralized; establishment of a system for the periodic receipt and issue of epizootiological information.

SITUATION IN VENEZUELA

Venezuela has all the services outlined above, and we shall attempt to describe them. First, however, we shall offer a brief general description of the livestock industry and trade.

The livestock industry, which was one of the basic sectors of the Venezuelan economy during the colonial period, suffered a number of serious setbacks in the last century as a result of the wars of independence and the subsequent wave of civil wars lasting until the turn of the century. This was followed by a period of recovery and by economic conditions which made it possible for Venezuela to become an exporter of cattle and animal by-products in the 1920's and 1930's. During this period the country exported breeding and meat cattle to Colombia, Central America, Cuba, other West Indies islands, and Mexico. Later, the shift to an oil-based economy, together with the hardening of the currency, the rapid increase in population, and other factors, completely reversed the situation and, in the last 30 years, halted the export of cattle and even converted the country into a net importer of breeding cows and bulls for the improvement of production and productivity, as well as an importer of processed meat and milk, and at times, chilled or frozen meat (Tables 1 and 2).

TABLE 1. Imports of animal products by Venezuela, principal items, 1956–1967.

1956–1967	*Metric tons*
Canned milk	478,209
Cheese	78,245
Pork meat	43,719
Sausages	11,643
Ham	25,069
Canned meat	328
Eggs	142,304
1960–1967	*1-cc Ampoules*
Bovine semen	26,539

TABLE 2. Livestock population in 1967.

Cattle	6,911,024
Horses	414,186
Swine	1,989,255
Goats	1,241,140
Sheep	97,724
Poultry	14,169,182[a]

[a] Excluding chicks born each year (48 million, approximately).
SOURCE: *Anuario Estadístico*, 1967, Ministry of Agriculture and Animal Husbandry.

Reflecting its current status, Venezuela imported a total of 94,916 herd of cattle, an average of almost 8,000 per year, between 1956 and 1967. Of these, 80 per cent were Brahma and other zebu bulls and 20 per cent were dairy cows, mainly Holstein. These imports came principally from the United States and, to a lesser degree, from Canada, Cuba, and other countries in the Caribbean area.

In the same period, 13,941 hogs, almost all from the United States, and 3,326 horses, mostly racing thoroughbreds, and mainly from Argentina, Uruguay, Chile, England, and the United States, entered the country. There was also a continuous import and export flow of smaller livestock, mainly dogs and poultry of various kinds.

In Venezuela the control of livestock traffic is the responsibility of the Animal Health Service in the Livestock Department of the Ministry of Agriculture and Animal Husbandry.

Domestic traffic is controlled through the Regional Veterinary Offices, which issue a Shipping Permit, a document required to be shown at highway traffic control stations to National Guard or Police, and, in the case of livestock bound for the slaughterhouse, also at the place of destination.

External traffic is controlled by the External Quarantine Stations at ports, airports, and other authorized points of entry or departure, and statistical information is centralized in the Division of Animal Health.

The legal authority for this control is contained in the Plant and Animal Quarantine Law of July 29, 1941, specifically by Resolutions GAN-034 of 5 February 1968 and SIA-429 of 4 November 1964, which set forth detailed regulations for the import of animals and products of animal origin, respectively.

Other resolutions, mostly temporary, establish specific procedures to be followed in animal quarantine situations. (Example: Resolution suspending the importation of hog products originating in countries affected by African swine plague.)

The issue of import and export permits by the Services is centralized in Caracas.

The Division of Animal Health issues import permits with due regard to the animal health situation in the country of origin, provided the applicant complies with all the entry requirements of local health services. Special requirements are imposed in the case of foot-and-mouth disease, and animals from countries infected with C virus may be imported only through the Quarantine Station at Paraguaná, where rigorous tests begun in the country of origin are completed.

Each local service has a veterinarian and auxiliaries, generally with many years of experience and training. These stations receive a copy of the permits issued and all the necessary information they need in order to take appropriate decisions. These local services for external quarantine are responsible for examining the documentation required in the import and export permits. Failure to meet the requirements results in exclusion, quarantining, or seizure of the livestock or animal products.

After they are cleared for entry into the country, the animals are tagged with an internal control ticket which must remain on them until they arrive at their place of destination, where they can be subjected, as appropriate, to preventive vaccination and possibly other diagnostic tests.

In order to permit the entry of valuable breeding cattle from countries infected with type C foot-and-mouth diseases virus, a Quarantine Station was constructed in 1967. Here, these animals are subjected to strict diagnostic tests which complete a process initiated in the country of origin as a means of minimizing the health risks involved.

Imports of this kind were first allowed from Brazil in the form of groups carefully screened from a genetic and health standpoint, the number comprising each group being 120 head of cattle per quarantine period.

With the valuable cooperation of the Pan American Foot-and-Mouth Disease Center and the animal health authorities of Brazil, a diagnostic test for carriers of foot-and-mouth disease virus, consisting in the extraction of pharyngo-esophageal material is now being administered along with other routine tests. This test, which has never before been done on so wide a scale in any other country, is administered twice to each animal prior to export and is followed by another series of three tests at the Venezuelan Quarantine Station. Other details of the Quarantine Station will be found in Table 3.

Venezuela has developed and maintains the largest possible exchange of animal health information not only with neighboring countries and with others supplying most of the imports, but also with other nations with which there has been little or no trade in animals or animal products until now. Information is also exchanged with the principal international organizations specializing in this field. All this is done through our *Boletín Mensual de Información Epizootiológica* (monthly Bulletin of Epizootiological Information) and through publications received in exchange,

TABLE 3. Paraguaná Quarantine Station.

Location	El Morro, Peninsula de Paraguaná, State of Falcón.
General condition of isolation	The Peninsula of Paraguaná is separated from the main part of the country by an isthmus 25 kilometers long. El Morro is a headland of the Peninsula.
Means of access	National highway; port and airport.
Total area	68.5 hectareas (about 170 acres).
FACILITIES	
1. Residential area	Housing, mess hall, kitchens, recreation.
2. Administrative area	Offices, radio station, dressing rooms, laboratories, pathology incinerator, biological materials collection, laundry, power plant, workshop, and warehouse.
3. Livestock facilities	Corrals, crates, hoses, ramps, silos.
4. General installations	Water and power service, access roads, fencing, sewerage, sewage treatment facilities.
Total area devoted to receiving and isolation corrals	800 square meters (approximately 960 square yards).
Total area devoted to corrals (partially covered)	2,000 square meters (2,400 square yards).
Length of distribution passages	600 meters (approximately 650 yards).
Base area completely covered	2,500 square meters (approximately 3,000 square yards).
Silos (2), total capacity	400 tons.
MAXIMUM CAPACITY	
Normal	120 head of cattle
Maximum	140 head of cattle
Personnel	Technicians, 5; administrative staff, 2; auxiliaries, 12; (Total, 19).
Average charge for quarantine	1,500 bolivars
Total cost of Station	2,700,000 bolivars

as well as through the continuous study of information issued by the countries or by the specialized agencies. Attendance at international meetings and direct contact help to provide a clear, up-to-date picture of the world epizootiological situation, which we regard as extremely important for action and which, when it is effective, will avoid the imposition of unnecessary obstacles to trade in livestock and animal products.

THE VENEZUELAN EXPERIENCE

One of the major catastrophes caused by the import of livestock or animal products, the one that has had the most serious effects in Venezuela, was the entry of foot-and-mouth disease. Its precise etiology, while still a subject of controversy, is associated with shipments of cattle from Brazil and of frozen meat from Argentina in the second half of the 1940's. Since the two imports were made at roughly the same time and to destinations close to each other, and since the subsequent foci were also close together, it is difficult to determine the exact origin of the outbreaks.

This, however, has relatively little importance for the purposes of this discussion. The fact is that the problem arose from imports of animals or meat. The situation prevailing at the time of these costly experiences is also worthy of notice. In point of fact, this was the period in which the veterinary services were just being organized in Venezueala and the standards and systems mentioned above were practically nonexistent. The Plant and Animal Quarantine Law was already in force, but its regulations and standards had not been prepared.

There was a lack of proper organization and no adequate international information. The quarantine systems were ineffective, and the approach to the situation was generally superficial, despite the issuance of several warnings and even the resignation, in the case of the meat imports, of the Director of Animal Husbandry and the Minister of Agriculture, both of whom were outstanding Venezuelan farm specialists.

Whether it was the Brazilian cattle or the Argentinian meat that brought the type O foot-and-mouth disease virus into this part of the continent, the fact remains that in the early 1950's the problem grew to alarming proportions. The gravity of the situation can be deduced from the anguished initial reports, including the official declaration of the Ministry of Agriculture and Animal Husbandry that the outbreak was foot-and-mouth disease and that almost 1,900 animals had already died. It was reported that in Los Cristales, one of the first ranches to be affected, "200 head of cattle were lost and that it was necessary to sell a similar number to the slaughterhouse." Milk production declined from 2,000 to 300 liters a day. (It took two years to restore milk production to its former level.) The losses were estimated at 800,000 bolivars (US$179,000). The report of the Foot-and-Mouth Disease Institute estimated that "60 per cent of the calf crop was destroyed by the disease" and Dr. Galloway reported "a 5 per cent mortality rate, 50 per cent of the calves affected with mastitis and a decline in milk of 80 to 100 per cent during the acute period."

These are the bare outlines of a sad situation that sorely affected the livestock industry and the production of meat and milk. The impact of foot-and-mouth disease in Venezuela was dramatically reflected in concrete facts: the national average weight of the beef cattle dropped by 21.3 kilograms, and it required almost 10 years of substantial effort and investment to regain the 1949 level.

In a study we estimated that the direct economy loss during the initial stage of the problem, added to the money spent in fighting the disease, amounted to 255 million bolivars (US$56.9 million). On the other hand the direct and visible losses that foot-and-mouth disease would cause in Venezuela if not fought in an organized way would be approximately 54 million bolivars (US$12 million) per year, considering only the bovine species.

While it is true that our systematic, compulsory, and free campaign has enabled us to keep the losses within reasonable bounds at an annual expenditure of about 9 million bolivars (US$2 million), it is no less true that the situation represents a serious drain on the budget, which is a long-term consequence of the problem arising from inadequate controls over the import of animals and animal products.

But this brief summary of the problem as it affects Venezuela does not describe the entire problem. Following its entry into Venezuelan territory, the foot-and-mouth disease virus, in a brief period of six months, showed its extraordinary striking force by crossing the country from north to south and quickly spreading to the neighboring republic of Colombia, where it overran most of the country and caused an enzootic which has inflicted upon our neighbor direct and visible economic losses estimated at more than 300 million pesos per year, considering only the bovine disease, and hampering or preventing the expansion of Colombia's livestock shipments to the international markets.

In subsequent years, the return flow of foot-and-mouth disease has constituted a continuous and difficult problem for the Venezuelan foot-and-mouth disease campaign, which is faced with a permanent source of reinfection from Colombia.

This sad chain of events affected not only one country but an entire region and, for reasons of geographical proximity, poses a continuing threat to the neighboring countries that are free of the disease.

To a certain extent, however, we may consider the situation of the Greater Colombian region to be fortunate in one respect: only two types of virus have been active in Venezuela, notwithstanding the constant threat represented by the presence of C virus in neighboring countries and by risky imports of fighting bulls from Spain.

Other diseases whose consequences we probably have suffered as a result of the import of livestock or animal products have not yet been studied in Venezuela as they have in the case of foot-and-mouth disease, the principal reason being that our veterinary services were only recently organized on a sound structural basis.

As examples of such diseases we may cite brucellosis and tuberculosis, which were presumably brought into Venezuela by cattle imports from Europe in the early part of the century and from other areas later, and affected the cattle population of Venezuela.

Fortunately Venezuela has managed to reach the threshold of total elimination of *bovine tuberculosis* after an eradication campaign in which animals reacting positively were slaughtered. To do this, however, it has had to apply substantial efforts and investments involving more than 3 million tuberculin tests, the slaughtering of almost 24,000 positive reactors, and the payment of compensation totaling 5,553,-300 bolivars (US$1,239,000), apart from the costs of the campaign itself.

The problem of *brucellosis* continues despite the control work that has been done. The annual losses inflicted by the presence of this disease in cattle are serious indeed. The losses of milk, meat, and by-products are currently estimated at 63,662,500 bolivars (US$14,210,000) making it necessary at this time to develop a vigorous campaign against the disease. In this case, as with foot-and-mouth disease, the problem seems to arise from illegal imports of cattle into the western part of the country, where, despite all efforts, the problem persists and tends to spread to other areas.

Another problem, although a more recent one, caused by the importation of animals, is the presence of *leptospirosis* in bovines and other livestock. This disease has been a source of concern in the last few years to the veterinary services in various South American countries and would seem to originate, in our case, in cattle from the southern part of the United States.

In addition to the disease mentioned, which also affects hogs, a disease peculiar to this species (*atrophic rhinitis*) was imported in young hogs from North America and caused serious problems to our hog producers in the period from 1958 to 1964. Fortunately it has now been virtually eliminated.

As for *bird diseases*, the imported poultry or fertile eggs are a convenient vehicle for their spread, with very grave consequences.

We shall single out Newcastle disease, which, because of its explosive spread and high mortality, results in large economic losses and sometimes even prevents the development of the poultry industry. This was the case in Venezuela only 10 years ago when the egg production of laying hens was limited by Newcastle disease brought into the country a long time before with poultry imports.

By 1958 the high pathogenicity of the strains active in Venezuela was hampering poultry development, particularly egg production, to the point that it was necessary to import more than a million eggs per day for consumption. Fortunately the preparation of an effective vaccine and its large-scale application enabled us to surmount

the problem in a period of five years, and since 1963 we have practically been able to eliminate all imports by raising production from 92 million eggs in 1958 to 569.5 million in 1967 and increasing the production of chicken meat during the same period from 14,461 metric tons in 1958 to 52,799 in 1967.

A study we made in 1966 indicates that the net increase in production during 1958–1964 was 309,898,867 bolivars (about US$69 million), without counting other direct or indirect benefits. The corresponding figure for 1967 is approximately one-third higher.

Apart from these economic considerations, the increased production gives rise to considerable benefits to public health by providing a rich source of protein at prices within the consumer's reach and helping to reduce the earlier and almost exclusive dependence on beef.

Other poultry diseases arising from the importation of poultry or fertile eggs are now under control or in process of being controlled. These include pullorosis, today well in hand, respiratory diseases, and avian leukosis.

PRINCIPAL RESULTS ACHIEVED BY EXTERNAL QUARANTINE SERVICES

Ever since these services began operation, Venezuelan regulations have prohibited all imports of bovines from countries where *bovine pleuropneumonia, malignant catarrhal fever,* or *bovine plague* are known to exist. This prohibition, generally practiced by almost all countries in the Hemisphere, has been a definite aid in keeping these serious problems outside the Hemisphere.

In regard to foot-and-mouth disease, Venezuela maintains a rigid control system which has prevented the entry of type C virus into the country. Imports of cattle from Brazil are starting this year, thanks to the establishment of the Quarantine Station and, particularly, the application of exhaustive diagnostic methods for the detection of possible carriers, as mentioned above.

In the case of horses, control measures have been equally effective in preventing the entry of diseases such as *equine plague, glanders, equine syphilis,* and, possibly, *laryngo-tracheitis,* a frequent epizootic disease in the countries to the south.

During the present decade, strict control measures have prevented the entry of *African swine plague,* the disastrous consequences of which in Portugal and Spain led to a special alert. Also, the imposition of control measures for *atrophic rhinitis* helped to resolve substantially the problem created by earlier imports.

In this same domain, but with special reference to public health, highly effective results have been achieved with the control measures against *rabies* and *hydatidosis,* which came to Venezuela from other countries, and, even more important, *psittacosis* and *trichinosis,* of which the country has completely rid itself. In regard to trichinosis, it should be noted that, apart from other requirements, the prohibition on the import of hogs more than 90 days old is considered to have been highly useful.

Although this practice has caused certain difficulties in the diagnosis of atrophic rhinitis, it constitutes, along with the compulsory treatment of imported pork meat, one of the greatest successes of the control services.

FACTS TO BE CONSIDERED IN CONNECTION WITH INTERNATIONAL MOVEMENT OF ANIMALS AND ANIMAL PRODUCTS

The import of fighting bulls into the countries of the Greater Colombia region entails a considerable risk of infecting the area with C virus or its subtypes. Although

even a cursory analysis shows the completely undesirable features of this trade, whose threat to the livestock industry is out of all proportion to the benefits obtainable from these imports, it frequently happens that pressure groups, operating at times at high political levels, can subject an extensive region which is free of certain types of foot-and-mouth disease to seriously threathening situations.

Another fact to be noted is the intensive traffic and trade in thoroughbred race horses between the southern and northern parts of the Hemisphere, from the southern countries of South America (Argentina, Uruguay and Chile) to Venezuela and the United States and, particularly in the last few years, between the United States and Venezuela. Thought might be given to the possibility of setting up a joint system that would meet the sanitary requirements of the countries while also facilitating the transportation of these delicate and costly animals.

In regard to poultry diseases, we should consider the effects of the shipment of fighting cocks and hens from Spain to the countries of the Caribbean area and, to a lesser extent, between these countries, as well as the heavy import traffic in ornamental birds, songbirds, etc., from distant regions, particularly Asia.

There are also imports of various kinds of small animal pets, rodents, etc., which are serious threats to public health. Also to be considered is the shipment of wild animals from the Caribbean area to North America and Europe.

In Venezuela, and surely in other American countries, substantial importance is given to controlling imports of products of animal origin made in the home and in factories, mostly from Europe or the Middle East. Such products, imported in small quantities, appreciably in the aggregate, as part of the baggage of immigrants or other persons coming from those areas, necessitate a difficult and bothersome inspection. Among the problems these imports can cause, the entry of African swine plague is currently of particular interest. The practical difficulties of inspecting this kind of product indicate the need for a preventive system which might be based on adequate information supplied to consulates and shipping agencies.

SUMMARY AND CONCLUSIONS

So far we have discussed the basic aspects of the subject of this paper: causes and their effects, structure and functions of services, and lessons to be drawn from favorable and unfavorable experiences. It has been shown that the spread of animal diseases through international movement in livestock or animal products is a matter of considerable economic importance. We cannot conclude, however, without considering certain questions relating to future security. Failure to consider these questions would be tantamount to relegating ourselves beforehand to a secondary role in a fast progressing world.

It is essential for every sector involved in the international movement of animals and animal products to take stock of the situation. It is a matter of pressing urgency for government officials, transportation companies, ranchers, veterinarians, public health officers, businessmen, etc., to join efforts to achieve practical results leading to mutual benefits.

If we fail to do this soon, technological developments in other sectors, increasing population pressures, and pressing requirements generated by industry and commerce in increasingly industrialized societies will render it impossible to arrive at a workable system of hemispheric organization capable of effectively solving the problem.

While the last 30 years have seen a tremendous advance in communications, particularly air transportation, it is equally certain that progress in the next 30 years will be incalculable. One of the impressive conclusions of a recent Hudson Institute report is that within that period, time and space will cease to play an important part in the problems of communication. In a similar vein, statistics prepared by the National Science Foundation of the United States indicate that the impetus given to research, especially in transportation, communications, and electronics, warrants the conclusion that these are undoubtedly the major sectors of the future.

It is obvious that transportation, especially by air, will attain a colossal development in the near future and it is therefore a matter of utmost urgency to achieve a corresponding degree of development in controlling the shipment of animals and animal products if the costly spread of animal diseases is to be avoided. Failure to achieve such development will place us in an ironic situation in which technological advances in certain sectors render these controls increasingly ineffective.

The problem becomes, by virtue of these conditions, an open challenge. It is a serious challenge which can only be answered by timely and considered action based on rapid and sound decisions. This calls for earnest and effective cooperation among all the countries and sectors involved. It requires the development of precise, factual, and up-to-date information and documents backed by the best professional and technical judgment.

The largest contribution should come from the more advanced countries, since it is they that are in the best position to contribute and, in the long run, it is they who face the greatest risk of serious losses as a result of possible reinvasion by diseases already controlled or eliminated. In this connection I consider it extremely important for these countries and the international organizations to direct their efforts to systematic and timely dissemination, by the best possible means, of the results of research and of experience with structural and functional methods and systems, in an attempt to resolve the existing impasse and, eventually, to prevent a widening of the disparities caused by the increasing technological gap separating the advanced countries from most of the less developed nations.

We must also consider that although progress in the transportation field is largely responsible for the increasing complexity of the problem, it is possible to profit from the favorable aspects of comparable developments in the field of communications. Procedures can be made more responsive, and decision-taking can be facilitated through increased utilization of modern communications media to permit a continuing exchange of appropriate information.

We must also give new consideration to the methods by which knowledge is transferred, so that innovations arising from research and experience will yield practical results in a reasonable time. The traditional methods for the transfer of information are obviously outdated and overwhelmed by the enormous volume of reports and publications, which makes them inadequate to answer the demands of the times. It is imperative, therefore, to consider new systems that will make it possible to put the increasing volume of information to effective use.

Finally, I should like to mention the increasing importance of problems arising from international trade in livestock and animal products in view of the increasing tendency of countries to form economic integration groups as part of their search for larger markets. In Latin America this trend appears as an urgent reality and one

which, in relation to our discussion, calls for the greatest possible standardization of laws, regulations, diagnostic standards, etc., to make them completely comparable, and, even more, calls for the equalization, by means of the requisite improvements, of animal health situations in the countries involved. Failure to meet these requirements will mean that the powerful politico-economic need for trade in animals and animal derivatives will ultimately lead to a "downward equilibrium"—that is, to the spread of diseases into areas that have never known them or to the reinfection of those which have managed to eradicate certain diseases through tremendous effort and investment.

To avoid these serious risks and irreparable retrogression, it is necessary for those responsible for economic integration to consider on a priority basis the technical methods of advance coordination warranted by these facts.

PROBLEMS OF PRODUCERS AND PROCESSORS IN THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

1. PROBLEMS OF U.S. CATTLEMEN

C. W. McMILLAN*

Speaking as a trade association executive, representing the commercial cattle growers and feeders of the United States, it is somewhat difficult to adequately express firsthand problems encountered by those individuals who agressively have been seeking to ship livestock to countries outside the United States. From secondhand knowledge, however, I am aware that there are problems that do exist at home as well as abroad.

Livestockmen throughout the world are concerned about the well-being of their respective domestic industries. We in the United States are no exception. First and foremost in the cattleman's mind is the need to prevent any disease not present from gaining entry through whatever means. Foot-and-mouth disease is a classic illustration, and I need only reflect back a scant three years at the controversy raised through the new quarantine system established by Canada, principally designed to permit the entry of Charolais cattle into the North American continent from countries known to be infested with foot-and-mouth disease virus. Some individual Charolais breeders felt that the posture of the American National Cattlemen's Association was dictated by the fear on the part of some that a new bloodline would be competing from long-established British lines of breeding. This accusation was far from the truth because our sole fear was that of foot-and-mouth disease gaining entry into the United States and of the economic impact it would have on the domestic cattle industry. A brief look at what happened during the recent outbreak of foot-and-mouth disease in Great Britian clearly brings into focus the economic loss caused by the disease in a country now free of it. We are informed that nearly one-half million cattle, sheep, and swine had to be slaughtered. This represented approximately 1 per cent of the livestock population in Great Britian. The disease was found on 2,363 farms and the dollar cost, direct and indirect, including such items as indemnities, approached $500 million. Applying just the 1 per cent figure for the United States livestock inventory would make the cost astronomical to say nothing of the loss in animal protein to the consumers of the nation.

The United States cattleman who desires to export any of his produce has to be prepared to study a variety of regulations governing the movement of animals from country to country. But at the outset, he has to take precautionary steps that his own nation requires of all livestock exporters. These include veterinary inspection at point

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of origin, tests for tuberculosis and brucellosis, inspection of the vehicles that haul the livestock to the port, and veterinary inspection again at the port of debarkation. Essentially, he has to meet many of these tests before he even moves livestock between the various states within the United States, even if he is not exporting. The exception to this would be practically no tests required for cattle going directly to slaughter.

The next requirements that all exporters must meet are those of the nation to which they are sending the cattle. Most countries have restrictions that imported animals be free of certain specified diseases. For example if some cattle exporter's farm or home state has a history of vibriosis infection, his livestock will be denied entry into Brazil, France, the Phillipines, or Yugoslavia.

In addition to the general sanitation regulations, most foreign governments issue licenses for each consignment of livestock, and reserve the right to improvise additional limitations on any given consignment if its point of origin or some other factor seems to call for special attention. The stringency with which regulations are enforced varies from nation to nation.

At best, even a broad view of the export picture indicates that many uncertainties are involved in livestock exportation. Therefore, before the cattleman does actively engage in the business, he should follow the rules of the road:

First of all, he should comply with all U.S. regulations. He then should get in touch with his foreign consignee and have the consignee take out a license for the consignment. All import limitations, standard and special, will be spelled out in the license. From it the exporter should be able to tell in advance whether his stock will prove acceptable.

One of the interesting aspects is that the United States does not have a mandatory disease-reporting system. Many other nations do have such a system, therefore, even though a herd may be disease-free, it still remains suspect in the eyes of officials in nations where the disease reporting is mandatory.

Other problems, of lesser significance but nevertheless deserving attention, involve vaccines and disease-testing techniques. Some nations require that livestock be vaccinated with vaccines that are not allowed in this country, such as foot-and-mouth vaccine, for example. Disease tests vary somewhat from country to country because many instruments and testing techniques do differ. Some confusion, therefore, arises in the interpretation of the test results.

The advent and wider use of air transportation has been helpful to the welfare of the animals. Large shipments by air are just around the corner with the advent of huge jets in just a year or so. However, this does not help too much from the standpoint of delays caused by other factors.

To sum up, the exportation of live cattle is at best, not easy. Apart from the disease problems and the mechanics involving them, there is the matter of regulations and specifications laid down by various humane groups. The solution to the complexities are not easy. However, continued close liaison with the various nations of the world on these problems of mutual concern will be a major factor in resolving may of the difficulties experienced in the past. Additionally, further disease eradication work, where practical, should have a direct influence in the future in the same positive direction. Meanwhile, we strongly urge all nations to apply restrictions solely on the basis of need and not for economic reasons, such as fear of competition.

PROBLEMS OF PRODUCERS AND PROCESSORS IN THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

2. PROBLEMS OF LATIN AMERICAN CATTLEMEN

OCTAVIO OCHOA Y OCHOA*

Since I am neither a professional nor an expert in animal diseases or public health but a mere cattleman, I must deal with a subject that is sufficeintly difficult and delicate in itself and is all the more so for me as President of an organization whose membership represents the great majority of livestock producers in the countries of the Americas. Many of these producers are suffering the consequences of infectious diseases in cattle that make it impossible for them to market their animals and animal by-products.

One of the principal aspirations of the Inter-American Livestock Producers Association is to succeed in eradicating this type of disease from the entire Hemisphere. This Symposium is an excellent opportunity to bring ourselves closer to the realization of that goal.

As part of worldwide economic processes, the marketing of cattle and animal products accomplishes the dual purpose of satisfying the vital needs of mankind and furnishing raw materials to industry on the one hand and of providing producers and exporters with hard currency on the other hand—which at the same time promotes the quantitative and qualitative development of the livestock industry.

The industry, however, involves the risk of introducing and disseminating infectious and parasitic animal diseases, which are also transmissible to man, not only in the importing country but also in countries crossed in transit, and even in neighboring countries.

Among the possible vectors of both infectious and parasitic agents, we must remember man. He may be a carrier or may be attacked by parasitic or infectious diseases which are transmissible to animals. Even if well, he may unwittingly carry in his clothes or luggage an infectious disease agent capable of causing an epizootic.

To prevent the propagation of epizootics either nationally or internationally, governments have incorporated in their health legislation effective import and export control measures for animals and their by-products. The enforcement of such health provision has been supported by animal health agreements concluded between countries and by international and regional organizations such as the International Office of Epizootic Diseases, the World Health Organization, the Pan American Health Organization, and the International Regional Organization for Health in Agriculture and Livestock (OIRSA).

In an attempt to protect livestock against infectious diseases, practically every coun-

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try has established sanitary legislation with strictly enforced standards for the marketing of animals and their by-products, whether for internal consumption, importation, or exportation. Any sanitary regulations for the import and export of live animals and animal products should include the following as a minimum:

1. A standard nomenclature of infectious diseases.

2. A set of standard sanitary measures for all infectious and parasitic diseases, particularly those of compulsory notification; isolation, quarantine, inspection, and prohibition of the transportation and movement of animals; suppression of livestock auctions and fairs; disinfection of places, vehicles, and persons in transit; application of prophylactic measures; where required, destruction of any diseased, suspect, or contaminated animal and elimination of its carcass; supervision of by-products from such animals that are destined for human use and destruction of any unusable portions thereof.

3. Special regulations applicable in each country for all contagious diseases.

4. Health inspection and quarantine control measures for the importation of animals and their by-products.

To insure maximum reciprocal guarantees in the exchange of animals and their by-products, a number of countries have concluded international treaties or bilateral animal health agreements, which specify the requisites of each of the interested parties. There are numerous provisions in such international health legislation. Here we shall refer to only a few:

Importation of live animals. All imports must be controlled by the animal health authorities. No imports, even of healthy animals, will be permitted from countries that are officially known to have a disease from which the importing country is free.

Importation of products of animal origin. These must also be controlled by the health authorities. Dealers should be notified which products may be imported and which may not.

Animal transport. Animals coming from a country free of diseases, but which for any reason have had to make a stop in an infected country, must not only be refused entry but steps must be taken for the ship, or any other vehicle which brought them, to leave the country immediately. This regulation is one of the most delicate. The reason is that perfectly healthy animals are capable of contracting a contagious disease during the voyage, owing to the presence of an agent in the poorly disinfected vehicle or through the ingestion of contaminated food or water. For that reason we believe that rigorous measures must be enforced to have such vehicles suitably disinfected and disinsected before the animals are shipped; water must be potable, and sufficient forage and "bedding" should be taken from the place of origin to last for the duration of the voyage. Before authorizing debarkation of live animals in the country of importation, inspectors should demand certificates issued by the health authorities in the country of origin.

Inspection of airplanes, ships, and mails. Countries should maintain a corps of animal health inspectors who have been duly trained. The prevention of diseases will depend on their efficiency. This service should be performed at international airports, seaports, borders, and wherever international mail is received; in addition, there should be incinerators to destroy condemned products.

Quarantine stations. Countries should also have quarantine stations available in which to house animals for observation and test-

ing to guarantee that they are in good health.

Official diagnostic laboratories. These should be adequately staffed and equipped so as to properly diagnose diseases.

PHYSICAL IMPOSSIBILITY OF ABSOLUTE CONTROL

In spite of health legislation, some of which is quite comprehensive, and in spite of the efficient inspection and control of export animals and by-products, it has become practically impossible to control the risk of contagion, due to the speed of international trade by commercial aviation and the clandestine movement of animals and livestock products.

In addition to the accidental causes of introducing infectious diseases because of either legal or clandestine trade of animals and their by-products, there is a permanent danger of disseminating epizootic diseases through the reservoir of wild animals.

We must be extremely cautious to the point of not trusting anyone who might, through ignorance or ill will, be the transmitter of epizootics that could be catastrophic.

INTERNATIONAL ORGANIZATIONS AND ANIMAL HEALTH

The International Office of Epizootic Diseases (OIE) is in charge of reporting the presence of infectious and contagious diseases that constitute a risk to animal health and is the organization to consult on appropriate control steps. It is an agency of inestimable value in a time when animal industries are on the increase and the possibility of spreading animal diseases grows each day. As a veterinary institution, it studies the proposed international agreements of enforcement agencies regarding animal health, places them at the disposal of governments, and indicates suitable control measures.

The OIE regional office for the Americas was established in 1950 with headquarters in Caracas, Venezuela, and has been engaged in solving problems of this kind in the countries of the Americas. The World Health Organization, and particularly the Pan American Health Organization, have been most successfully combating the zoonoses of special importance in Latin America, because over 50 per cent of the population lives in rural areas where these animal diseases have a serious impact on both public health and the economy.

The Pan American Health Organization has established as part of its program a Pan American Zoonoses Center in Argentina and a Pan American Foot-and-Mouth Disease Center in Brazil. The Food and Agriculture Organization in its campaigns against diseases affecting animals and productivity has also been performing a most useful task.

OIRSA is active in animal health protetion and disease prevention on behalf of its member governments. Its program of foot-and-mouth disease prevention in the border area between Colombia and Panama, conducted in cooperation with the Government of Panama, deserves special mention.

OIRSA has also prepared such diverse items as a guide to the importation of agricultural and livestock products and by-products coming from countries affected by foot-and-mouth disease; a guide for inspectors of agriculture and livestock quarantine in the field of animal health; a set of draft regulations for the inspection and quarantine of animals, their products, and by-products; and the draft of a health law applicable to all countries of the area.

HEALTH REGULATIONS AND MARKETING OF ANIMALS AND ANIMAL PRODUCTS

Many agencies, particularly industrial and trade organizations, have been promoting uniform methods applicable to

international trade of animals and their by-products, with the elimination of anything considered an unnecessary obstacle to free movement within the countries that comprise the Central American Common Market; this is considered one of the requisities for the attainment of the goals pursued in the free trade areas.

Dr. Duhaut, in dealing with these matters at meetings of the International Office of Epizootic Diseases and at the European agency for productivity, was of the opinion that veterinary regulations must be unified in order to favor international trade and to protect the livestock industry against infectious diseases.

Dr. R. Vittoz, for his part, maintained that veterinary regulations were drawn up in various countries, not to hamper national or international trade but, on the contrary, to normalize animal health conditions as far as possible and in order to favor both median and long-range animal trade.

We believe that health standards should be rigorously applied, as should the provisions of the Treaty of Montevideo, as well as the decisions of the meetings of the Advisory Committee on Animal and Agricultural matters of the Latin American Free Trade Association (LAFTA), which advocates the following: that the contracting parties in matters of agriculutre and livestock unify their activities with the aim of eradicating the animal diseases and scourges of the area and protecting it against the introduction of new ones; that the products traded in the area be free from such diseases and adhere to the existing sanitary regulations as regards permitted tolerances of residues of pesticides, additives, contaminants and the presence of foreign bodies and other similar elements; that to this end the contracting parties will fulfill the provisions contained in the international agreement signed at Rome in 1951 regarding the protection of animal health and plant life; and, finally, that the decisions adopted by LAFTA be adhered to for both animal and vegetable products.

The fact that the solution of the problem of animal health is of great concern to the Governments of the Americas, was revealed by the Declaration of the Presidents of America subscribed to at Punta del Este, Uruguay, in April 1967. It contains a statement to the effect that the basic role of health in the economic and social development of Latin America requires the intensification of communicable disease control and prevention and implementation of measures to eradicate those for which the means of total elimination already exist; also, a statement that the control and eradication of such diseases should be given proper coordination within international programs, as required.

The Inter-American Livestock Producers Association in its Declaration of Principles of 22 May 1965 pointed out that epizootics and animal diseases and scourges severely affect the livestock industry. It also made special mention of foot-and-mouth disease, as requiring a united effort on the part of all countries in the Americas, whether affected by the disease or not, to prevent the serious economic losses it causes.

Among the goals and objectives of the Inter-American Livestock Producers Association is that of jointly drawing up economic and health plans to protect the potentials of the livestock industry. The Dallas Declaration of October 1965 invited universities, research centers, and professional associations to intensify their scientific work in order to make more efficient use of technical advances in the control of epizootics, in the increase of livestock productivity, in the suitable handling of ranches, and in the rational utilization of animals.

The Bogotá Declaration was signed at the meeting of the Inter-American Livestock Producers Association held 23-24 July

1967 in Bogotá, Colombia. It recognizes the urgent need for effectively combating foot-and-mouth disease by the use of prescribed health measures and urges the countries to cooperate.

At its Second General Assembly, also held in Bogotá, 3–7 December 1967, the Association agreed:

That the aim of veterinary health legislation is the protection of human health and the health of livestock and other species which are the source of nutrition and basic raw material for the industry;

That legislation should be directed toward the control, prevention, cure, and eradication of animal diseases;

That on past occasions international trade in livestock and animal products has given rise to the spread of enzootics and epizootics;

That air transport has also been a factor in the spread of disease;

That importing countries should make it their business to learn about the disease of animals and the conditions of veterinary control of the exporting country, as well as to learn about the animal disease situation as it exists in the same geographical area, whenever there are commercial relationships between these countries;

That the agreement between countries should be multilateral and not bilateral as is now cutomary, since the number of countries participating in the international livestock trade and animal products trade increases daily (many of these countries, even though they may have no trade agreements, also run the risk of importing infectious disease);

That uniformity of text in legislation in the countries of the Americas is difficult, if not impossible, to achieve, owing to differences in political constitutions, in the formulation of laws, and in administrative procedures.

The Inter-American Livestock Producers Association further agreed:

That a working group be constituted in the Association to conduct an analysis of the health situation of the countries of the Hemisphere (diseases, health legislation, programs, research, etc.) and that this group present its findings to the Association, which will in turn submit the findings to the countries and international agencies, with a recommendation that the findings be implemented by appropriate legislation;

That a reporting system be established that would function in a timely and continuing manner to inform livestock owners about the health situations in the various countries;

That the Association impress upon the governments of the countries in the Hemisphere (and the international agencies) the need to increase economic support for official programs of health protection;

That the Association recommend to livestock owners that they participate to a greater degree in the reporting of outbreaks of diseases of compulsory notification, with the object of having the national or international agencies confirm the diagnosis as soon as possible, so that appropriate steps may be taken;

That the Association encourage the creation of a special fund for the payment of indemnities for losses incurred as the result of the application of extreme measures to eradicate the epizootic (studies should be made to see to what extent modern insurance methods might cover this particular application);

That the countries concerned approve and implement the recommendations of the Bolivian Organization of Animal Health (OBSA). Such an agency, together with OIRSA, the animal and agricultural health organization of the Southern Cone of the Hemisphere, and the Pan American Health

Organization constitute a real and worthwhile means for collecting information, establishing coordination, and applying health protection measures at regional and continental levels;

That the Association encourage all livestock organizations in the Hemisphere to contribute moral and financial support (to the extent that they are able) to the control programs and to the possible eradication of foot-and-mouth disease in the affected countries, as well as to the prevention of the spread of this disease to countries that are presently free from it;

That the Association request the Governments of Colombia, Panama, the Republics of Central America, Mexico, and the United States to approve as soon as possible the draft agreement for the prevention of foot-and-mouth disease in the northwest area of Chocó and in the countries of Central and North America; and at the same time to ask the Government of Canada to participate in this agreement;

That, since vaccination is the most efficient weapon in the foot-and-mouth disease control arsenal, the member countries increase production of vaccine of established quality and that the agencies which have been entrusted with research and study of attenuated live virus vaccines continue in their work; and

That the governments as well as the international agencies of animal health constantly revise sanitary standards so that these may be brought up to date in order to increase livestock production.

An analysis of the foregoing permits us to come to the following conclusions:

1. The control measures against infectious and parasitic diseases of animals, some of which are transmitted to man, assume a very special importance in both the social and economic well-being of Latin America, a major portion of whose national economies are based on livestock production.

2. The continuing increase of livestock population, changes in production methods, and the ease with which such animals can be transported, as well as other factors, bring in their wake increasing difficulty in the control of transmissible diseases in animals and make it easy for disease conditions which were unknown or which previously had little importance to develop.

3. Sanitary laws and regulations are fundamental for the control of animal disease and to avoid the introduction of other diseases by means of livestock movements or through the importation of infected products of animal origin. These juridical concepts should include penalties or fines of a severely deterrent nature; the intentional contamination of foodstuffs and the intentional transmission of animal scourges or epizootics should be considered a crime against humanity.

4. All countries should establish strict methods and procedures for the prompt issuance of certificates for import and export, so as to avoid failures and delays which might harm trade and defeat the purposes of health regulations.

5. Restrictions or prohibitions on the importation of animals or their by-products, as far as the health laws are concerned, should be directed exclusively to the prevention of the transmission of disease, regardless of the commercial outcome, which is a matter for separate legislation.

6. Protectionist health measures of the industry of a country should never be violated or broken under the guise or pretext of a commercial transaction that would benefit the country in other respects.

CONCLUSIONS

The control of animal diseases is a concern of all governments and international

and regional health agencies of the Hemisphere; it is also the concern of trade agreements between the countries and a matter of individual concern to cattlemen, a concern expressed through the actions and recommendations of their associations.

As a result, cattlemen should be given the opportunity for greater intervention in government programs, whether national or regional, aimed at the prevention, control, and eradication of animal diseases, in order to achieve efficient cooperation and compliance with the pertinent sanitary regulations.

The importance of giving direct participation to cattlemen has become clearly evident in the campaign to eradicate foot-and-mouth disease, which was carried out in Mexico, and in the current campaign against the screwworm, which has benefited from the participation and cooperation of North American cattlemen. This cooperation has consisted of both financial contributions and the sending of samples for testing: Mexican cattlemen have also played an important part.

Although it is a well-known fact, mention should be made of the tremendous losses sustained by the livestock industry through various diseases and epizootics, which decrease the productive capacity required to meet the needs of a growing world population and hence diminish the economies of our countries.

Sanitary regulations should be expressed through simple and efficient control systems, readily understandable, so as to obtain the cooperation of all parties who are directly concerned. Without such control systems the necessary health provisions cannot be readily enforced.

To obtain the fullest knowledge possible about existing veterinary health legislation in the Hemisphere, it will be necessary to inventory existing legislation and then attempt, through international agencies, to have another world-wide set of legislation drawn up and distributed as widely as possible.

To avoid any problems that might arise with the issuance of health certificates, international uniformity should be sought. It would be advisable to print certificates in the language of the interested parties.

The application of safe vaccines, which do not carry the risk of contamination, should be made compulsory in the case of trade involving live animals.

Owing to the increase of commercial aviation, it is essential to regulate the importation of animals and animal products by air by establishing veterinary inspecspection services at airports.

Regular disinfection and disinsection of transported cattle under the control, vigilance, and responsibility of veterinarians should be made compulsory.

PROBLEMS OF PRODUCERS AND PROCESSORS IN THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

3. PROBLEMS RELATED TO THE DEVELOPMENT AND INTEGRATION OF LATIN AMERICA

RUBEN LOMBARDO, D.V.M.*

In the light of the development and integration programs in Latin America, problems originating in the international traffic of animals and animal products acquire great importance and relevance. As far as the improvement of livestock and animal products is concerned, the problem of animal disease is one of the most serious drawbacks to integration and will require intensive work, more research, and new ideas if we are to find appropriate solutions to the problem.

Latin America's future constitutes a challenge in this field. We are all well aware of the need for an increase in food production and food exportation, especially food of animal origin. In Latin America, some countries have to purchase animals as food for human consumption and products of animal origin for industrial uses; other countries are able to sell but, owing to the existing sanitary regulations, are not able to export.

As an example, there are in the Hemisphere three large epizootiological regions as far as foot-and-mouth disease is concerned, and, because of the presence of this disease, trade among them is carried out to a limited extent as regards animals and by-products of animal origin. These three regions are:

1. Central and North America, including the Caribbean islands, Guyana, Surinam, and French Guiana—free of the disease.
2. Venezuela, Colombia, and Ecuador—two types of virus present (A and O); one outbreak of virus type C occurred without any commercial significance.
3. All the other countries of South America—three types of virus present.

Undoubtedly, the sanitary measures which regulate international traffic have serious repercussions on the economy and possibility of exchanges among the three regions.

As a result of the tremendous increase in means of transportation, in the Americas, as in other regions, some diseases of local character are assuming a regional and even continent-wide importance.

With reference to foot-and-mouth disease subtypes, it has been shown that animal displacement was the main factor in the spread of the A_{27} subtype in three or maybe four countries in the Andean region and the A_{25} and A_{24} subtypes in several countries of the River Plate basin in a short period of time.

In this paper we shall consider the pres-

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ent situation and the possible changes to be introduced at short or medium term in the regulations for interregional transit of animals and animal products in relation to projects of development and integration, especially in the transportation and communication sectors.

AGRICULTURAL PRODUCTION AND EXPORTS AND IMPORTS NEEDS

Latin America must increase its food production at the minimum rate of 4.5 to 5 per cent annually in order to reach the goals established in the Charter of Punta del Este, which established the urgent necessity of stimulating the growth of the agricultural sector.

The importance of the increase of exports and its close relation to the ability to import essential goods for development has been recognized. For the majority of the countries which do not base their export trade on oil and other minerals, the agricultural sector represents more than 90 per cent of the total exports. Within this sector, livestock has been increasing in importance.

The need for increasing interregional trade has been pointed out in several meetings of the Inter-American Economic and Social Council (IA-ECOSOC) and, as a result, the Latin American Free Trade Association (LAFTA) was established. As has been mentioned, however, sanitary regulations can represent a great deterrent to interregional trade in animals and animal products.

More than 200 million cattle, including zebu, are exploited in Latin America. However, their distribution is not related to the human population; most of the animal population is concentrated in the southern zone of South America, where a large surplus exists for export and the per capita meat consumption is very high, while in the rest of the region the situation is precisely the opposite. Livestock production and productivity in Latin America are in general poor, and in some cases reach a very low level. In several countries agriculture can be extended, especially in the sparsely populated regions in the tropical zones, where there are possibilities for future colonization. Almost all the countries are implementing or preparing plans for livestock development, which include imports of a large number of animals and some breeding specimens of high pedigree, as in Bolivia, Chile, Colombia, Ecuador, and Venezuela. Other countries, like Argentina, Brazil, Paraguay, Uruguay, and most of Central America, are planning to increase their exports of animals, meat, and other products of animal origin.

At present, in South America the main movement of cattle (including zebu) can be summarized as follows:

In the northern region, Colombia is the country with the greatest livestock potential, and trade has been established with Ecuador, Peru, and Venezuela. It should be mentioned that the occurrence in Peru a few months ago of an outbreak of foot-and-mouth disease virus subtype A_{27} originating in Colombia, had as a consequence the discontinuation of livestock imports from Colombia to be slaughtered in Callao for consumption in Lima.

Transportation of cattle from Colombia to Peru is made by ship or by surface through Ecuador, which is considered a transit country. Ecuador also exports a certain number of animals to Peru.

Chile buys annually from Argentina a considerable quantity of cattle for consumption and is also a transit country for the Argentinian animals exported to Peru. Animals for production and breeding are normally traded among Argentina, Brazil, Paraguay, Peru, and Uruguay. A certain number of animals pass from Brazil to Boli-

via, and in the Amazon region trade is conducted between the Federal Territory of Roraima and Guyana.

In Central America there is also some exchange of animals and products, especially exports of cattle from Honduras to Guatemala for fattening and slaughtering and the traditional sale of Mexican cattle to the United States.

There are various types of transportation for cattle among these countries. In some regions, cattle are transported on foot, but trucks are the commonest means used. To cross the mountains from Argentina into Chile, rail is used. In some regions steamships are used. Airplanes are used in special cases, but surface transportation predominates.

From this brief explanation of cattle exchange, one can infer its importance and the interest of the authorities concerned in the various countries in this subject. Considerable improvement at the regional level has been achieved in the unification of criteria, diagnosis systems, certificate requirements, and control of transit in South American countries, especially in the south, through the Regional Technical Commission on Animal Health. Central American countries, Mexico, and Panama are also adopting measures for the solution of sanitary problems related to cattle movement.

The Pan American Foot-and-Mouth Disease Center has been collaborating with the countries in the establishment of cooperative program agreements at the border level, which include such measures as vaccination and control, inspection, exchange of information, and periodic consultations with authorities. The Argentina-Chile Commission, the Colombia-Ecuador Agreement, the Argentina-Paraguay Agreement, and the Brazil-Uruguay Agreement are examples of the great concern of the countries in developing cooperative efforts to prevent and control the spread of foot-and-mouth disease. A similar agreement is being negotiated by Brazil, Guyana, and Venezuela.

It should also be mentioned that border quarantine stations recently started operating in Brazil and that Argentina and Peru are planning to expand existing stations.

In Latin America, one of the main features of livestock exploitation is the great movement of cattle made necessary by grazing conditions (great number of animals in vast areas) and grazing locations, generally far from slaughtering and consumption centers. Millions of animals are moved monthly from one area to another, over intermediate or long distances. This type of exploitation increases the chances of spreading diseases. The marketing system, carried out in public auction markets distributed throughout livestock zones, and the other conditions mentioned give some idea of the important role played by the transit of animals through the countries, its importance in the epizootiology of several diseases, and the need for its control at the national and border levels.

On the other hand, it can be said the livestock industry is essentially transportable. Meat especially is self-transported raw material, and this is the basis for the role played by livestock in the colonization of large areas of South America.

There has been an increase in roads and railways, both in number and extent. In some countries, such as Brazil, there has been a considerable increase during recent years in both the number of trucks and their size and, as a result, animals and animal products are rapidly transported large distances. At present in Latin America, this situation acquires special significance from the standpoint of exotic diseases, which can enter a country, causing economic losses and, because of the above-mentioned reasons, find favorable conditions for spreading over fairly large areas. As far as animal health is

concerned, the spread of such diseases is greater in American and European countries, in which the means of communication are more developed. For that reason, transportation of animals and animal products has attained greater importance than in the past.

Latin America, mainly South America, is experiencing a great change in the factors that favor the movement of herds, which will increase in the next few years. These factors carry a larger possibility of transforming the region into a closed zoological zone—a possibility that is of great interest from the standpoint of health.

THE INTEGRATION PROCESS

The conditions to be taken into consideration with respect to livestock development, exchange of animals and animal products, and sanitary control to protect livestock and to promote this exchange will depend upon the development of regional and subregional programs of integration.

At present, a great tendency toward interdependency and integration prevails, resulting in new concepts in regard to borders, since, to paraphrase André Hillion, human efforts do not chart beforehand on a map a limit for their activities.

The integration concept is to a certain extent opposed to the traditional border concept, and we have to analyze the possibilities and future health problems of a new form of wealth: the exchange of animals and their products.

The importance that authorities give to regional integration is well known, and its aspects were fully discussed at the Meeting of American Chiefs of State held last year in Punta del Este. The Inter-American Economic and Social Council (IA-ECOSOC) as well as the Inter-American Committee on the Alliance on Progress (CIAP), and international credit agencies such as the Inter-American Development Bank (IDB) are actively collaborating in order to promote the integrational process.

In cooperation with the Latin American Free Trade Association (LAFTA), the Foreign Affairs Ministry Council was created. The parliament of member countries participates in LAFTA projects, and several consultant commissions have been established.

The Central American Common Market was established some time ago. In South America there are two subregional integration movements in process: one is that agreed on in the Bogotá Declaration less than two years ago, which created the Sub-Regional Andean Group made up of six countries; the other is the River Plate basin countries, grouped to promote the integrational development of the great potentialities of this region. Also Colombia-Venezuela, Colombia-Ecuador, and Peru-Bolivia are promoting joint programs for border development.

Recently, the Presidents of Argentina and Uruguay signed an agreement in which physical integration is considered a basic element for economic integration; the connection between the two countries through the construction of bridges over the Uruguay River and the improvement of navigation on border rivers are considered essential.

Railway connections between northwest Brazil and Bolivia and between Argentina and Bolivia have already been established.

In April 1968 the IDB and the CIAP established a Working Group for executing the proposal for the development of infrastructure and physical integration in Latin America (i.e. to interconnect and expand surface, maritime, fluvial, and air transport, as well as telecommunication systems, power, pipelines, etc.). The resolutions of this Working Group will be presented toward the end of 1968.

On the other hand, the Ministers of

Foreign Affairs of the five countries of the River Plate basin decided in a meeting held in Santa Cruz, Bolivia, to start studies on multinational projects, which include improvement of navigation in several rivers and interconnections of roads, railways, communications, and power systems. In May 1968 in Lima, a meeting of the Ministers of Foreign Affairs from Argentina, Bolivia, Paraguay, and Peru was held to examine achievements in the construction of the Marginal Jungle Road which, in the future, will connect the eastern part of the Andes, from Venezuela to Paraguay by a highway of 6,390 kilometers, of which 2,500 kilometers have already been constructed.

Within a few years there will be greatly increased possibilities for the transportation of animals and animal products, owing to closer communications between countries.

Finally, it should be mentioned that a surface connection between South America, Panama, and Central America will be in effect when the construction of the projected Pan American road connecting the Jungles of Chocó in Colombia and Darién in Panama, is completed. From the health standpoint, and especially in regard to foot-and-mouth disease, the completion of this road will acquire great importance.

In South America the Andes Mountains and the jungle regions constitute a large part of the border between different zones, which gives pathology a certain subregional character. Air transport has shortened distances; roads, as well as river navigation and railways, will approach even closer to these zones and countries, thus accelerating commercial exchange and favoring a greater spread of diseases. Epizootiological geography is a subject which will require more consideration and more thorough study.

Bearing in mind what has been discussed above, I would like to present the following suggestions.

MEASURES TO BE CONSIDERED IN THE INTERREGIONAL TRANSIT OF ANIMALS AND ANIMAL PRODUCTS

The execution of national campaigns of control and/or eradication of animal diseases, coordinated at the multinational level, is one of the most important present and future goals in accord with the policies of development and integration in the Americas.

The financial support received from international credit agencies for the execution of national programs to control animal diseases and the programs of regional integration are of a great significance. The support that the Inter-American Development Bank is giving to the foot-and-mouth disease campaigns deserves special mention. On 18 July 1968, the first two loans were granted for a total of $5.1 million, to Chile and Paraguay. Other affected countries are preparing their requests. This support is of the utmost importance to the animal health programs and it opens the possibility that such action may be extended in the very near future to other similar problems that have a bearing on the economic and social development of the Latin American countries.

Bilateral agreements for the coordination of action at border levels must be increased and consolidated; to this end, the efforts being made for the control and prevention of foot-and-mouth disease in South and Central America, Mexico, and Panama show the steps that can be taken.

It will be of great value to establish sanitary legislation of an interregional character in order to ensure that marketing practices take duly into account problems related to animal health.

Research on virus carriers, other disease agents, and food technology must be increased in order to ensure food purity and

thereby make possible the improvement of trade among countries in which present sanitary conditions hinder such trade.

The establishment of a greater number of quarantine stations and quarantine border posts is required in order to control either subregional, interregional, or intercontinental exports and imports.

It will be necessary to greatly reinforce measures to prevent the introduction into the Hemisphere of exotic diseases, especially those having unfavorable repercussions on marketing and exports, such as rinderpest, African swine fever, and types of foot-and-mouth disease which do not exist in the region. And, finally, it is necessary that each country promote the training of personnel for the purpose of diagnosing exotic diseases and establish a program to facilitate intervention in emergency cases. Adequate services for prompt action and trained specialists for the job of eradication in the field are indispensable.

Central America, Mexico, and Panama have achieved considerable advances in the control of foot-and-mouth disease, which should be incremented. The other countries, mainly in South America, will have to devote themselves to a more detailed study of the action that should be taken if an exotic disease appears, and of ways of obtaining funds to be used in an emergency.

To conclude, I would like to express my confidence that, by combining a willingness to face problems and an understanding of the important role played by animal health in development and integration, it will be possible to find solutions to the problems in this sector and to achieve the desired rapid development of Latin America.

PROBLEMS OF PRODUCERS AND PROCESSORS IN THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

4. PROBLEMS OF THE PROCESSORS OF ANIMAL PRODUCTS

DR. J. W. CUNKELMAN*

When Dr. Herrell DeGraff of the American Meat Institute called a couple of weeks ago and asked that a paper be prepared and presented at this Symposium, it appeared to be a monumental task, particulary in view of other duties and commitments.

However, the subject assigned contains one word that also appears several other places in the program—that word being "problems"—and since the subject matter of the other speakers on this panel is generally directed toward problems of producers of food animals, this paper was planned to deal largely with problems of processors of animal products.

Accordingly, several meetings were arranged with representatives of processors, and, after general discussion of the program of this meeting, each was asked what his problems were, if any, having to do with international movement of food animals and animal products. Invariably, the replies and discussions fell into two categories:

1. Problems other than problems of meat inspection
2. Problems of meat inspection

In the first category there was considerable interest in the possible effects on international movement of animal products of several diseases and disease diagnosis and control programs currently active or being activated in the United States. It was quite apparent that with the increased sophistication of livestock breeding and feeding operations in this country during the last few years, there is also an increased interest and demand for improved quality in those animals in the market place. Processors, more than ever before, are aware of and alert to the need for an ever increasing volume of healthy livestock to keep the pipelines to the consumer, whether domestic or foreign, filled with meat product that is safe and suitable for human consumption in every way.

Pork processors are watching with great interest the field trials at a major Midwest packing plant to determine the feasibility of a newly developed method of testing swine carcasses for trichina. Satisfactory control or eradication of trichina from our swine population would be a great boon to increased pork consumption everywhere that pork is consumed.

Pork processors are very much concerned over the possibility of decimation of their raw material supply (hogs), should there be a widespread outbreak of hog cholera in this country, where there has only been enough

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vaccine produced in the last year to vaccinate less than 30 per cent of the entire hog population if all the vaccine had been used. Disease control and regulatory officials at local, State, and Federal levels and the swine producing industry are working tirelessly to prevent such a happening and to reach the goal of complete eradication of this disease in the next few years. Adequate control of trichina and hog cholera should open international markets for swine products to a much greater degree than ever before.

Another current problem that processors are concerned about has to do with the promotion of and attempts to organize a system of animal identification, whereby any undesirable condition found in an animal anywhere between farm of origin and final inspection in the processing plant may be traced back to the farm of origin. There can be little question but that the basic concept of being able to trace diseased livestock found in the marketing channels back to the farm of origin would be a tremendous adjunct to disease control. Meat inspectors or regulatory personnel have for many years collected specimens, such as skin scrapings, tumors, blood samples, bone specimens, etc., for submission to cooperating labatorories, and these have been unquestionably of help in the disease control programs.

Now, however, processors are beginning to realize that identification of all livestock back to the farm of origin involves much more than what has been done up until now, and that they and the producer have not been adequately and satisfactorily informed as to the mechanics of animal identification, or as to responsibilities and costs. Some feel that all-animal identification procedures should be restricted to use in quarantined areas in the control of specific disease outbreaks. The great concern of some is that a full program of all-animal identification back to the farm would expose a veritable Pandora's box of ills with unknown but feared repercussions affecting their livelihood and standing in the community and that this in turn might revolutionize our livestock marketing system. It is expected that, as this identification problem and process becomes better understood and better utilized, each improvement will be reflected in the form of improved disease control, whether this is recognized or not at the particular time.

In the second category (problems of meat inspection) there were numerous incidences cited both at the national and international level wherein there had been problems that were not settled to the satisfaction of one, or both, parties. Almost without exception, and as might be expected, these problems had to do with lack of uniformity of interpretation and application of the Regulations Governing Meat Inspection and of the Manual of Inspection Procedures. This problem of lack of uniformity of application of the regulations at local levels is very serious in some areas, so much so that processors are able to identify duty time of certain inspectors merely by comparing disposition reports.

Again, this problem of lack of uniformity of interpretation and application of the regulations is a very serious one because meat inspection is a public policy, and the laws and regulations are expected to be enforced intelligently and impartially.

Processors look forward hopefully to the day when the basic principles of meat inspection and the accompanying regulations and procedures will be meaningful and acceptable to all countries engaging in international trade, yet they fear that this will be a long time in view of practices that must be known to others. They cited instances where it was somewhat routine to arrange to handle animals or product at a time or place, domestic or international, where experience had shown that a more knowledgeable and

mature judgment could be expected from the inspection service. They find it difficult to understand why countries will accept U.S. Department of Agriculture inspection as satisfactory, but with exceptions that vary from country to country with no apparent reason. They express much concern over what appears to be excessive, unnecessary, and expensive labeling requirements and changes. And they become very concerned when international shipments are held up for weeks on end while language requirements acceptable to both countries on the certificate can be translated, notarized, and otherwise made satisfactory. They emphasize that the undue expense of such experiences, multiplied many times over the year, constitutes a major burden on the livestock industry out of all proportion to the intent of the meat inspection program.

There were more reports of problems associated in some manner with the international movement of food animals and animal products, the reporting of which at this time would serve no useful purpose. The pertinent observation was that each processor interviewed pointed out at some time that there must be meat inspection—that the livestock industry of our country and of all those we trade with must have meat inspection and that every attempt must be made to have that meat inspection firmly based on knowledge and understanding and on practicality and uniformity.

PUBLIC HEALTH IMPLICATIONS ASSOCIATED WITH THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

1. PROTECTING THE CONSUMER

ROBERT K. SOMERS, D.V.M.*

Those of us in the U.S. Department of Agriculture find that meetings such as this Symposium provide an excellent forum for communication and discussion of the many problems that are of mutual interest to all of us. The principal purpose, of course, is to integrate our knowledge about livestock and poultry in order to accomplish our common goals in a more effective and economical manner.

Among the many programs administered by the Department of Agriculture's Consumer and Marketing Service are: Meat and Poultry Grading, Market News, Meat and Poultry Inspection, Commodity Distribution, Food Stamp Program, the National School Lunch Program, a Food Trades Staff, and many others. All of these programs are designed to assure the nation of a dynamic food marketing industry.

The international trade in meat and meat food products involves complex and varying economic factors. Certain countries depend heavily on their export trade in meats in order to import other needed commodities. Other countries may be deficient in one kind of meat or product but have a surplus of another.

Apart, however, from economic considerations, trade in meats between countries is complicated by the concepts and procedures advocated by governments as effective meat inspection systems for assuring the consumer of receiving only meat that is sound, wholesome, healthful, and fit for human food. Also a factor of major concern is the potential danger of disseminating animal and poultry diseases between the exporting and importing countries. Many governments, including our own, have found it necessary to impose restrictions on the importation of meats, particularly fresh and frozen meats, from some countries because of disease conditions that are in existence among livestock and poultry. The free movement of meats between countries is not, therefore, regulated entirely by the laws of supply and demand.

Essentially, an export and import inspection program is based on the requirement of the importing country that the imported meat and meat food products have been handled and processed under a standard of inspection equal to its own system. It would seem logical then to approach any plans for greater trade between countries by:

1. Providing minimum inspections and controls necessary to assure the wholesomeness and acceptability of meat and meat food products.

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2. Gaining general acceptance and use of these standards so that meat products can flow freely without undue reinspection between those countries that follow the standards.

The U.S. Department of Agriculture actively and continuously strives to provide consumers with an abundant, wholesome, and nutritious food supply. All poultry and food-producing animals slaughtered in plants for sale in interstate or foreign commerce must be federally inspected. In this program, each bird or animal is individually examined by a trained Federal inspector. Animals and poultry found to be affected with any disease or condition that would be harmful or cause unwholesomeness of the meat are condemned and destroyed for food purposes.

Meat is derived from individual animals and birds, any one of which may display conditions and/or symptoms that must be considered on their own merits. There can be no substitute for an adequate original inspection. Any attempt to fully control or even adequately assess meat and meat food products by exclusive reliance on sampling would discredit the need for effective antemortem, postmortem, and preventive "in-plant" meat inspection procedures. No such system has ever been devised for meat. We are confident that we must continue to insist on effective antemortem, postmortem, and processing inspection of all imported and domestic meat.

To be eligible for exporting from the United States, meat and meat food products must be produced in plants operating under official inspectional control. The products are then reexamined at time of export by our inspectors and certified as meeting the requirements of the country to which they are being shipped. Last year we exported 630 million pounds of meat and meat products to about 40 countries. This is about one-half as much as our total meat imports.

As I stated, an essential part of controls to assure wholesome meat products is competent antemortem and postmortem inspection of animals and poultry under the direction of qualified veterinarians. Antemortem inspection is necessary to identify diseases which may not show gross lesions during inspection of the carcass. An example of this is rabies. A thorough postmortem examination of all parts of the slaughtered animal or bird is necessary to sort out those afflicted with communicable diseases as well as those conditions which are potentially dangerous because of bacteria or toxins or are objectionable from an esthetic standpoint.

Although meat imported into the United States is subjected to inspection at our ports, most conditions which are detectable on antemortem and postmortem inspection are not apparent in meat products in this finished form. It is very important, therefore, to know that the livestock and poultry from which meat is derived were subjected to competent veterinary inspection in the country of origin. For this reason, among others, we have assigned to a group of Consumer Protection Program veterinarians the responsibility for visiting exporting plants in other countries and reporting on the effectiveness of the meat and poultry inspection programs. The Foreign Programs Officers, as these reviewers are called, also assess the effectiveness of inspection controls designed to assure that the meat derived from healthy animals and birds remains wholesome during processing and is not adulterated or treated with prohibited preservatives or harmful substances.

Because of the unique access to the bird or animal, Consumer Protection Program veterinarians serve as a focal point for obtaining information regarding conditions affecting them at the time of slaughter. These veterinarians are an essential part of the defense team against the introduc-

tion and dissemination of communicable diseases of livestock and poultry which could gain a foothold and create havoc among the entire meat industry.

With the rapid expansion of air freight services and the common practice of transporting livestock and poultry long distances for slaughter, these diseases could be widely disseminated in a matter of hours. As a part of the Department of Agriculture's team effort to prevent the spread of animal and poultry diseases, our veterinarians report to the Animal Health Division of Department's Agricultural Research Service any unusual conditions suggestive of a communicable disease when found on antemortem or postmortem inspection. This information concerning the disease conditions found at slaughtering plants and traced back to the origin of the animal is of great value in assisting Federal and State officials in controlling and/or eradicating communicable diseases of livestock and poultry. This is especially true with such diseases as tuberculosis, cysticercosis, hog cholera, anthrax, vesicular diseases, Newcastle disease, duck plague, and fowl cholera.

Adequate meat and poultry inspection programs provide controls that will assure against the contamination of the product by unacceptable additives, residues, or contact materials. Today chemicals are widely used in nearly every type of livestock and crop production. These include a large number of pesticides, antibiotics, fungicides, growth regulators, and chemicals designed to increase the feeding efficiency and health of livestock. They are essential tools of production. Improperly used, however, they can be harmful or even dangerous. The greatest problem in meat animals is presented by the pesticides with which animals are treated directly or which they ingest in forage and feed. Of the pesticides, those chemicals belonging to the chlorinated hydrocarbon group are most troublesome because of their properties of persistence and accumulation.

For adequate public protection and assurance of a wholesome meat and poultry supply, there must be a continuing program designed to identify those areas (both domestic and foreign) where residue problems might exist. Laboratory service is necessary to detect these residues. This service must be combined with continuing and positive field control methods.

Our Consumer Protection Program continually monitors the tissues of animals and poultry for insecticide, chemical, and drug residues. The program provides information regarding residues in the edible tissues to aid in (1) the determination of the incidence and amount of residues present, (2) the determination of compliance with established tolerance limitations and withdrawal periods, and (3) the determination in the control and elimination of residue problems arising from unanticipated and unavoidable sources, as well as from misuse.

The wholesomeness of meat in trade should not be subject to question. Each country should assure this by assuming full responsibility for meeting accepted standards. Above all, each country should conduct its inspection program so that meat products offered for export will need only minimum reinspection by importing countries. It is good for trade, both ways, when there is reliable assurance that the products are derived from healthy animals and birds, are produced under modern sanitary standards, and are completely wholesome, unadulterated, and truthfully labeled.

PUBLIC HEALTH IMPLICATIONS ASSOCIATED WITH THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

2. PREVENTIVE MEASURES—THE UNITED STATES

BENJAMIN D. BLOOD, D.V.M., M.P.H.

Prevention of the spread of transmissible diseases of livestock to and from the United States is a responsibility of the Secretary of Agriculture. According to the applicable law (*1*):

> The Secretary of Agriculture shall have authority to make such regulations and take such measures as he may deem proper to prevent the introduction or dissemination of the contagion of any contagious, infectious, or communicable disease of animals from a foreign country into the United States . . . and to seize, quarantine and dispose of . . . any meats, hides or other animal products coming from an infected foreign country . . . whenever in his judgment such action is advisable in order to guard against the introduction or spread of such contagion.

The responsibility thus outlined is carried out by the Animal Health Division of the Department of Agriculture under the terms set forth in Federal Regulations (*2*). The diseases of specific concern are rinderpest, foot-and-mouth disease, fowl pest, Newcastle disease, and African swine fever, and the prescribed requirements and procedures are designed and applied for them. It is especially noteworthy however, that the measures taken with respect to those diseases are such that they serve also to prevent the introduction of most other transmissible diseases of domestic livestock, including the vast majority of the diseases classified as zoonoses. There are some 175 disease entities shown in the latest list of zoonoses, prepared by the U.S. Public Health Service (copies of which are available for distribution).

The preceding speaker, Dr. Robert Somers, has mentioned the volume of this country's foreign trade in meat products. It is interesting that the amount of animal products not intended for human food that are imported into the United States equals or exceeds our imports of meat and meat products. Well over one billion pounds of animal products not for human consumption are brought into the United States each year. The variety and amounts of such products imported during 1967 are shown in Table 1. The public health implications of the work of the U.S. Department of Agriculture's Animal Health Division in the international movement of food animals and animal products are indeed very great.

Such products as hides and skins, wool, hair and bristles, bones, bone meal, horns and hoofs, tankage and blood meal are in demand not only for agriculture but also for industrial purposes. Fortunately, the industrial processing of these products is usu-

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ally such that disease agents are destroyed, but that is not always the case.

Feathers and down are allowed entry by the Department of Agriculture if they are reasonably clean and free from blood, fecal matter, or other contamination. Such products are used principally by the bedding and upholstered furniture industries, which are subjected to special public health regulations in several states.

TABLE 1. U.S. imports of animal products (not for human food), 1967.

	Pounds
Hides and skins	112,887,330
Animal casings	24,186,464
Wool and hair	338,572,196
Bones and bone meal	113,311,689
Gluestock	36,094,925
Meat meal (tankage)	6,818,431
Horsemeat	41,319,657
Dried milk products	116,162,427
Glandular products	855,555
Soluble dried blood	2,375,680
Miscellaneous	279,900,879
Total	1,072,485,233

SOURCE: Data provided by the Animal Health Division, Agricultural Research Service, U.S. Department of Agriculture.

Many thousands of pounds of various foreign animal glands, originating from all parts of the world, are being imported for use in the preparation of pharmaceuticals. These include insulin from the pancreas, numerous hormones from the pituitary gland, livers for the preparation of products used in the treatment of nutritional deficiencies, and ox bile for the preparation of cortisone. These are only a few of the many products prepared from glands. Fresh animal glands are considered to be an especially dangerous class of imports. They arrive fresh chilled or frozen, and are allowed entry only in leak-proof containers for shipment directly to approved establishments for processing by specified procedures.

As mentioned earlier, the particular concern of the U.S. Department of Agriculture is with those products that come from countries where foot-and-mouth disease, rinderpest, and certain other virus diseases are known to be present. Accordingly, unless it has been possible for effective and acceptable processing to have been done in the country of origin, animal by-products from the infected countries are permitted entry only under restrictions.

In the case of bones, horns, hoofs, and bone meal, usually imported for agricultural uses, there is the additional risk of anthrax. Since anthrax is known to occur all over the world, all bones and bone products are permitted entry only under restrictions intended to prevent the further incidence of anthrax in our livestock. Lather brushes made from animal hair or bristles presented for importation are subjected to careful sampling and laboratory examination by the Public Health Service to determine their freedom from anthrax spores.

Restricted importation, as defined by the Department of Agriculture, involves the inspection of the cargo at dockside, supervision over the loading of the restricted products onto railroad cars or motor trucks, sealing of the transporting vehicles with government seals, and release of the shipment to processing establishments previously approved by the Department's Animal Health Division. The processing must be done so as to preclude the spread of disease-producing agents. Residues incidental to such processing, including effluents, must be safely disposed of in order not to contaminate surrounding areas. Provision must be made for cleanup and sterilization within the establishment.

It is not practicable to provide direct supervision over the actual processing of restricted animal products in the establishments presently approved for their receipt and handling; accordingly, the Animal Health Division has designated representatives of the establishments who are held

responsible and are checked by frequent unannounced visits of inspection.

Animal products may arrive for entry at ports where U.S. Customs Service is located, and no prior permit for their importation is required. The U.S. Customs now serves some 400 points of entry into this country. These include 289 regular ports of entry and many other substations and satellite ports. Air shipments pose the greatest problems because, in an emergency, the port of entry can be any airport capable of receiving the aircraft.

Air shipment of livestocks and perishable animal products was developed commercially following World War II and has steadily increased since then. In 1946, there were 47 airports of entry, 16 airports at which landing rights were granted for regularly scheduled international flights, and an additional 19 air terminals at which emergency landing rights had been granted (*3*). At that time, most of the air freight was carried in DC-3 aircraft, and it is interesting to examine the freight potential of that airplane in comparison with a modern air freighter. The effective capacity of the new Super DC-8-63F is 110,000 pounds. To fly that amount of cargo across this country in the DC-3 would require 16 trips, 128 landings, and 99 pilots. The Super DC-8 does it in one trip with two landings and three pilots. The DC-3's in order to move that amount of cargo would burn fuel costing more than $8,000, as compared to a fuel bill of a quarter of that amount for the Super DC-8.

As to importations of meats, there are no restrictions—beyond those mentioned by Dr. Somers under the Meat Inspection Act—from countries free from foot-and-mouth disease and rinderpest. However, from the infected countries, only certain meats that have been cured and dried so that they may be stored and handled without refrigeration are permitted unrestricted entry. Cooked meats may come in from the infected countries for consignment to approved meat processing establishments under specified restrictions. There are no restrictions on commercially canned meats.

With the increasing number of foreign vessels coming into United States ports each year, there is a corresponding problem in the presence on board of prohibited animals. Such animals are sometimes carried as sea stores, although this is not common now that adequate refrigeration generally is available for fresh meat products. But frequently prohibited animals are carried as pets or mascots by the ship's crew, and this always creates a difficult situation when it comes to the destruction and disposal of the animals. U.S. Public Health Service inspectors are the first to board foreign vessels. They cooperate closely with the Department of Agriculture and promptly report the presence on board of prohibited animals. U.S. Department of Agriculture inspectors then make immediate arrangements for disposition of the animals.

Prohibited animals aboard incoming aircraft present a special problem. Planes must be landed and disposition of the animals cannot be made, as in the case with ships, before actual arrival at the port. Slaughter must then be done in such a place and under such conditions prescribed by the inspector so as to prevent the dissemination of disease. Usually this is done aboard the aircraft and special attention is given to the disinfection of the plane and any other space or equipment that could possibly have become contaminated.

Many vessels carry prohibited meats at sea stores, and this results in meat scraps in ships' garbage. Our inspectors in boarding the vessels make certain that such meats are not landed and also supervise the landing of garbage containing meat scraps. When garbage must be removed from a vessel, it is done only under supervision and then only

for incineration. Garbage may, however, be held on board vessels in tight-covered containers for later disposition at sea.

Procedures for processing various restricted import products are based, insofar as possible, upon the normal plant operations for handling the material and at the same time prevent this material from being the source of livestock or poultry diseases. These procedures include the following:

Pharmaceutical Products Heating the product for specified periods of time is considered necessary to inactivate any foot-and-mouth disease virus that may be present. The heating of a product throughout to a temperature 156°F, or higher for at least 15 to 30 minutes is considered adequate to destroy any disease agent of concern.

In the foreign country, if the product is finely ground and the pH is adjusted to 5.5 or less for a period of at least 4 hours in the presence of at least 30 per cent moisture before drying takes place, the product is then considered safe. Small samples are collected from each shipment for our examination to determine eligibility of the product.

Wool. The destination establishment during the normal processing, washing, and bleaching must subject wool to a caustic wash or to heat temperatures which we believe will destroy disease agents that may be present.

Bones, Horns, and Hoofs. These items are often imported for processing into bone meal, animal feeds and other products as well as for souvenirs, trophies, or as consignments to museums.

During the manufacture of animal feed containing bone we consider 250°F for at least 2 hours to be adequate. During the manufacture of gelatin and glue the acidulation process is considered adequate to destroy any virus with which we are concerned. Boiling of bones for 1 hour in a 2 per cent solution of sodium hydroxide is considered adequate when they are to be used in the manufacture of knife handles, buttons, dog toys, souvenirs, and the like.

Hides and Skins. The normal procedures of liming and bating during the manufacture of leather, also the 24-hour soak in a 1/10,000 solution of sodium bifluoride is considered safe for handling restricted hides and skins to prevent the introduction of virus or other disease agents.

The importation of animal semen is allowed only by special permit from the U.S. Department of Agriculture Animal Health Division, and under such conditions as the Division may require in preventing the dissemination of any communicable disease of livestock or poultry into the United States.

A few words about the export of animals and animal products from the United States: Livestock must be inspected, found free from disease, and a certificate to that effect turned over to the Collector of Customs at the port of embarkation. This is known as the minimum export requirement. No such minimum requirement applies for animal products. However, special additional requirements, either for livestock or animal products, may be applied at the request of the country of destination.

The measures taken to prevent the introduction of diseases into the United States through importation of animal products have been remarkably effective. Yet with the shrinking of travel time between countries and the increasing of international trade, it becomes more and more difficult to maintain the defensive measures described. The time is at hand to supplement—and perhaps eventually replace—those defenses with well-planned offensive campaigns to eliminate animal diseases wherever they exist. This will require a degree of international cooperation far beyond anything we have seen, but I am confident that it is not only desirable but also reasonable.

REFERENCES

(*1*) February 1903–32 Statutes 791 (21 USC 111) Section 2 (Extract).
(*2*) Code of Federal Regulations, Title 9 (Animals and Animal Products) Parts 91, 92, 94–96.
(*3*) Blood, B. D. "Veterinary Sanitary Problems of Air Transport." *JAVMA*, 110:1–8, 1947.

PUBLIC HEALTH IMPLICATIONS ASSOCIATED WITH THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

3. PREVENTIVE MEASURES—LATIN AMERICA

BORIS SZYFRES, D.V.M.*

Many important zoonoses were first introduced into the New World along with their domestic animal hosts. The international movement of animals and animal products continues to be the principal factor in the spread of etiologic agents from one geographic area to another. Other vehicles potentially important in spreading zoonoses are biologics, including immunizing agents as well as products used for diagnosis and research, and wild animals introduced for sport purposes or biologic control.

Nearly all countries have promulgated legislation to protect their countries against the importation of exotic diseases and to prevent new introductions of pathogens which already exist to some degree within their national limits, through animals or contaminated products. The effectiveness of this legislation is dependant to some extent upon the quality of the veterinary services in each country, the number of veterinarians and the quality of the training received by them, diagnostic laboratories, quarantine facilities, and other factors.

Measures taken by individual governments fail to offer complete security. With modern transportation exotic disease agents can be spread from the most distant geographic areas by animals, human beings, vectors, and fomites. The Committee on Foreign Animal Diseases under the chairmanship of Dr. Frank A. Todd, in its report to the U.S. Livestock Sanitary Association (*1*), stated: "Under the conditions of modern transportation, however, it is practically impossible to prevent permanently the introduction of any animal disease into any part of the inhabited world if the infection is prevalent in another part." This point merits special emphasis because transportation continually becomes more rapid. International coordination and collaboration offer the best answer towards the solution of this problem. The world's distances have become so short that before long a foreign disease could be one's own.

It is not necessary, however, to use the argument of jet or ultrasonic planes to illustrate this point. The danger of introducing or reintroducing diseases has always existed. There are many examples of disease introduction by sea, river, or land. An example is the reintroduction of canine rabies in Uruguay in 1964. Even though the dog is excluded from this session of the Symposium, which refers to animals for human consumption, we are taking the liberty of including this example because canine rabies is an

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important zoonosis and the movement of dogs is a constant threat to human health. Insular countries such as Great Britain, Australia, and New Zealand, because of their geography, have been able to maintain their countries free of rabies. Countries with large land frontiers cannot establish a reliable animal transit control. It is difficult under such conditions to supervise the movement of cattle, sheep, and swine, and it is nearly impossible to maintain vigilance against the movement of stray dogs across large borders. Uruguay eradicated rabies from its capital city, Montevideo, in 1944; during the following 20 years throughout the country there were only occasional outbreaks along the Brazilian border (*2*); rabies was considered an exotic disease. Diagnostic laboratories were dismantled, and physicians were not clinically familiar with the disease when the infection was reintroduced in 1964. It was impossible to determine how reintroduction occurred—from Brazil by land or Argentina by river. The dog population in Montevideo and the rest of the country was highly susceptible and the infection became widespread before control measures were initiated. In 1964, 10 cases of dog rabies were registered (*3*), 282 in 1965, 516 in 1966, and 29 in 1967 (*4*). Due to the lack of awareness of the medical profession, the first human case was erroneously diagnosed, and prior to the illness the patient did not receive the appropriate prophylaxis. The population was also unaware of the hazards of this disease, and another human case occurred because the parents of the bitten child failed to notify the health authorities.

This experience in Uruguay serves as another example of the need for a common effort and coordinated action at an international level for the control of the zoonoses and other diseases. Towards this end, besides directly supporting the control measures of the Uruguayan Government, the Pan American Health Organization (PAHO) is promoting rabies control in the neighboring areas of Rio Grande do Sul, Brazil, and in the city and province of Buenos Aires, Argentina. A similar action is being carried out along the Mexican-U.S. border with the collaboration of the two Governments and of PAHO.

The danger of the introduction of a rapidly spreading exotic disease into an uninfected area must be faced jointly by all the countries comprising that area. To deal with this danger, an active regional technical-administrative organization is needed, which can coordinate and develop with the countries concerned the legislation and operational measures needed without depending upon the slower diplomatic mechanism. In 1949 Uruguay proposed a conference of members of the South Atlantic countries, to adopt legislation and common measures to protect their developing poultry industries against the introduction of Newcastle disease. At that time, Argentina, Brazil, Paraguay, and Uruguay were free of the infection. Attempts to convene this conference through diplomatic channels were delayed and postponed until Newcastle disease was introduced into Brazil and then into Argentina, thus eliminating the reason to convene. Fortunately, in 1964 the Regional Technical Commission on Animal Health (COTERSA) with the representation of Argentina, Chile, Brazil, Paraguay, and Uruguay was organized. Bolivia and Peru are soon to become members. This Commission, which we hope will soon include all the South American countries, meets twice yearly and develops accords on methods to keep its countries free from exotic diseases, to standardize diagnostic methods, to control procedures, to regulate intercountry animal transit, to establish procedures for the control of biological products, and to formulate legislation on meat hygiene and other products of animal origin.

A similar commission, the International Regional Organization for Health in Agriculture and Livestock (OIRSA), exists in Central America and Panama.

The Pan American Zoonoses Center has high hopes for the work of these regional organizations and collaborates with them actively, especially with COTERSA. The common defense necessary against an exotic disease, such as failed in the case of Newcastle disease, today would be easily carried out by an agreement within COTERSA.

A factor of great importance in the international movement of animals is the standardization of antigens and diagnostic tests. In the past there has been a wide variation in antigens and testing procedures in regard to brucellosis and tuberculosis in the different countries. Animals reported free of the infection by the exporting country were found to be reactors by the importing country. In 1959, 66 recently imported cows were tuberculin-tested in the milk shed of Asunción, Paraguay. Of the 66 animals, 17 (25.7 per cent) reacted positively, and tuberculous lesions were found in 11. This type of problem is more frequent in regard to brucellosis, not only because of differences in antigen sensitivity and test interpretation but also because of a lack of intercountry agreements for the acceptance of animals vaccinated with *B. abortus* strain 19 vaccine.

The Pan American Zoonoses Center since its inception has had as one of its purposes the promotion of the standardization of *Brucella* antigens. In this connection, it produces and distributes reference antigens to member countries and performs quality control tests on antigens elaborated in other countries. It also provides training for microbiologists in the production and standardization of antigens. The Center's program includes the establishement of a pilot plant for production of PPD (purified protein derivative) tuberculin for use in bovines. This plant will be used for training, production of a reference product, and for special projects. In this way, the Center and the regional agencies work together in preventing the transmission of important zoonoses from one country to another.

Although some zoonoses, such as brucellosis and tuberculosis, present problems which can be solved relatively easily in respect to the international movement of animals, there are others, such as leptospirosis, in which there are difficulties in establishing rules for animal interchange due to the lack of criteria and practical methods to determine when an animal should be considered infected.

Products of animal origin constitute another important vehicle of pathogens for animals and for man. Among these pathogens not only the zoonoses should be included but also human infectious agents that occasionally can contaminate animal products. The salmonellas constitute the most important problem in the international transport of infectious agents by food. In recent years a considerable increase in the reported incidence of human salmonellosis, generally due to nonindigenous serotypes for man, has been noted throughout the world. *Salmonella* serotypes previously unknown locally have appeared in many countries (*5*). These pathogens have been introduced by products for human consumption and/or for domestic animal food. Developed as well as underdeveloped countries are responsible for the spread of these pathogens. In the near future, this problem could be reduced by carrying out a better sanitary supervision of the elaboration process for products of animal origin, beginning with the entrance of the animal or the product into the processing plant until the process is completed and the final product is being transported, In the near future the Pan American Zoonoses Center will establish a food microbiology laboratory to cooperate with

member countries in problems related to the contamination of products of animal origin.

Quarantine measures are important in preventing the introduction of animals and animal products which are a threat to human health, but they do not solve the problem as a whole. Scrapie, blue tongue, and *Rhipicephalus evertsi* have recently passed (*6*) undetected through the international quarantine in the United States. Newcastle disease has spread to almost all the American countries in recent years. The most important pathogens should be attacked in their habitat with international collaboration, and in this way the risk of their international spread will diminish. In this sense, the criteria followed by the Inter-American Development Bank is very promising since it is willing to grant long-term loans for multinational projects on animal disease control, such as foot-and-mouth disease, brucellosis, tuberculosis, and bovine rabies.

Cooperation, such as that between the United States and Mexico to eradicate foot-and-mouth disease in Mexico and prevent its entrance to the U.S. and the canine rabies control program along the U.S.-Mexican border presently underway, should be extended to other diseases among the American countries.

In planning for the prevention of the introduction of exotic diseases, the need for trained epidemiologists and well-equipped laboratories with competent personnel for diagnosis and research should also be considered.

In summary, our recommendations are to establish:

1. Regional agreements for common protection against the introduction of exotic diseases;
2. A Pan American agreement to standardize antigens and diagnostic tests for the most important zoonoses;
3. Multinational programs for the control of the most important zoonoses, such as brucellosis, tuberculosis, and rabies; and
4. Training of personnel in epidemiology and diagnosis.

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PUBLIC HEALTH IMPLICATIONS ASSOCIATED WITH THE INTERNATIONAL MOVEMENT OF FOOD ANIMALS AND ANIMAL PRODUCTS

4. THE SITUATION IN CHILE

ENRIQUE MORA, D.V.M.*

The public is already aware of the fact that partial approaches to health problems are meaningless unless they are considered within the overall context of the socio-economic development of countries.

The standard of living of the countries should be based on education, housing, and health, and in order to maintain health it is essential to provide foodstuffs for the population in sufficient quantities.

One of the constant characteristics of developing countries is the marked contrast that exists among the various groups that comprise their populations.

In the field of nutrition, particularly with regard to animal products, this is especially evident. Thus, in a study of the consumption of meat by the various strata of society, in Chile, it was found that, while the annual per capita consumption of meat in the working class group was only 18 kilograms, the middle class ate 31 kilograms, and the annual per capita consumption in the highest level of society amounted to 163 kilograms. It should be noted that average annual consumption of meat (33.9 kilograms per person) still falls short of the 37 kilograms (exclusive of fish and seafood) established as the target by the National Health Service of of Chile. It is obvious that meat production is insufficient in our country.

The reduced purchasing power of most of the population should also be emphasized. Because of the geographic characteristics of Chile and the distribution of its population, most Chileans are cut off from the areas that produce animal protein. This is particularly true in the case of milk and beef and renders difficult the uniform distribution of such production. This has compelled the country to maintain imports of animal products and foodstuffs, the value of which accounts for approximately 20 per cent of the total foreign exchange used in foreign trade.

Before analyzing such imports, we should consider certain aspects that impede the achievement of self-sufficiency in a sector as important as that of nutrition. Generally speaking, producers of foodstuffs fall into three principal categories: small, medium, and large-scale. They share a common characteristic: they do not possess a social awareness of their role or of their contribution into community development. Although it is true that it is important, and indeed essential, that their operations be profitable, the need for them to play the

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role which they themselves have assumed within general productive activities cannot be ignored.

In the case of large landholdings, it is possible that operations—albeit under deficient conditions—will produce more than sufficient income for covering the needs of the owner and his family. Consequently, he is not interested in larger and better production.

At the other extreme is the small landholding, which barely covers the food and sustenance needs of the family group and contributes only in very small measure to the food needs of the population.

Perhaps the major contribution to the production of foodstuffs of animal origin is to be found among medium-size producers. They are compelled to maintain intensive operations in order to achieve maximum production in terms of tillable area and animal units.

All producers are affected by government price-fixing, which compels them to maintain prices that will make foodstuffs relatively accessible. Sometimes this goes beyond all possible restriction of profit margins and, consequently, becomes a decisive factor in the low production of foodstuffs and animal products.

Over the years efforts have been made to cover protein deficiencies through the consumption of fisheries products, but such efforts have run counter to the deep-rooted nutritional habits of the population.

The usages and customs of the developed countries have influenced the requirements of the community so that it is faced with a dilemma: the apparent conflict between quality and quantity. We have referred to the impact of the volume of imports of foodstuffs on the national economy; day by day, requirements with reference to quality also increase, leading logically to restrictions on the availability of nationally produced animal products.

The imbalance that exists in Chile between production and consumption makes necessary the development of adequate technology which will permit preservation of the quality that is sought so assiduously. However, such technology entails a larger investment, which would multiply costs at a time when the volume of production is not large enough to make such an investment profitable.

In accordance with existing legislation, control of imports of foodstuffs of animal origin which have not been processed industrially is entrusted to the Ministry of Agriculture, and entry into the country of foodstuffs that have been processed in the countries of origin is controlled by the Health Service authorities. This not only entails the existence of two agencies, performing very similar functions, but also the use of two different methodologies for control. While most, if not all, inspections carried out by officials of the Ministry of Agriculture are subjective and apply only to the organoleptic character of the products in question, those carried out by the Health Service consist, principally, of chemical-bromatological analysis and even bacteriological inspection.

Regardless of the preceding considerations, all foodstuffs are controlled by Health Service personnel after entry into the country. The effectiveness and importance of the initial analysis by the Ministry of Agriculture, with a view to avoiding public health dangers, is open to question.

Let us consider developments in the field of imports of meat and other animal products at the three customs ports of entry of the country. As indicated in Table 1, the major impact is created by imports of cattle on the hoof enroute to slaughterhouses. The principal reason for this is that, until recently, the methods employed for preserving chilled meat and the available storage capacity did not permit the creation of stocks

TABLE 1. Imports of animal products and by-products, Chile, 1967.[a]

Product	Quantity	Value (in escudos)
Chilled meat	14,493,800 kg.	47,787,404
Meat extracts	11,600 kg.	311,609
Pure gelatine	7,000 kg.	48,171
Lard (hog)	6,179,910 kg.	8,751,778
Fat (cattle)	4,050,288 kg.	4,003,806
Grease (cattle)	1,556,477 kg.	1,920,820
Frozen poultry	477,789 kg.	1,387,299
Hides (cattle)	11,311,251 units	25,890,776
Wool (sheep)	1,632,578 kg.	18,173,214
Wool (alpaca)	12,300 kg.	256,025
Yearlings on the hoof, enroute to slaughterhouses (estimated)	225,500,000 kg.	63,361,698
Total		171,892,600[b]

[a] At three customs ports of entry (Santiago, Valparaiso, and Los Andes).
[b] On the basis of US$1 = 5 escudos, the total value of the imports is US $34,378,520.

for regulating the market. In the past large quantities of such meat were lost because of faulty preservation processes. Meat that had originally been chilled was frozen. Prior to sale it was unfrozen and then chilled in order to make it presentable. Furthermore, in view of the fact that most of this production was sold as fresh meat, one can readily understand that it did not keep long and that most purchasers soon stopped buying it.

It should also be borne in mind that imports of already processed products resulted in unemployment of personnel of the slaughterhouses in the most important urban centers, a situation which was untenable for obvious reasons.

These imports of cattle on the hoof create two types of problems, indirectly related to public health: (1) because of the lack of adequate and sufficient quarantine stations, there is the possibility of introducing into the country diseases that are either controlled or nonexistent in the national territory; and (2) such imports have a serious impact on the sale of national cattle, as they compel the producer to hold his cattle back from the market in the hope of obtaining better prices, with a resultant increase in prices of meat.

In summary, it may be stated that such imports have the following effects on public health in Chile:

1. They affect national production of foodstuffs, by permitting government maintenance of prices, thereby retarding the development of agriculture.
2. Backwardness in agriculture results in reduced consumption in an important segment of the population.
3. Such imports create complex problems in health activities pertaining to the hygiene and control of foodstuffs.
4. They create the possibility of introduction of animal diseases that do not now exist in the country or that may be under control.
5. Insufficient capacity for adequate preservation of foodstuffs impedes the efficient processing and adequate distribution of national and imported products.
6. Such insufficient capacity usually causes outbreaks of food poisoning, because of deficient preservation.
7. Imports facilitate fraud, as they are based on public bidding; suitable quality is not assured, for instance, in the case of poultry meat (for payment of the price of first-class poultry meat the purchaser obtains "C" grade meat).

8. They affect the local market to a marked degree, since in most cases the products imported must be placed on the market rapidly.

9. At present, there are no agencies capable of guaranteeing sanitary quality and composition of foodstuffs in international trade.

In view of the above, we submit the following recommendations for consideration by the participants in this Symposium.

RECOMMENDATIONS

1. Upon agreement with countries interested in exports of animal foodstuffs and by-products, to establish standards governing the following:

Identity, composition, and purity;
Materials used in preparing containers and wrappings;
Labels and names of products;
Methods for sampling, and interpretation of results;
Methods for detecting contaminants, as well as their dosage and tolerance; and
Definition and classification of technological processes and of their governmental control and certification.

2. To establish under the auspices and with the technical assistance of United Nations agencies, such as the World Health Organization and the Food and Agriculture Organization, and with contributions from the exporting countries, Regional Centers with appropriate equipment for providing to these countries advisory services in the following areas:

Proposal of standards for regulating international trade in foodstuffs;
Research related to animal products and by-products;
Permanent study and review of standards;
Training of specialized personnel in the disciplines related to the sanitary quality of foodstuffs, their preservation, and distribution;
Service as reference centers for control of quality;
Compilation, processing, and dissemination of information on volume of production, international trade in animal foodstuffs, prevalence of animal diseases in the countries of the region, incidence of diseases among humans that originate in the infection of animal foodstuffs; and
Maintenance of current information regarding progress achieved in food technology.

Part II

INTERNATIONAL MOVEMENT OF EXPERIMENTAL ANIMALS

KEYNOTE ADDRESS—UNITED STATES

WILLIAM H. STEWART, M.D., M.P.H.*

The subject of this Inter-American Symposium is both timely and highly significant. It represents yet another example of the leadership provided by the Conference of Public Health Veterinarians. The fact that the Pan American Health Organization is a sponsor of this Conference adds another dimension to its importance, for this organization has a most distinguished record in bringing together the health resources of our Hemisphere to work on problems of common concern.

To people outside the health field, the subject of our concern and the title of this Symposium may seem a bit bizarre, yet man's destiny and his health have been interwoven with our fellow creatures since before the dawn of history. Man the hunter followed the herds. Man the herdsman brought his animals with him. Man the soldier has fallen victim to the diseases borne by animals, through the long sweep of history, fully as often as he has fallen before his human enemies. Now, that most recent development, Man the Scientist, has found among the animals one of his greatest sources of knowledge and insight.

With this advance, as with so many others, has come an accompanying hazard. Animals for use in scientific research have become an important item in international commerce. They carry the potential threat of disease. We were forcefully and tragically reminded of that hazard last year in the episode that brought death to seven laboratory workers in Germany as a result of the importation of green monkeys from Uganda. Clearly, as the number and variety of animals involved in international movement increase, the threat increases proportionately unless we take swift and constructive action to counteract it.

It is interesting to note in this connection that the very beginnings of public health are closely related to commerce and international movement. Our base of action in this field is long established, going back to the 17th century when the commercial nations of the world, lacking the scientific capability to prevent epidemic disease, sought to check its spread by quarantine procedures. Today, although our biomedical knowledge has increased manyfold, we still find that new developments in commerce pose new challenges to health. As our sophistication grows, we are moving away from the traditional practices of erecting barriers to international movement. But the problems are always with us, in constantly changing forms.

Thus, it is most appropriate that the Pan American Health Organization should be instrumental in bringing this group together for this purpose. The countries of our Hemisphere are firmly joined together in a mutual effort to improve the living conditions of all our peoples as rapidly as possible. In our era, for the first time, humanity possesses the knowledge and skill to relieve its suffer-

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ing: science and technology have given us the tools to combat the ancient ills of poverty, ignorance, disease, hunger, and overpopulation. We must now seek the wisdom to exploit our achievements properly and to control the unwanted by-products of progress.

Ironically, our technological tools have sometimes proved the instruments of our frustration. Progress is not always an unmixed blessing. Ralph Waldo Emerson remarked on technology's tendency to master man when he wrote a century ago, "Things are in the saddle and ride mankind." This Symposium, the first of its kind, signalizes an effort to put men back in the saddle where they belong. Specifically, we must devise courses of action that will mitigate the effects of the demands of science and the technology of the jet age on the transmission of disease before there is another deadly animal-related health incident.

We have an old adage that an ounce of prevention is worth a pound of cure. This is an extremely important concept in the development of public health planning, both on the national and international levels. Perhaps the best-known efforts at international disease control in this Hemisphere have been directed against yellow fever, malaria, and smallpox. The Pan American Health Organization is now undertaking a major effort in the fight against zoonoses, including foot-and-mouth disease, spearheaded by two international research centers.

Turning to the specific problem on your agenda for today, there are several ways to measure its importance and scope. Measured along the axis of hazard, we know that there are over 175 infections and diseases of animals that are transmissible to man under certain conditions. There may be many more to add to the familiar list that includes plague, typhus, encephalitis, tuberculosis, brucellosis, and rabies. Every animal that moves from one country to another, whether as a pet or for experimental, food, or exhibition purposes, presents a potential hazard. Every species newly exploited for scientific purposes represents an unknown quantity.

Yet such exploitation will surely continue and grow in the years ahead, for it is evident that the most important scientific advancements in the next decade will come through man's understanding of biological processes. And animal experimentation, which seeks to elucidate the complex actions and interactions of biological systems on all levels from the submolecular to the intact animal, will be the key to these coming advances.

We have vast, untapped potential resources for animal research. It is estimated that there are over 1,200,000 species of animals. Relatively few of these have been used for experimental purposes. Among these, several which possess unique biological characteristics have proved of great value in research. The electric eel's ability to produce high action potentials was important to studies in nerve physiology; the axion of the giant squid advanced our understanding of nervous function. The ability of the camel, the kangaroo rat, and the hare to withstand high environmental temperatures elucidated the mechanisms of temperature regulation. There must be untold numbers of other animals with special characteristics which would provide equally useful new knowledge if they were studied.

Moreover, it is increasingly apparent that for most human diseases, similar or identical diseases exist in some species of animal. Animal disease models, resulting from such factors as genetic mutations, acute or chronic infections, toxic agents, nutritional or metabolic imbalances, and degenerative processes, have proved important to the understanding of human health problems. For example, work with the cebus monkey (an experimental animal imported from South America) proved that atherosclerosis could be produced by diets with elevated serum lipids.

It then became possible to evaluate the effects of the modification of the diet on these processes. Muscle disorders in the chicken and horse are particularly productive models for research on human muscle disease.

Animal studies led to the first use of the anti-inflammatory drug, cortisone, in the treatment of rheumatoid arthritis. Subsequent animal investigation searching for more effective treatments of arthritis led to the development of steroid therapy, and eventually to the discovery of a new non-steroidal anti-inflammatory agent called indomethacin. As a result, many people who would otherwise have been completely or partially disabled have resumed productive lives.

Animal research has been instrumental in advancing man's long struggle against malnutrition. Most of the 50 known dietary essentials discovered since the first coining of the word "vitamin" in 1911 were identified through animal experimentation. Continued research at more and more sophisticated levels has led to the development of new foods, like the cereal mixture, Incaparina, which serves as a substitute for animal protein. The discovery that wheat enriched with the essential amino acid lysine is a practical and immediate way of alleviating protein malnutrition also came through animal research.

Animal experimentation has, of course, been a critical element in the development, testing, and production of vaccines. Indeed, when the green monkey disease was discovered in Germany, our first action was to suspend production of polio vaccine dependent on the kidney tissue of these animals. This temporary suspension received little public attention in 1967; it would have been headline news a few years earlier when the demand was high. As for today's medical headliners, the organ transplants, they are not only built on the foundation of animal experimentation but will depend on similar work for further refinement.

Thus animal research is a keystone of biomedical advance. Consequently, there is a heightened demand for more and better research animals. According to statistics gathered by the Institute of Laboratory Animal Resources, over 58 million laboratory animals were used by the major research institutions in the United States in 1966. These included some 37 million rodents, 13 million marine animals, 4 million frogs, and 2 million birds. They also include 415,000 dogs, 143,000 cats, and 73,000 primates. These figures will surely be higher in the future. How many of these are involved in international movement we do not know, but those numbers also seem certain to increase. Expressed in monetary terms, these millions of animals were valued at about $80 million, and their care cost an additional $210 million. We have estimated that about 64 per cent of the research projects supported by grants from the National Institutes of Health require the use of animals. Extrapolating from that figure, we estimate that the total amount of medical research in the United States which requires animals amounts to over $1 million per year.

How shall this huge and growing enterprise be managed so as to reduce risk and assure continuing scientific progress? That is the challenge before this Conference today and before all of us with an involvement in health protection and research. The response to this challenge which emerges from your discussions can constitute a very important contribution to health. Without presuming to suggest any answers, I should like to sketch out a few directions in which your thinking might be directed.

First, you will be concerned with protecting the health of the laboratory workers and others who are directly exposed to the potential hazard. Experience to date indi-

cates that their best line of protection is the maintenance of high standards of sanitation and precaution in laboratory procedures.

Second, you will be concerned with reducing the risk to a minimum. This is a process involving several stages—careful control of the animals at the source, thorough inspection procedures enroute, and responsible handling throughout.

Third, you will be interested in assuring the supply of experimental animals, both as to quantity and quality. Here it seems imperative to me that we in the health field join forces with conservationists and others so that our demands upon nature do not imperil the survival of species. Too many kinds of animals have vanished from the earth because of man's depredations—it would be irony of the highest order if extinction were the result of scientific endeavor. At the same time we need to explore every possibility for domestic breeding of exotic species to ease the strain on nature, to enhance the quality of research animals, to reduce costs of transportation, and of course to reduce the possible transmission of disease.

All of these courses of action are easier to describe than they are to carry out. I am sure that all of you in your respective countries share, to a greater or lesser extent, the complex problems that we are constantly grappling with in the United States. The fact that at least four major departments of our Federal Government are rightly and necessarily involved in matters associated with the international movement of animals is one of many demonstrations of this complexity. Modern problems refuse to be neatly compartmentalized. They won't fit the boxes on our organization charts.

Therefore each of us has an added, unwritten responsibility, over and above his normal professional duties—the responsibility to work in close collaboration with a growing number and variety of colleagues, representing many interests and disciplines. True cooperation is hard work. It involves a willingness to learn, to share one's own knowledge, and often to sacrifice prerogatives in a common cause.

The Pan American Health Organization and the Conference of Public Health Veterinarians have already written many fine chapters in the history of true cooperation across both national and disciplinary lines. This Symposium opens the door to another important field of mutual endeavor.

KEYNOTE ADDRESS—MEXICO

PEDRO DANIEL MARTÍNEZ, M.D., M.P.H.*

The problem posed for public health by the international movement of livestock and other animals is not an exception, nor could it be. It is a problem, like others of similar nature, whose solution depends much more on national health conditions than on the ordinances and dispositions which may be established to regulate international transit.

But it would be difficult to find another example more characteristic and demonstrative of the fact that national health measures should be adapted not only to the circumstances of the country but also to the requirements of other countries. In the sense that the health of the individual depends on community health in general, so national health depends on international conditions. Neither in man nor in animals is it possible for us to attain an ideal and complete state of health; we can only follow, and must do so, the health program which offers the most benefits for all, in conformity with the dynamics of life at each of its various levels—individual, national, and international—and in each of the historic moments of our peoples.

The struggle of public health is neither romantic nor emotional. It is a rational task based on the conditions and the objectives of our lives. It is not a static and rigid process but a changing phenomenon that constantly adapts itself to social dynamics.

The planning of health programs therefore requires constant and permanent revision, the interchange of information, the coordination of efforts, and adjustment of objectives in the interests of all. Public health programs strengthen international solidarity to the degree that they are based on reality, with vision extending beyond political boundaries, because, apart from being more efficacious, they tend to augment the interdependence of countries through the specialized character of their functioning.

Because of this I am happy and privileged, in the name of Mexico, to express our thanks to Dr. William Stewart, Surgeon General of the Public Health Service, United States of America, and to Dr. Abraham Horwitz, Director of the Pan American Sanitary Bureau, for extending to us their kind invitation to take part in this important meeting.

It is not the first time Mexico has benefited by this policy of mutual cooperation. Our country is pledged to carry out a national public health program which will raise the level of living conditions and welfare of our people and at the same time contribute to the attainment of the objectives established by other countries of the Americas. It is particularly appropriate to emphasize at this moment the constant interest and genuine cordial collaboration which we have received from the U.S. Public Health Service in the development of public health measures capable of solving the problems with which both countries are faced. I am convinced that the progress and results we are obtaining justify our optimism. The enthusiastic and efficient cooperation of the Pan Amer-

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ican Health Organization ensures, moreover, the full success of our efforts.

The interchange of experiences, the frank discussion of differing points of view, and the eventual agreement for coordinated action are sufficient by themselves to explain and justify this meeting, but, in addition to these immediate benefits, others will undoubtedly become manifest in the future. Among these future benefits, the remodeling of our health structures stands out by its importance, since the prevention of the transmission of diseases through the international movement of animals depends not only on established programs but also on available facilities, both in the field and in the ports of entry, for carrying out the indispensable physical and laboratory examinations and complementing specific studies in conformity with regulations and established priorities.

The international transit of animals and their products is becoming both more intense and more complex. Between the United States and Mexico there exists not only an immense bilateral flow of human beings but also a heavy transportation movement of all classes of animal life, from ocean products, cattle and livestock, fowl and poultry, and domestic animals to wild and exotic types of animals.

Commercial, recreational, scientific, and cultural interests motivate this current, which carries with it the possible spread of various diseases. Some of these diseases are capable of generating economic disaster, others, human disability and death; others can upset and ruin programs of scientific investigation and the production of biologicals destined for health protection. In all these diseases the common and frequent characteristic is the extent of their impact as a consequence of mass methods of industry in general, of rapid transportation, and of favorable epidemiological conditions.

I consider that a knowledge of the national situation in relation to animal health conditions and a recognition of the consequences that international transit of animals can entail for public health calls for a coordinated and systematic study with the highest priority, as the only means of drawing up an intelligent program within the complex of animal pathology, economic interests, cultural interests, research interests, and those interests proper to public health itself.

It is clear that these studies (and also the planning, organization, and execution of such programs) require, above all, well-trained veterinary public health personnel with creative personalities, capable of looking for and finding the right diagnoses and solutions. Such professionals must be capable of understanding both the animal and human world as an ecological reality which overflows the narrow limits of political confines.

Such professionals, with mentalities free from prejudice, pressure, and dogmatism, can develop only if given the opportunity of active and constant participation in the study and solving of health problems, in exploring the origin of these problems, unraveling their mechanisms, and becoming acquainted with their peculiarities. The majority of public health professionals reach universal stature only when they live and think and work outside national levels. Because of this, I believe that the most important goal to be achieved by this meeting will be the assurance of continued and permanent discussions between interested and responsible professionals.

When all is said and done, although man has dominated to a large degree the animal world, there still remains the difficult task of dominating its diseases, which threaten not only man's health but also his welfare and his progress. This domination must be signified by the conditioning of the animal world to the higher interests of man for the purpose of attaining an optimum ecological

equilibrium, a goal which will be reached not so much just by control of the animal world as by the improvement and perfection of man himself and of his institutions and programs.

This is our common aim. Mexico joins with enthusiasm in the pursuit of such a noble purpose, convinced that the frontiers of our countries will become still more free as the health of our peoples and improvement in our environment continue to reach higher mutual levels.

VIRUS DISEASES OF NONHUMAN PRIMATES*

S. KALTER, PH.D.†

Extensive use of nonhuman primates for biomedical research has resulted in an unprecedented traffic in these animals. Nonhuman primates are now obtained from practically every geographic area of the world and transported internationally, primarily to the United States and Europe. Little is known concerning the biologic impact such redistribution of populations may have on other animal communities or on the animals themselves. It obviously is of sufficient importance to stimulate a conference such as this as well as similar meetings. It may be recalled that the New York Academy of Science held a conference approximately 10 years ago entitled Animal Disease and Human Health (*1*). While the main theme of that conference was not directly related to health aspects as a result of international movements of animals, it was rather apparent that this problem was implied in many of the reports. It is also interesting to indicate that this 1957 conference may be considered as a supplement to a previous New York Academy of Science meeting held in 1947 entitled The Relation of Diseases in the Lower Animals to Human Welfare (*2*).

Several hundred diseases of animals are known to be communicable, and more than half of these are probably transmissible to man. The number of human agents infectious for animals is not known, but many agents are common to man and other animals. Specific information relative to the exchange of organisms between man and nonhuman primates is limited. It is obvious, however, that the health of man is intimately related to that of other animals. It is also important to emphasize that many agents exist in nature which, while not closely related antigenically to human agents, may be considered as their counterparts primarily on the basis of epidemiology, symptomatology, and pathology. How these agents evolved, however, is not the subject of this communication. Our intent is to present data relating to various virus findings in primates (including man), emphasizing their importance as agents of infection. Secondly, an attempt will be made to demonstrate a relationship between shipment of animals and their excretion of viruses.

A number of well-known virus diseases and infections of simians have been recognized and reviewed in the literature (*1, 3, 4, 9-12*). These diseases are apparently

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relatively unimportant for their natural host and only become a problem when they cross the species barrier. Perhaps greatest attention has been given to the *Herpesvirus* group. An example of this is the fatal infection of man with *H. simiae* (Herpes B) transmitted primarily by *Macaca mulatta*, although other species of Asian simians have been incriminated. Another herpesvirus, *H. tamarinus* (marmoset herpes, Herpes T), has been recovered from a number of fatal cases occurring in various New World monkeys—marmoset, tamarins, owl. It appears that the natural host for this virus is the squirrel monkey (*Saimiri sciureus*). No clearly related disease of man due to this agent has been reported. The poxviruses have recently received considerable attention, although the vaccinia-variola complex has been a problem for man and his fellow-travelers for many, many years. A benign infection of monkeys and their handlers with monkey poxvirus has required attention in several centers. Monkey pox will undoubtedly continue to be of concern during the immediate future, although vaccination with vaccinia virus apparently reduces the incidence of disease. A hemorrhagic disease occurring in primates maintained at several centers in the U.S. as well as at Sukhumi, U.S.S.R., has resulted in a large number of fatalities in the monkey colonies (primarily macaques) but fortunately it does not appear to cause overt disease in man. Little will be said at this time concerning chimpanzee-associated hepatitis. Information pertaining to clinical disease of the animals is scanty, although it is now well established that transmission of this virus to man from chimpanzees does occur. The vervet-associated disease occurring in Germany and Yugoslavia has been well described in the recent literature. This outbreak, occurring primarily among individuals working with tissues of the animals, singularly emphasizes the dangers of transmission of infectious agents to man. The interesting epidemiologic story associated with the Germany outbreak ovbiously is related to the theme of this conference.

The material presented herein is an attempt not to emphasize the past but to demonstrate various findings that may be consequential for the future.

MATERIALS AND METHODS

Serological and virus isloation procedures and handling of animals have all been previously described in detail (*5-8, 13*). Briefly, these consisted of using serum neutralization (Nt), complement-fixation (CF) and hemagglutination-inhibition (HI) tests for serologic evidence of past infection with the viruses of human and simian origin. Virus isolation attempts were by standard procedures utilizing kidney cells derived primarily from the baboon (*Papio sp.*), African green monkey (*Cercopithecus aethiops*) and rhesus monkey (*Macaca mulatta*). It should be emphasized that an attempt always is made to use kidney cells from the particular simian species under study. Such cells as may be obtained from the gorilla, orangutan, chimpanzee, and other rare and expensive animals, however, are not always readily available nor forthcoming. Lack of such preparations must be reflected in any attempt to interpret negative isloation results. The possibility exists that an agent may grow only in cells derived from the natural host. Elimination of this shortcoming is not possible inasmuch as a continuous supply of tissues from these exotic primates is simply unobtainable. In addition to primary kidney cell preparations, many serial cell lines of human and simian origin (WI-38, $LLCMK_2$, etc.) are frequently employed to enhance the virus isolation capability.

Primate sera. Sera have now been col-

lected on numerous primates representing Old and New World simians. Many of these sera were made available through the cooperation of several different primate facilities in the U.S. and elsewhere. Sera were collected from sources other than the Southwest Foundation for Research and Education (SFRE), San Antonio from the following primates:

Common name	Genus and species
Man	*Homo sapiens*
Gorilla	*Gorilla gorilla*
Chimpanzee	*Pan sp.*
Orangutan	*Pongo pygmaeus*
Gibbon	*Hylobates agilis*
Gelada baboon	*Theropithecus gelada*
Rhesus	*Macaca mulatta*
Vervet or African green monkey	*Cercopithecus aethiops*
Patas monkey	*Erythrocebus patas*
Cynomolgus monkey	*Macaca irus*
Marmoset	*Saguinus nigricollis*
Owl monkey	*Aotus trivirgatus*
Spider monkey	*Ateles paniscus*
Howler monkey	*Alouatta beelzebub*
Cebus	*Cebus capucines*

In addition, baboon (*Papio sp.*) sera are available from several geographic locations including sites of capture in Kenya, Africa. Baboons captured at 10 different areas in Kenya and Tanzania were bled and sampled (throat and rectal swabs) immediately following capture. Approximately 50 animals of nearly 500 so captured and sampled have been followed microbiologically after transport to this facility. Other available sera include those obtained from an inbred domestic group of baboons residing in captivity for approximately 40 years, baboons maintained at this facility (SFRE) for varying periods of time but born in Africa, and baboons born in Africa, sampled just prior to shipping (but after several weeks in captivity) and now periodically sampled. About 150 of this latter group of animals are maintained as a breeding colony and also serve as participants in a longitudinal microbiological study. Other sera obtained at SFRE are from a small group of breeding chimpanzees as well as laboratory personnel. Army recruits serve as a human control group as do specimens obtained from individuals residing in Kenya. All sera, regardless of contributor, are handled and treated identically. Sera not tested immediately are stored at −20°C until used. Inactivation of sera is at 56°C for 30 minutes, although for certain tests 60°C for 20 minutes (to help decrease anticomplementary activity) is employed.

RESULTS AND DISCUSSION

In order to ascertain whether or not an animal has had a past antigenic experience with a particular agent, animal sera are tested in one or another of the serologic tests for the presence or absence of specific antibody. Satisfactory test antigens must be available for such purposes, as tested antigens may frequently present a problem. In addition to the general difficulties associated with the adequate production of suitable reagents, uncertainties related to infectivity for laboratory personnel or the experimental animals must be considered. Introduction into the laboratory of the newly isolated agent recovered from patients in Germany, for example, requires facilities specially suited for the handling of highly infectious material. Serologic surveys do offer several important epidemiologic points of evidence and reference, e.g., they (a) indicate past infection (not necessarily disease) with the agent in question, (b) allow a comparison of species capability to immunologically respond to various agents, (c) suggest a geographic distribution of the agent and its antigenic relatives, and (d) suggest a choice of experimental animals susceptible to a particular agent for further laboratory

study. Furthermore, if longitudinal studies are included in protocols such as those described for the baboons, then development and recognition of seroconversions offer an indication as to the time and perhaps locale of such conversions. It then follows, if the human population is simultaneously studied, that this evidence assists in understanding and evaluating the interchange and direction of exchange of organisms involved. For example, it is well documented, and will be further demonstrated below, that rubeola (measles) in monkeys is a result of human contact.

Perhaps most important to understanding and interpreting serum conversions and incidence of infection is the recognition that "remote or isolated areas" where simians are captured is a relative term. In many instances, these animals live adjacent to human populations, frequently sharing the same food and water supply. Invariably, trapping sites are frequented by curious natives who often assist in the handling of the trapped animals. It is also well recognized that the capture of animals by commercial trappers habitually involves animals trapped and held by natives for varying periods of time, as well as the holding of animals under persistently deplorable conditions. Thus, the data presented herein must be examined accordingly. As indicated above, information is currently available only for the baboon and to a certain extent for a small colony of chimpanzees from the time of capture in Africa to their new residence at SFRE.

Table 1 lists the various microorganisms that have been included in the serologic survey. These include viruses of human and simian origin as well as selected bacteria, fungi, and parasites. It is apparent that this listing, while extensive, excludes numerous additional agents important to the health of man and other animals. Studies are now in progress expanding the list of primate serum donors as well as test antigens. Most desirable will be inclusion of sera from animals immediately upon capture for comparison with sera obtained after residence in various primate facilities. Also of importance will be sampling and examination of sera obtained from natives living in the vicinity of the capture site. Sera from individuals involved in handling the animals from time of capture and through their maintenance at each laboratory facility are equally important for final evaluation of data.

Previous reports from this laboratory and others (*5*, *6*, *7*, *14*, *15*) have presented certain preliminary and cursory microbial serology findings on various primates. Antibodies to most antigens are encountered to varying degrees in the primates examined. The source of these antigenic contacts is unavailable although in certain instances the epidemiologic facets are recognized or suggested. For example, measles antibody could be presumed to be from human contacts; the extensive number of animals in nature with Q fever (*R. burneti*) antibodies would suggest natural infection and possibly a reservoir for this agent.

For the purposes of this conference, it may be of value to indicate a number of microbial findings relative to nonhuman primates. As indicated, parasitism of simians evidently occurs to varying degrees. Thus, certain species animals are extensively infected, others only to a very limited extent. As an example of extensive virus infections of simians, measles virus (Figure 1) or reovirus (Figure 2) can be cited. A bacterial infection that is in this same category is that caused by *Proteus vulgaris* or by *Mycoplasma* (Figure 3). Intermediate type infections may be exemplified by adenoviruses (Figure 4) and perhaps lymphocytic choriomeningitis (Figure 5) as well as by *Salmonella typhosa*. Infrequent or limited infections include mumps (Figure 6), respiratory syncytial

FIGURE 1. Number of primates with hemagglutination inhibition antibodies to measles virus.

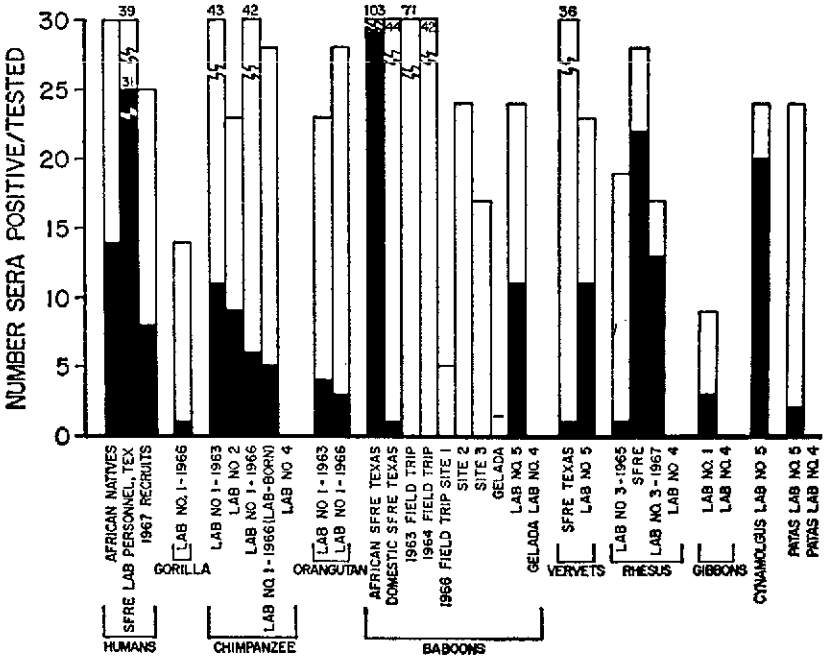

FIGURE 2. Number of primates with hemagglutination inhibition antibodies to reovirus I.

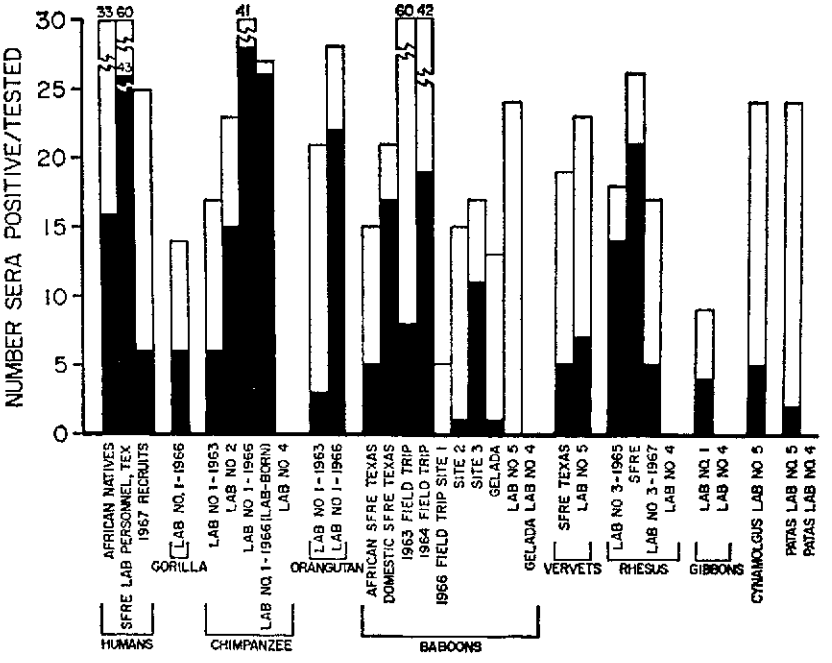

FIGURE 3. Number of primates with complement fixing antibodies to *Mycoplasma pneumoniae.*

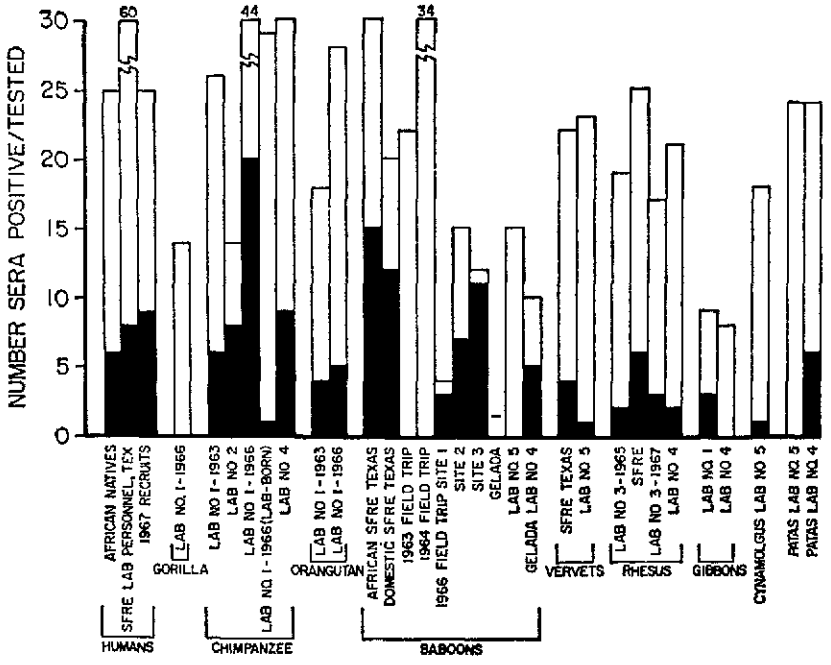

FIGURE 4. Number of primates with complement fixing antibodies to adenovirus.

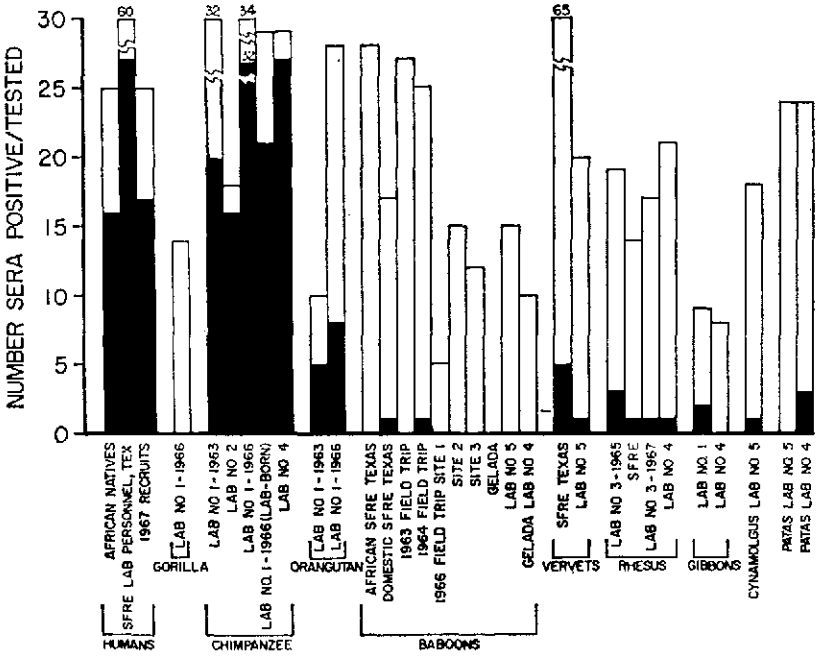

FIGURE 5. Number of primates with complement fixing antibodies to lymphocytic choriomeningitis virus.

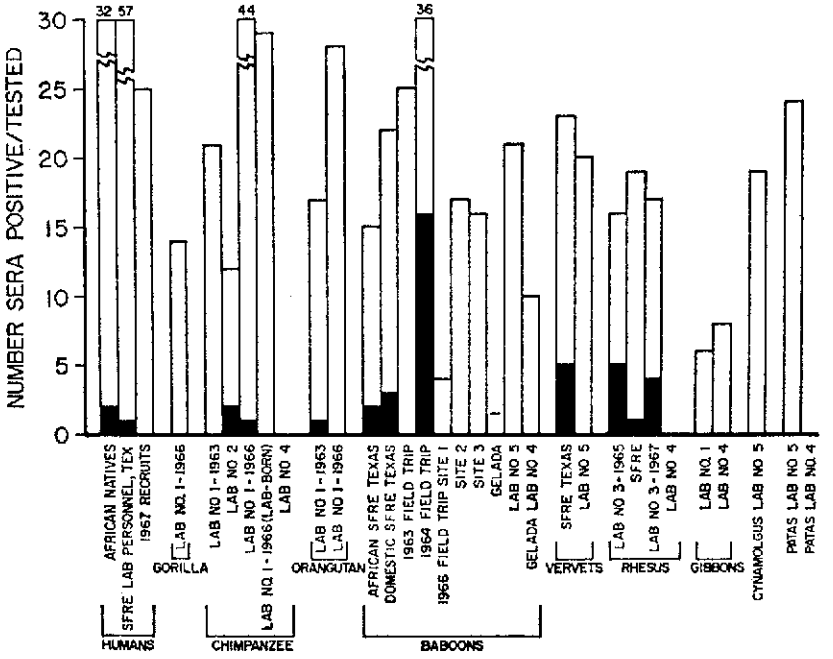

FIGURE 6. Number of primates with complement fixing antibodies to mumps virus.

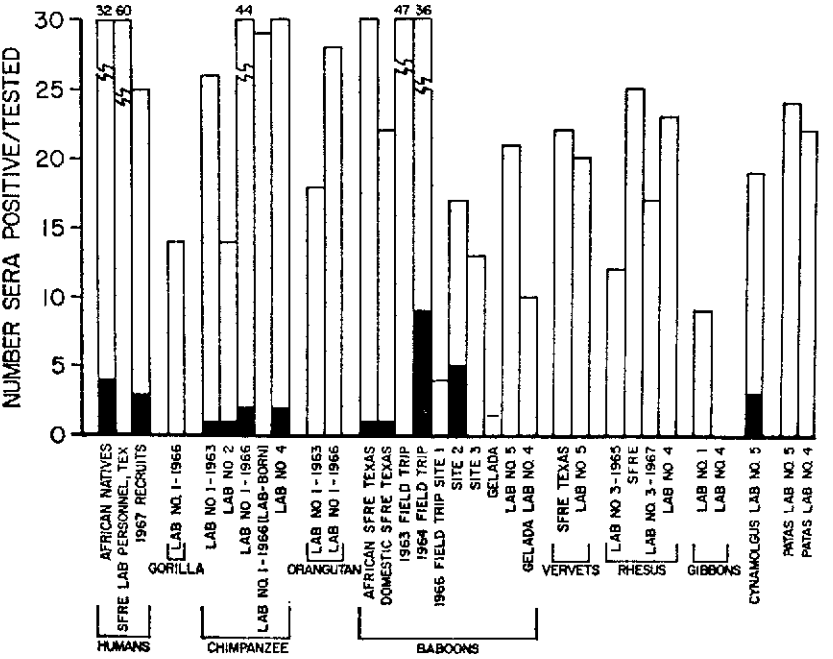

FIGURE 7. Number of primates with complement fixing antibodies to respiratory syncytial virus.

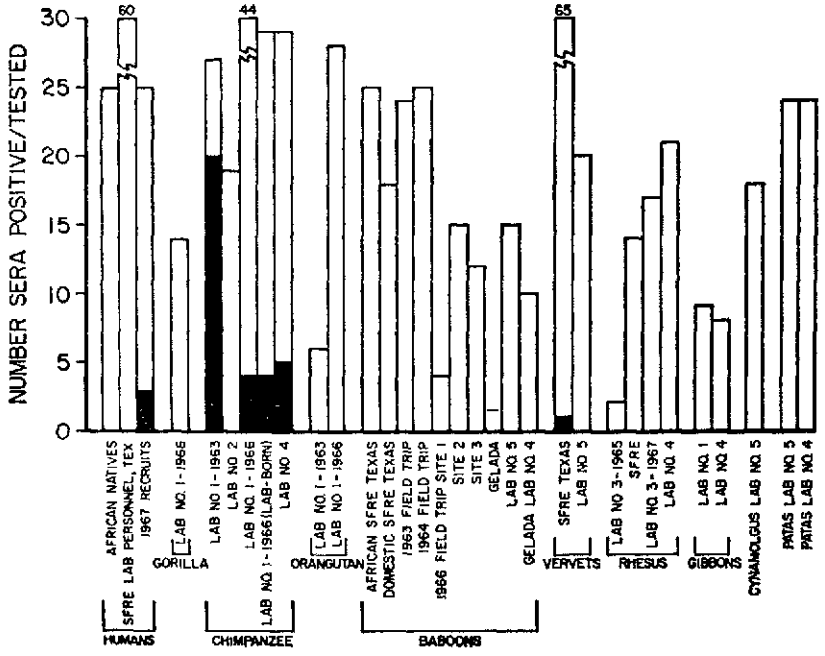

FIGURE 8. Serum neutralizing antibody to SA-7 in various primates.

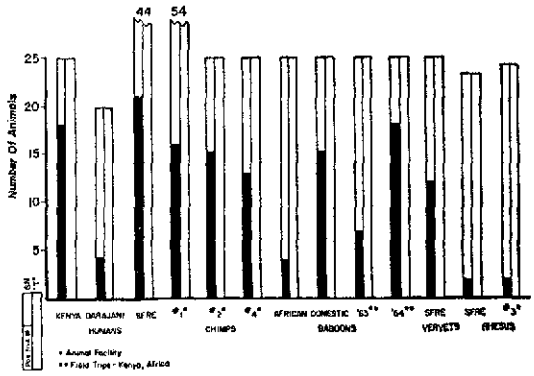

FIGURE 9. Serum neutralizing antibody to SV-40 in various primates.

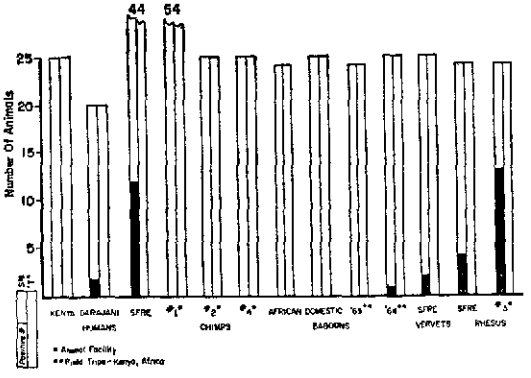

FIGURE 10. Number of chimpanzees (Yerkes Primate Center) with serum neutralizing antibodies to various viruses.

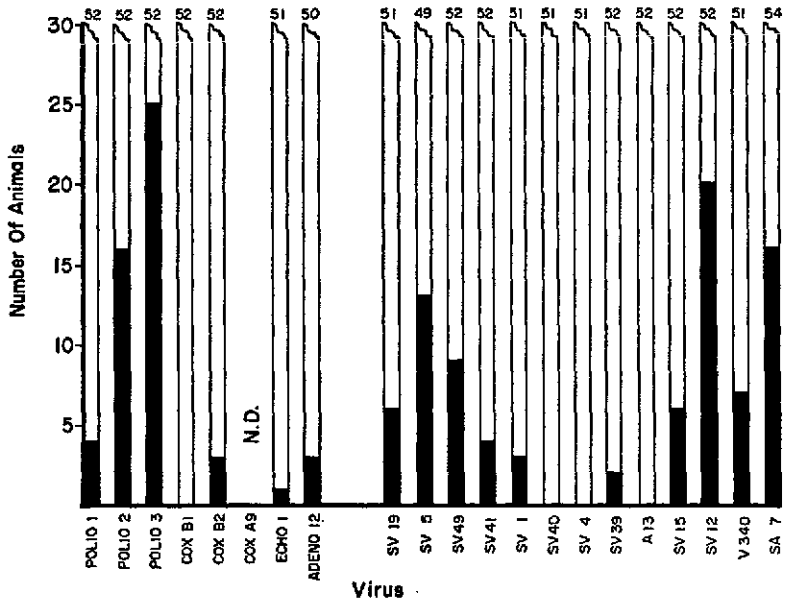

FIGURE 11. Number of rhesus (commercial sources) with serum neutralizing antibodies to various viruses.

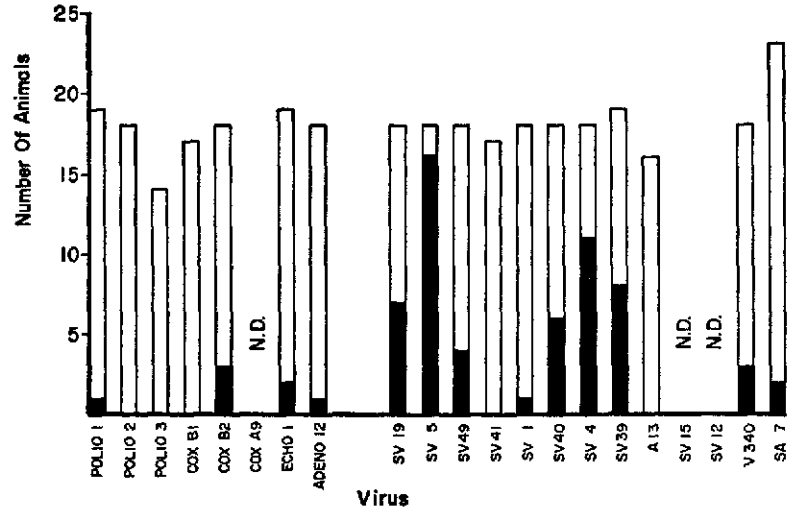

FIGURE 12. Number of humans (personnel of Southwest Foundation for Research and Education) with serum neutralizing antibodies to various viruses.

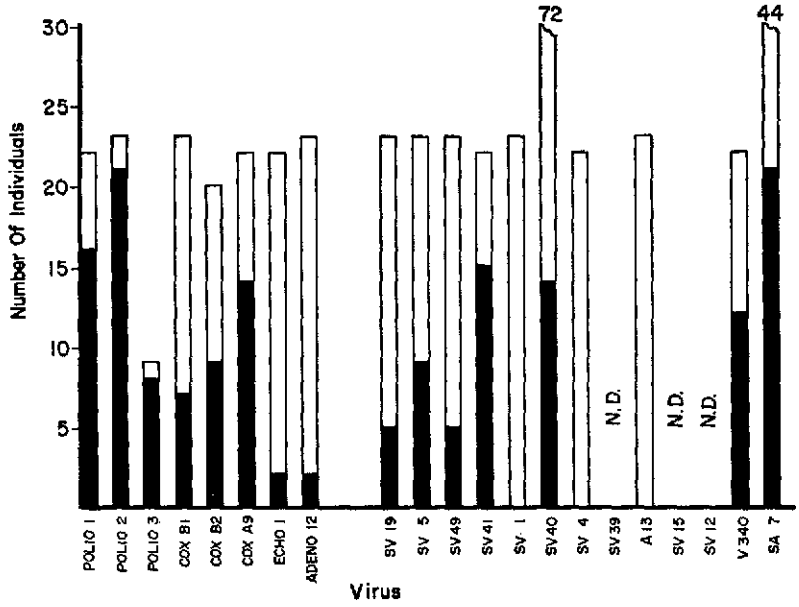

FIGURE 13. Virus shedding by baboons upon arrival at the Southwest Foundation for Research and Education.

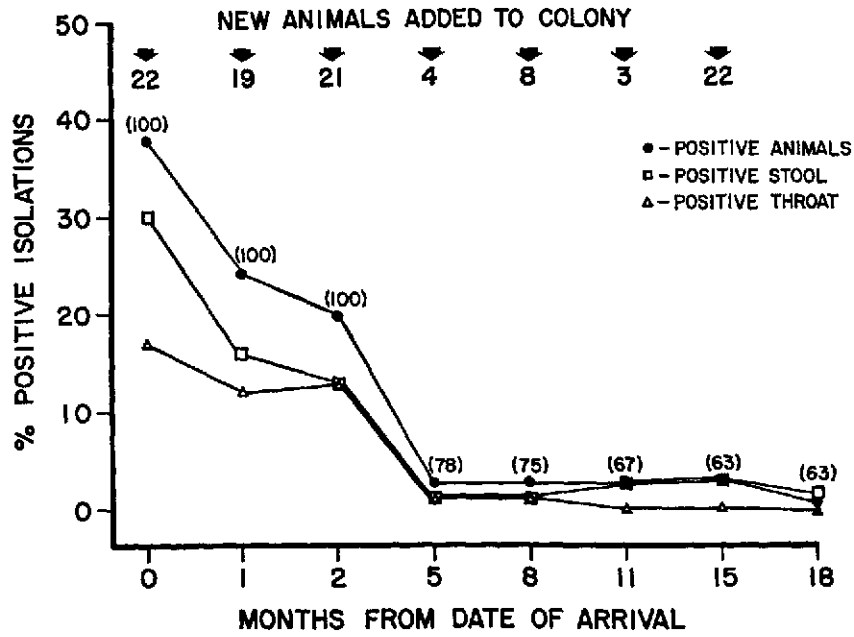

TABLE 1. Microbial agents and parasites employed in the serologic survey.

Viruses	Human	Simian
Enteroviruses	Polio 1–3 Cox A9, 20, B1–6 Echo 1, 3, 6, 7, 9, 11, 12, 13	SV4, 16, 45, 49, A13[a]
Myxoviruses	Influenza A, A_1, A_2, A_3 Measles (rubeola) Mumps Parainfluenza 1–3 Respiratory syncytial	SV5, 41 Foamy virus 1–3
Adenoviruses	Adenovirus (group antigen) 12	SV1, 15, 39 V340 SA7
Reoviruses	1-3	SV12, 59
Arboviruses	WEE EEE SLE Yellow fever	
Poxviruses	Vaccinia	Monkey pox
Papovaviruses		SV40
Herpesviruses	*H. hominis*	*H. simiae*
Miscellaneous	Rubella Lymphocytic choriomeningitis Psittacosis—LGV (group antigen)	
Rickettsiae	*R. typhi* *R. mooseri* *R. burneti*	
Bacteria	*Mycoplasma hominis* (PPLO) *S. typhosa* (H&O) *S. paratyphi* (A, B) *Brucella abortus* *B. melitensis* Proteus OX2, OX19, OXK *P. tularense*	
Fungi	Histoplasmosis Blastomycosis	
Parasites	Echinococcus Entamoeba Toxoplasma Schistosoma Trichinella Plasmodium	

[a] A new simian enterovirus isolated from baboons.

virus (Figure 7), the psittacosis-lymphogranuloma venerum group of agents, *Leptospira*, *Histoplasma*, and various human parasites such as *Toxoplasma*, *Trichina*, etc. At this point two major factors must be emphasized: the agents presented are primarily human agents, and the data are based upon limited observations and may, therefore, not reflect the true and final picture.

With regard to the simian viruses, the

situation here is strikingly different; however, the same extremes of infectivity may be observed. Most notable is the greater preponderance of extensive infections rather than the infrequent infections for the various viruses tested. The two simian virus extemes are exemplified by the results obtained for SA7, an adenovirus (Figure 8) and SV40, a papovavirus (Figure 9). The general pattern of virus infectivity among simians is exemplified by results obtained among chimpanzees (Figure 10) and rhesus (Figure 11). It may be noted that humans, at least as reflected by laboratory personnel, show an immunologic responsiveness to many of the simian agents (Figure 12).

These findings emphasize the ability of microorganisms to produce infection in these various hosts. At this time it is not important to distinguish between overt and latent infections. Most significant is the demonstration that evidence of infection with human agents was found in simians and vice versa.

In addition to these serologic findings, an attempt was made to isolate viruses from various simian species. Unfortunately, except for the baboons, these data as well as those of other investigators generally reflect animals in captivity, such as those in zoological parks or at primate centers. Sampling of approximately 500 baboons at time of capture with a virus isolation follow-up over several years has demonstrated a highly significant pattern of virus shedding. As seen in Figure 13, virus shedding by baboons upon arrival at SFRE is approximately 40 per cent. It may be noted that this figure gradually declines over the first five months of captivity to 5-10 per cent, which concides with the incidence of virus shedding by animals as determined for the day of capture. Therefore, it may be assumed that some factor (or factors) is instrumental in producing this change in incidence of virus excretion. Two considerations, operating either independently or concomitantly, may explain this event: "crowding" of animals following capture during their holding prior to shipment, and a "stress" phenomenon peculiar to the shipping of the animals or brought on by shipping, analogous to shipping fever seen in cattle. Studies are underway in this laboratory relative to virus shedding and stress.

CONCLUSIONS

Recent large-scale employment of nonhuman primates for biomedical research has necessitated shipment of these animals from remote geographic and ecologic areas. Initially little if any consideration was given to the possible effects such activities might have on either the human or simian population. Recent events, unfortunately, have suggested more careful exploration of the relationships existing between man and experimental animals. It is of interest to note, in retrospect, that minimal consideration has been specifically given to the interplay of agents between such closely related animals as man and simians, although there was sufficient evidence to advise and perhaps warn us regarding the potential dangers. Amazingly, only cursory attention was given to the deaths caused in man by *H. simiae*. Occurrence of hepatitis in man only insignificantly changed current procedures for handling nonhuman primates. The poliomyelitis outbreak among the higher apes at Yerkes scarcely precipitated more than local interest in the exchange of viruses. The outbreaks of poxvirus disease and hemorrhagic disease, as well as the very recent occurrence in Germany of human cases, undoubtedly was instrumental in motivating Dr. Leon Schmidt of the National Center for Primate Biology to organize a workshop in 1968 for attempting to evaluate and

correct the situation. Greater efforts along these lines must be made!

The data presented herein were not intended to point out, nor were they related to, known outbreaks. The intent was simply to demonstrate that numerous organisms are exchanged among different species animals and potentially may be a problem for man or the primate colony. Obviously the organisms described were presented as examples. Others not as yet studied may be more directly related to the problem. Furthermore, an attempt was made to demonstrate that transportation of simians is associated with a drastic change in virus excretion. The full significance of this finding is still to be determined. As mentioned previously, the data reported herein are based upon available animals. These animals may represent survivors of past devastating epidemics, or outbreaks may have occurred in other geographic areas involving troupes of animals not represented by these samplings.

Lastly, and perhaps more pertinent for future concern of this group, is an observation recently made in our laboratory (*16*) regarding Rous's sarcoma virus (RSV). Briefly, an immature baboon, receiving daily injections of cortisone but not inoculated with virus, developed a fibrosarcoma on his leg. Biopsy of this tumor demonstrated a "typical" RSV type pathology. Continual observation of this tumor evidenced little if any tumor growth but the animal did manifest continuous signs of general debilitation. No other evidence of tumor development or metastasis was observed. Approximately 250 days after introducing this animal into the study, it suddenly died. Examination of the animal at necropsy demonstrated the presence of numerous small tumors at many diverse sites—bones, meninges, adrenal. Histologic examination of these tumors demonstrated not fibrosarcoma but lymphosarcoma. While the complete significance of this finding is not clear, it would appear that this animal became infected by RSV as a result of direct contact, through a vector or by aerosol. Regardless of the epidemiology, the important consideration is the development of a fatal tumor in an *uninoculated* primate. With more and more primates, as well as other animals being introduced into oncologic studies and studies of other types, the role of infection and the mode of spread among primates is indeed extremely important.

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POTENTIAL PUBLIC HEALTH HAZARD OF SIMIAN MALARIA

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It would be fallacious to consider malaria in the simian species as important a disease entity as some of its bacterial or viral counterparts. Frequently, however, diseases such as this which are often clinically silent can create more difficulty than those which are readily manifested clinically.

The geographic distribution of simian malaria is not unlike that of its human counterpart. The "hotbed" is in Southeast Asia, but parasites are distributed in the Far East, Africa, and South and Central America as well (*1–3*). In essence, malaria parasites are found in almost every area from which laboratory primates are procured.

The importance of the simian malaria parasites is threefold: they can be transmitted to man; they are morphologically and behaviorally similar to human malaria, making them excellent laboratory models; and because of their insidious nature there is at least the possibility that, if undetected, they may confuse laboratory data. All these factors are equally important. However, the transmissibility to man will receive our sole consideration here.

The question as to whether simian malaria could be transmitted to man plagued malariologists for a number of years. It is not therefore surprising that as early as 1922 Blacklock and Adler (*4*) vainly attempted to establish in humans an infection of *Plasmodium richenowi*, which is native to the chimpanzee. The first successful transmission of a simian species was performed by Knowles and Das Gupta in 1932 (*5*). They transmitted *Plasmodium knowlesi* of the *Macaca irus* monkey to man by the inoculation of parasitized blood. From that time until 1960 numerous species were experimentally transmitted to man, the mode of transmission being confined to inoculating parasitized blood. In 1960 Eyles *et al.* (*6*) reported the first mosquito-induced simian malaria infection in man. Interestingly enough, at approximately the same time, in a separate laboratory, Schmidt *et al.* (*7*) reported a similar incident. Both of these transmissions were fortuitous. With this breakthrough, numerous mosquito-induced simian malaria infections have been established in human volunteers (*8–13*). To transmit parasites in the laboratory with scores of heavily infected, appropriate vectors under controlled conditions is one thing, but to claim the same results in nature is something entirely different. It is not, therefore, unexpected that these experimentally induced infections were considered by some to be laboratory curiosities.

In 1965 the first documented, naturally acquired case of simian malaria in man was reported (*14*). It occurred in a 37-year-old Caucasian male, who apparently acquired the infection in Malaysia. Ironically, the parasite was identified as *Plasmodium knowlesi*, the first simian malaria species to

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be transmitted to man by blood inoculation. In 1966, still another naturally acquired infection was reported in Horto Florestal da Cantateira—in the outskirts of the city of São Paulo, Brazil (*15*). The parasite was identified as *Plasmodium simium*, which is morphologically similar to *Plasmodium vivax* of man. The affected individual was a member of a team studying simian malaria in that region. In both cases symptoms were moderate to severe and short-lived, terminating spontaneously in one or two weeks. These two events have played a major role in revising the concepts of what constitutes malaria reservoirs for man.

It is obvious from the previous discussion that simian malaria can be transmitted to man. The dissemination and severity of these infections in the human populace, however, depends on numerous factors. In 1936 Bray (*16*) presented a detailed discussion on the probability of naturally acquired infections of simian malaria in man. Although made prior to the first reported cases, his comments are still germane. He stated that man could be infected with simian malaria providing (a) that he entered an endemic area, (b) that the vectors in that area would be willing to bite him preferentially to their normal host, and (c) that, if man became infected, he would have to return to a predominately human environment to perpetuate the infection. He also noted that the parasite would have to adapt to the aberrant host (man) and produce gametocytes suitable for anthropophilic mosquitoes. He was of the opinion that the possibility of man-to-man transmission of simian malaria in nature was much more remote than the occasional, fortuitous monkey-to-man transmission.

Even in light of the two reported naturally acquired cases, we would be hard-pressed to disagree with Bray's conclusions. To speculate that simian malaria parasites in man would have to produce gametocytes adapted to anthropophilic mosquitos may, however, be a moot point. In 1963, Warren *et al.* (*17*) stated that several members of the *Anopheles leucosphyrus* group had been identified as vectors of simian malaria in Asia. In fact, Coatney in 1963 (*18*), considered this group of mosquitoes so important that he considered their absence from North-Central India as responsible for the lack of simian malaria in the *Macaca mulatta* from that region. The *Anopheles leucosphyrus* group also contains important vectors of human malaria. Recently, it has been demonstrated that certain species of this group, given the opportunity, may bite monkeys as well as man (*19,20*). The same situation appears to be true of some vectors in the Western Hemisphere (*15,17*).

An ounce of prevention is worth a pound of cure, and so it is with simian malaria. Diagnostic techniques for the disease are readily available but woefully inadequate. We are still dependent on the identification of parasites within erythrocytes. Even the thick film methods (*21,22*) are somewhat cumbersome and meaningful only if parasites are observed. Immunological techniques are useful, but again are often difficult to interpret. In laboratories where large numbers of primates are utilized these diagnostic techniques are more often than not impractical. There are, however, certain procedures which can be performed to minimize the problem:

1. The animals can be treated with standard antimalarials, since the simian species of malaria are ostensibly susceptible to them.

2. All animals and laboratory specimens should be handled as if they were infected. Protective clothing, such as long-sleeved shirts and gloves, will safeguard individuals from exposure to parasitized blood.

3. The animals should be housed and transported in vector-proof enclosures. Since other zoonoses have been transmitted by

vectors and/or contamination with infected blood or tissues, these latter points should already be standard procedures.

Simian malaria is a threat to public health. Numerous species of subhuman primates are exposed to and infected with these protozoa. When man is exposed to the hostile environment of an endemic area, whether it be in the laboratory or in nature, he becomes a potential host. As Bray (*16*) pointed out: "At least one can now treasure the thought of agitated workers chasing the mosquito that got away around the room—where previously an attitude of lassez faire prevailed in relation to a few heavily infected mosquitoes buzzing around one's head."

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HERPES VIRAL DISEASES IN NEW WORLD PRIMATES*

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Nonhuman primates from Central and South American countries are being imported to the United States in great numbers for biomedical research as well as for educational and sentimental reasons (for zoos, wildlife studies, pet shops, etc.).

The study of infectious diseases of primates from the Hemisphere is one of the various studies in progress at the New England Regional Primate Research Center of the Harvard Medical School. This Center is one of seven centers established in the United States with the support of the National Institutes of Health for the study of nonhuman primates.

The Divisions of Microbiology and Comparative Pathology of the New England Primate Center have been studying viral diseases of the following nonhuman primates: squirrel monkey (*Saimiri sciureus*), marmoset monkey (*Saguinus species*), owl monkey (*Aotus trivigatus*) and cebus monkey (*Cebus apella*). As a result of these activities, the following findings have been obtained.

The squirrel monkey is a natural reservoir for herpes T virus (*1*). This virus rarely produces clinical disease in this monkey species, but when this disease does occur (Figures 1–3), it is characterized by the presence of vesicles and ulcers on the lips, tongue, and hard palate of the animals (*2,3*).

This disease in the squirrel monkey in many respects has a very similar symptomatology to the disease produced in man by herpes simplex virus. The disease in man usually is characterized by the presence of fever blisters or cold sores, mainly in the lips or mucosa of the oral cavity.

Herpes T virus has the property of producing a severe disease in marmoset and owl monkeys. The first knowledge of this virus was obtained by the observation of a fatal systemic disease in marmoset monkeys (*4*). This disease is also characterized by the presence of vesicles and ulcers, mainly in the lips and oral cavity of both affected species. A detailed description of the pathological features in the owl monkey has been given elsewhere (*5*). Herpes T virus can be readily isolated in appropriate in vitro cell cultures with materials collected from the natural orifices and lesions of the affected animals.

The finding that the squirrel monkey is a natural reservoir for Herpes T virus, and therefore a carrier of the agent, clearly indicates that this animal species must be segregated from those that can be fatally affected by the virus—such as owl and marmoset monkeys. It is relevant to emphasize at this point the need for proper handling of these primates to avoid the infection of the most susceptible species.

Owl and marmoset monkeys are also fatally affected by another member of the

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herpes group of viruses: herpes hominis or herpes simplex. Natural herpes simplex infection has been observed on two separate occasions in owl monkeys (*6*). It has been previously reported that marmoset monkeys can also be experimentally infected with herpes simplex virus (*7*). We have found in our laboratories that marmoset monkeys can also be naturally infected by herpes simplex virus.

The herpes simplex infection in the owl monkey is characterized by the presence of small to large necrotic plaques and ulcers on the tongue, similar to those produced by herpes T virus in the same species as well as in marmoset monkeys. Conjunctivitis and blepharitis are observed within 5-6 days in owl monkeys inoculated with simplex virus (Figure 4).

The histopathological and gross lesions produced by herpes T and herpes simplex virus are almost similar; thus differential diagnosis can best be done by employing viral identification procedures. The arboreal habitat of the fatally affected animals makes the exposure to herpes simplex virus very unlikely. However, when these animals come into contact with man, they can be infected, since man is a natural reservoir for this virus. This relationship between man and nonhuman primates provides adequate evidence for considering herpes simplex infection a new zoonotic disease.

Our interest in protecting the affected species against these fatal herpes infections led us to develop two vaccines—one against herpes T infection, the other against herpes simplex infection. These vaccines have been prepared with viral variants grown in rabbit kidney monolayers (*8*).

Laboratory tests done with these vaccines in small groups of owl and marmoset monkeys have so far been successful. The attenuated variants will be shared with laboratories interested in the vaccination of the fatally affected animal species as soon as the herpes T and herpes simplex vaccines become ready for general application.

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FIGURE 1. Multiple raised necrotic plaques with umbilicated centers (arrows) on the lingual mucosa of squirrel monkey. [Figures 1-3 from King *et al.* (*2*) by kind permission of the Editor of *Laboratory Animal Care.*]

FIGURE 2. Two depressed ulcers (arrows) on the hard palate of the squirrel monkey in Figure 1.

FIGURE 3. Same case as illustrated in Figure 1, three days later. The necrotic tissue has sloughed, and healing is taking place.

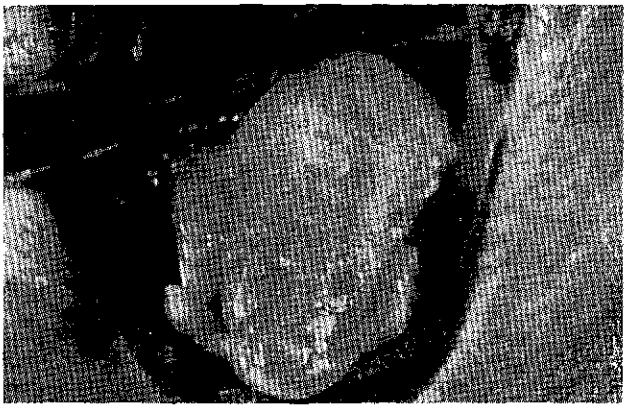

FIGURE 4. Owl monkey inoculated with herpes simplex virus by corneal scarification on the left eye. Conjunctivitis and blepharitis developed only on the inoculated eye. This animal died on day 6 postinoculation.

PROBLEMS RELATED TO THE IMPORTATION-EXPORTATION OF NONHUMAN PRIMATES

WILLIAM E. GREER, D.V.M.*

Adequately covering the many problems associated with primate transport would more likely fill a large volume than these few pages. However, it will be indicative of the scope of problems involved if we classify them into general categories:

Financial commitment
Source accessibility
Species population or volume concentration
Species quality
Trapper's capability and/or willingness
Political environment at source
Transportation
Import entry
Interim holding and transshipment
Public health aspects

The order of importance of the items in this list varies with the individual's interest. The present order of the list is realistic and proper if viewed by the businessman-importer. However it would be in reverse order when viewed by a public health official.

During the past 12 years, this author has been involved in many facets of the monkey business, from the tree through the laboratory, encompassing 28 species and approximately half a million animals. As must be apparent, therefore, problems are no strangers, but solutions often are.

Considering the general interest of this program, the business factors will not be expounded nor explored. Of immediate interest are three main factors:

Source and supply
Mechanical transport and housing
Infectious disease problems

SOURCE AND SUPPLY

Fortunately, after more than a decade of mass importation of monkeys into the research and pharmaceutical communities, many of the original problems due to ignorance on the part of all concerned have diminished. The monetary value of the monkey industry has caused most source areas to seek better methods of handling and supply. This has been carried to the point of a limitation on volume of export from some areas as well as total embargo on several species. Granted, some of this has come too late, but past experience will be a good lesson for the future.

One of the major problems at the source today is the inability of communicating the degree of quality necessary to keep pace with the end-user's capability and need. It is extremely difficult to relay to the native trapper that just because a monkey is breathing and biting, it is not healthy or of a quality to satisfy today's researcher. To the uneducated part-time trapper who catches monkeys when there is nothing else to do, it is impossible to explain modern research techniques and demands. A monkey is still just a monkey to him. This problem has

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necessitated the overseas extension of several import operations. In order for the importer to supply his accounts with better animals, he has gone to the source and established his own collection operations. Unfortunately, only a few importers have the financial capability to pursue this course. In other instances the end-users, pharmaceutical companies, research institutes, etc., have found it necessary to develop field teams and even permanent stations in order to fulfill their exact requirements. The small user, of course, is not capable of doing this and, consequently, often experiences difficulties in quality.

The proper education of involved personnel at the source would be of great benefit but seems to be a dream of the future. There have been efforts to use financial pressures to bring about improvement, but, as long as there are more buyers than suppliers, it often is unsuccessful.

MECHANICAL TRANSPORT AND HOUSING

With the advent of air transportation and subsequent incorporation of jet transport in the industry, great improvement has been realized. Primarily the diminution of time partially solved many previous problems. By shortening time from source to end-user, providing reasonable care and management in route was accomplished, morbitity and mortality were diminished. With the reduced time realized, the animals are not only placed in a suitable environment at the end-user's faster, but the rigors of travel are reduced and the limiting or depleting of the individual's metabolic reserve do not approach the critical point.

Most of the advances in transportation and housing are the direct result of the importer's improved knowledge and economic interest, coupled with that of the end-user. The source is paid by irrevocable letters of credit; consequently, the monkeys become the property and responsibility of the importer as soon as the shipment is accepted by the air carrier. Unless definite mechanical failure is established, the air carrier is not responsible for losses.

INFECTIOUS DISEASE PROBLEMS

Two major disease categories exist which are continuing problems in the monkey industry: animal diseases (natural diseases involving only the animal), and diseases of public health significance.

Animal Diseases

The diseases of monkeys are now a specific field of investigation in laboratory animal medicine, with many syndromes identified and others being recognized and classified almost daily. The practice a decade ago of merely distinguishing between pneumonia and enteritis was unsuccessful and costly in time and money.

Today the range of disease includes representative parallels to both human and veterinary medicine, including metabolic, congenital, parasitic (both endo and ecto), bacterial, rickettsial, and viral types.

It is most unfortunate that the vast raw material of monkey disease research was not totally realized and used when the peak of vaccine importation was experienced. Lesions and problems were then available in vast numbers, but few were interested or had the time and money to do basic research. Now that we have the desire, equipment, and time, the numbers of animals are not available.

The unfortunate (or fortunate, depending on one's viewpoint) close relation to man of this order of animals gives it intermediate capability of acquiring and transmitting

cross-species diseases. This factor alone is cause for concern.

Diseases of Public Health Significance

Unlike the importation of exotic ruminants and ungulates, the nonhuman primate does not jeopardize the livestock industry and food supply of a nation: it merely affords an opportunity for dissemination of exotic diseases, both as a carrier of its own diseases to other animals and as a carrier of human diseases from its native human population. It appears that since great sums of money have not yet been jeopardized, the stimulus for control has been limited. However, there are certain events which should be considered, and several disease conditions which have caused considerable concern.

Tuberculosis has been a consistent threat to the nonhuman primate world for generations. Although it is not as frequent in occurrence today as in the past, it is only because strict test and control measures are practiced by individuals concerned. Although the strain of organism is still being discussed, the fact remains that in areas of high human incidence it is correspondingly high in the monkeys. When considering the vast restrictions placed on other tubercular animals, international, national, and even local, it is difficult to accept the lack of uniform regulations for transporting monkeys. Other animals are tested and checked. Why then should the only requirement for monkeys be the broad health certificate clause "exhibits no signs or symptoms of infectious or contagious disease?"

Shigella dysentery is an important cause for concern in today's food industry. Its status is such that a Surveillance Report is issued periodically reporting its occurrence and source. In a current newsletter, it is stated that "recent episodes may be indicators that more of a food-borne Shigella problem exists than is realized" (*1*).

The apparent concern over food-borne transmission should be mirrored in the monkey industry. Shigella is an everday occurrence in many species and not always apparent as clinical disease. Monkeys can and do act as carriers for years without clinical development.

As reported in 1931, three children died of the disease in Germany after contracting the condition from an apparently healthy monkey. Again in 1962, a woman died in the United States within 48 hours after symptoms and signs commenced (*2*). This transmission was from her pet gibbon. Again, in 1965, seven children and one adult were afflicted in England after playing with a pet monkey (*3*).

These are just a few of the more readily available instances of monkey-to-human transfer. How many have gone unreported or undiagnosed or even passed over as an "intestinal virus" is difficult to say. But the fact remains it can be a serious problem.

Monkey B. virus is probably the most widely feared virus disease among primate workers due to its dramatic history and finality of outcome. This condition has existed since 1929, when B virus caused its first fatality. Here again is an example of carrier state. In this author's experience, not more than a dozen lesions have been noted which might have been active B. virus. The occurrence has been so limited that one can well afford to sacrifice the animal if in doubt. However, during the height of mass "vaccine importation," several titer surveys were accomplished and showed as high an incidence as 60–90 per cent in some macaque shipments.

Viral hepatitis is a continuing concern to workers associated with chimpanzees. The excellent report by Held, covering the incidence from 1953 to 1962, focuses atten-

tion on this disease situation. It has continued to occur almost as frequently during the past five years.

Green monkey disease. More recently, the world's news media made a monkey disease famous by reporting the unfortunate occurrence of "green monkey disease" in Europe. Here again the unexpected occurred with fatal results.

When the few examples presented here are combined with the various other related viruses, bacteria, and arthropod-borne parasites that occur in the natural habitat of monkeys, it will not be difficult to paint a potentially frightening picture of disease transmission and dissemination if every effort is not made to combat and control the translocation of nonhuman primates.

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A PROPOSAL FOR FEDERAL REGULATION OF PRIMATE IMPORTATION AND DISEASE CONTROL

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The use of animals has become an indispensable part of nearly every field of medical research. More specifically, many of the primates are essential to research in neurology, psychology, pharmacology, surgery, nutrition, and aerospace medicine because, among other things, of the similarities between these animals and men (*1–4*). One recent example of the recognition of the importance of primates to the medical sciences has been the establishment of regional primate research centers throughout the United States. Each of these centers focuses upon specific types of research involving primates and shares its findings with the other centers as well as with nonaffiliated projects and institutions (*5*). Pharmaceutical manufacturers and other organizations have been using about 200,000 primates a year (*6*) for both research and production and they are quick to respond to any measures which increase the cost or decrease the supply of these animals.*

There has been a slow accumulation of evidence, however, of serious hazards associated with primate use. There has not as yet been an effective response to the few cries for reform at the national level of the controls on primate importation and disease. The purpose of this paper is to show the magnitude of the threat to human and animal health that now exists and to propose a way to remedy the ineffectiveness of present federal law.

PRIMATE DISEASE PROBLEMS

Human Death and Disease Caused by Primates

It is not possible to list the number of deaths or cases of serious disease that have been the result of contact with primates. One of the reasons for this is the fact that the knowledge of what diseases primates may have or carry is far from complete; many cases must, therefore, have gone unrecognized as instances of infection from primates. There must also be taken into account the fact that many of the diseases which primates carry are diseases which are fairly common in man to begin with, and their occurrence in laboratory workers or keepers in zoological gardens might not be traced to the animals. Another category where primate-caused diseases must surely have been substantially unreported is that of individual owners of primates as pets (*7*). It might also reasonably be suggested that many institutions such as pharmaceutical houses would be quite reluctant to report any instances of primate infections causing death or disease among laboratory workers because of the unfavor-

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* See, for instance, the *Agreement Adopted by the Traffic Conferences of the International Air Transport Association Relating to Cargo Rates*, C.A.B. Agreement 16870, Order No. E-19380 (1963).

able publicity that might follow. An unreported case in the sense used above is one in which the medical profession or fields within it have not been informed through published reports and knowledge of the case is limited to comparatively secret conclusions of a medical examiner's report or a physician's diagnosis.

Cases of human death and disease have, nonetheless, been attributed to primates in the medical literature in addition to being widely discussed among individuals who work with primates. B virus (*Herpesvirus simiae*) has attracted a large amount of attention, possibly because it is the most deadly of the diseases currently known to result from contact with primates. B virus was named by Dr. A. B. Sabin, who reported the first two cases in the medical literature. The "B" of B virus is the surname initial of the doctor who was the first known victim in 1934. He was bitten on the fingers by an otherwise healthy *Macaca mulatta*—the rhesus monkey, or bandar (*8*, p. 127). Sabin described in detail his findings in that case (*9*, *10*) as well as in the second fatal B virus case, which he reported in 1949 (*11*). The victim in the latter case was believed to have been infected through a small cut which came in contact with the saliva of a *Macaca mulatta*. B virus produces an encephalitis (defined as inflammation of the brain) or encephalomyelitis (inflammation involving both the brain and spinal cord) in man(*12*).

Since the first two cases of B virus, several more have been reported, although, as mentioned above, we have no way of knowing how many cases have actually occurred. Ruch, while discussing the earliest cases of B virus, disclosed the following:

> That B-virus infection is a very real and serious hazard to persons working with monkeys or monkey tissues is exemplified by the occurrence in a single year of ten infections, nine of which were fatal (Sabin, personal communication). (*13*, p. 413)

A more recent discussion reported only two survivors out of a total of 15 cases (*14*). While it is not possible to present a larger number of documented fatal cases of B virus in man, such further demonstration seems unnecessary. It is clear that the disease is lethal and that it may be communicated quite easily from animals that are little harmed, if at all, by it. Furthermore, when the background and training of the individuals known to have died of B virus is considered, it is apparent that the loss to the medical sciences which they represent is not reflected by their numbers.

Other diseases have caused fatalities and serious illnesses, also communicated by primates, but they are fortunately less deadly than B virus. Among them are various strains of *Shigella* and *Salmonella*, infectious hepatitis, tuberculosis, and others. Perhaps because these diseases are more familiar than B virus and because they occur among large numbers of people who never come into contact with primates, few studies are available which document the magnitude of this aspect of the primate disease problem. The diarrhea and dysentery produced by strains of *Shigella* and *Salmonella* seem to be so common among primate researchers that the cause may be overlooked if the disease does not reach a serious level (*15*). Ruch summarized as follows:

> There is no doubt that the genera *Shigella* (comprising the organisms causing bacillary dysentery) and *Salmonella* (comprising some organisms which cause systemic infections such as typhoid fever and others which grow predominately in the intestines) can be pathogenic. At least some species of both genera are capable of causing serious illness in simian primates as well as in man. (*13*, p. 77)

Tuberculosis and infectious hepatitis—more widely recognized as dangerous diseases—can be communicated to man by primates with fatal results (*16*, *17*).

There have also been recent serious outbreaks of diseases which have not yet been reported in available literature, and attempts have apparently been made to see that they would not be. One such incident occurred in Germany where several scientists died who were working with *Cercopithecus aethiops*, known variously as green monkeys, vervets, or Savannah monkeys (*8*, p. 116). It is thought by many that the animals and all materials associated with them were destroyed, although an identification of the pathogen was made.*

One additional consideration must be mentioned with respect to this general area. Along with diseases not discussed here, new diseases and the occurrence of familiar diseases previously thought to be not carried by primates are being brought to light as time goes on. (For instance, F. L. Dunn (*18*) in 1964 drew only tentative conclusions about which animals carried malaria and cited the need for additional records in this area.) The degree of seriousness of these diseases therefore remains to be determined.

It seems reasonable to conclude, however, that primate diseases constitute a serious, if limited, threat to man and especially to those who are in frequent contact with these animals. Undoubtedly, if reporting requirements were in effect, a more numerically significant problem could be presented, but the small number of cases reported should not lead to the conclusion that there is no threat. As Mattingly put it:

> Although the number of deaths resulting from these diseases is fortunately limited, members of research teams using simian primates should value the lives of their colleagues and themselves sufficiently to continuously wage the battle of controlling these diseases. (*16*)

Primate Mortality and Disease

The high mortality rate among primates shipped to the United States has been a source of concern to researchers, zoological institutions, and individuals concerned with the humane treatment and conservation of animals. During hearings 20 years ago on proposed legislation to deal with this problem, one of the many statements read in part as follows:

> In this ship there was also a consignment of 300 monkeys—of this number 100 were dead in the hold of the ship and this, too, because of improper protection of the animals.
>
> I also know of another instance where a shipment of monkeys arrived in Providence during the dead of winter without any protection against the elements, and the fatalities were appalling. I have heard of other cases where lack of proper care has resulted in cruel deaths and I believe that, if our legislators were aware of such conditions, they would avail themselves of any opportunity to correct them. (*19*)

The statement was made a part of the committee report which accompanied the legislation enacted, which will be discussed in the following section. It is common knowledge among reputable dealers, however, that despite the legislation many importers or dealers in primates will take every shortcut possible in obtaining the animals, and high mortality rates are considered to be normal among such people.* Just one of many recent, documented examples of this fact was the importation of over 700 *Tamarinus nigricollis*, black-necked moustached tamarins (*8*, p. 20), from South America. Five per cent were dead on arrival, 46 per cent died within 30 days, and 16 per cent died within 90 days. The following conclusion was reached:

> The high mortality and morbidity rate in this study reflect the difficulty of obtaining healthy,

* Interviews with Dr. Bernard F. Trum, Director of the New England Regional Primate Center in conjunction with the Harvard Medical School, in Boston, Mass., 24 January and 23 February 1963.

* Interview with Mr. Ellis London, President of London Aquarium, Ltd. (New England's major dealer in exotic animals), in Northboro, Mass., 3 February 1968.

unparasitized tamarins. The source of the animals and the manner of shipment appear to be important for successful maintenance during the first and second months after receipt in the colony. (*20*)

Aside from the physical damage done directly to primates by improper and rough handling, the procedures employed by many dealers give rise to diseases that could be prevented to some extent if more sanitary and humane treatment were accorded the animals. Pneumonia in primates has been attributed to overcrowding and severe changes in ambient temperature by two authorities who made the following observation, which reveals much about the impact of the statements made 20 years ago to Congress:

> Prevention [of *Shigella flexneri* and *Salmonella spp.*, which produce mortality rates among laboratory primates in excess of 50 per cent in some cases] seems to depend upon the purchase of stock from reliable dealers who will not congregate sick animals in filthy holding pens, who segregate groups, and who will make swift and uncomplicated direct deliveries to the laboratories. (*15*)

Other researchers have confirmed that crowding of primates after capture increases the incidence of viral infections (*21*).

It is difficult to know how much of the mortality and disease rates among imported primates are attributable to the way they are handled and transported, to infection en route, or to diseases which they carry with them from their places of origin. The last category contains the problem of whether latent diseases have developed because of the conditions in the new environment of the animals or if they would have developed anyway in their native state. What is certain was summed up when it was said that "we have yet to find a single feral animal that comes to our lab of any kind from the sand rat to the chimpanzee that has not some kind of disease (or infection) that he is carrying" (*22*).

The literature on the types of diseases which primates bring into or develop in captivity or in their native state when compared to that available on primate-caused death and disease in man is abundant (*13*). Knowledge in the area seems to be increasing as interest in and a recognition of the importance of primates becomes greater (*23–25*). Despite these facts, there remains the reality of continuing high rates of loss among primates in shipment and in established laboratory or zoological colonies. Not only do these losses often destroy entire research projects representing long periods of work and offend the sense of responsibility to these animals which many people feel, they also in some cases threaten extinction for certain species (*26*). One of the lessons of the history of conservation is that apparently inexhaustible supplies of animals have been destroyed in very short periods of time. The most (as well as the least) abundant species could be destroyed, although the former do not receive the attention accorded the latter. The American Association of Zoological Parks and Aquariums has a "blacklist" by which member institutions agree to not import certain species such as *Pongo pygmaeus*, the Borneo and Sumatra orangutans (*8*, p. 154), which are becoming quite scarce.* Such endangered species lists can create misunderstanding between those seeking to achieve the same ends. Such was apparently the case when one of the primate centers acquired animals on the blacklist for the purpose of propagating them but were accused instead of endangering the animals.† Perhaps better communication can solve minor problems of this sort, but they serve to illustrate that there is presently

* Interview with Mr. Dudley Brown, Director of Education at the Indianapolis Zoological Society and nationally syndicated columnist, in Indianapolis, Ind., 29 December 1967.

† Interview with Dr. B. F. Trum, 14 January 1968.

no mechanism other than informal cooperation whereby endangered species can be protected and the signs of species considered abundant but about to be endangered could be detected. The lack of such a mechanism exists with respect to most other kinds of animals as well, but the high demand for primates certainly must place them among the most seriously threatened of animals.

THE STATE OF THE LAW ON PRIMATE IMPORTATION AND DISEASE CONTROL

Present Federal Jurisdiction

The present discussion is designed to show which Federal agencies of the United States can (as well as which are required by law to) exercise jurisdiction over primate importation and disease control. As will be seen, these jurisdictions greatly overlap. The next subsection will discuss the results in practice which stem from this situation.

The President. The President of the United States may order by proclamation that the importation "of all or any class of animals for a limited period of time" must be halted to protect domestic animals against infectious or contagious diseases (*27*). Such prohibitions are renewable, but this is of little significance in view of the fact that "limited period of time" is undefined. There is no evidence that this 1890 statute has been used for the prevention of the importation of primates, or any other animals for that matter, in the recent past.

Department of Agriculture. This Department has promulgated regulations in accordance with enabling legislation enacted in 1903 (*28*) which *require* the obtaining of permits from the Secretary of Agriculture before "organisms" or "vectors" may be imported into the United States (*29*). "Organisms" is defined as:

> All cultures or collections of organisms or their derivatives, which may introduce or disseminate any contagious or infectious disease of animals (including poultry). (*30*)

The definition for "vectors" is:

> *All animals* (including poultry) such as mice, pigeons, guinea pigs, rats, ferrets, rabbits, chickens, dogs, *and the like*, which have been treated or inoculated with organisms, or which are diseased or infected with *any contagious, infectious, or communicable disease of animals or poultry* or which may have been exposed to any such disease. (*31*) [Emphasis added]

A reasonable interpretation of the above might well indicate that the Department of Agriculture must provide permits for virtually all entering primates.

The regulations further provide that permits that have been issued may be revoked if the Secretary of Agriculture finds that continued importation of the organisms or vectors is resulting in the dissemination or communication of animal diseases (*32*). Presumably, then, the Department has the power to prohibit further importation of certain species of primates if it is shown that they have infected other animals, primates as well as nonprimates. A recent addition to the regulations strengthens the Department's powers of enforcement by providing the following:

> All aircraft and other means of conveyance (including shipping containers thereon) moving into the United States from any foreign country are subject to inspection without a warrant by properly identified and designated inspectors of the Division to determine whether they are carrying any animal, carcass, product or article regulated or subject to disposal under any law or regulation administered by the Secretary of Agriculture for prevention of the introduction or dissemination of any communicable disease. (*33*)

Under this regulation, the Department's inspectors may require unloading of animals or animal materials, a variety of disinfecting

and sanitizing measures, and they are given broad general powers to prevent the introduction of contagious animal diseases into the country.

Department of the Interior. The Department of the Interior, through the Bureau of Sport Fisheries of the Fish and Wildlife Service, has promulgated regulations under the authority of the Lacey Act—a part of the federal criminal code—which is also the source of the Department of the Treasury's authority in this area (*34*). The regulations begin with a general statement to the effect that any importation of wildlife is deemed injurious to people, domestic wildlife, agriculture, and horticulture. Such importation is therefore prohibited except under conditions later provided in the regulations (*35*). The later regulations allow the importation of any living animal for "scientific, medical, educational, exhibition or propagation purposes" except for a few designated species which can only be imported after obtaining a permit. Primates entering the country do not currently require such permits but they must be accompanied by a Declaration of Importation of Wildlife to be filed with Customs by the broker or owner. The declaration must list the name and address of the importer or broker, the name and address of the consignor, the number of animals, and the common and scientific names of the animals (*36*). The regulations further provide that imported animals may not be released without the prior written permission of the appropriate state wildlife agency (*37*).

Treasury Department. The Treasury Department has authority which is virtually identical to that of the Department of the Interior, but it has not promulgated regulations under that authority for all practical purposes. The Lacey Act does require the Secretary of the Treasury to "prescribe such requirements and issue such permits as he may deem necessary for the transportation of wild animals and birds under humane and healthful conditions" (*38*). The Secretary is also empowered to prevent the importation of illegally acquired animals or improperly labeled animals (*39*).

Department of Health, Education, and Welfare. This Department has prescribed the most extensive regulations on the importation of primates, primarily upon the authority of the Public Health Service Act (*40*). The regulations require that all primates entering the United States be inspected by a quarantine officer, who is to admit only animals "in which no evidence of communicable disease is revealed." Primates considered to be in poor health may be given a second chance to enter the country if the owner or broker provides a veterinarian to treat the animals and facilities for their detention. Reports of sickness or dead animals en route are to be made, and animals exposed to sick or dead animals may be admitted only after tests or examinations show no signs of disease. The regulations also require inspection of the cages or containers in which the animals have traveled and may prevent them from entering if the quarters are unsanitary unless they are cleaned to the quarantine officer's satisfaction. The officer is also to report such conditions to Customs for prosecution under the Lacey Act, if warranted by the circumstances (*41*).

Primates are subject to a special regulation which applies if they come from or pass through a designated yellow fever area. Animals falling within this regulation may be cleared by proof that it has been at least nine days since they were in the designated area, or by arriving in a specified mosquito-proof structure in which they have been for at least nine days, or by immunization (*42*). Excluded animals are either to be exported or destroyed (*43*). A

recent addition to the regulations makes it mandatory for vessels or aircraft to comply with any conditions or measures which may be specified in the pratique before arrival; quarantine inspection prior to entering port is also mandatory if the vessel or aircraft has on board a primate that does not meet the admission requirements, or if the Chief of the Division of Foreign Quarantine or the medical officer in charge has reason to believe the entry would be likely to cause the introduction of communicable disease (*44*). Also, bills of health describing the sanitary history of the vessel are required to state that all regulations which the Department is empowered to prescribe for the prevention of the introduction of communicable disease and for securing the best possible sanitary conditions have been met (*45*).

The Department of Health, Education, and Welfare is also empowered to prohibit the importation of property from countries where there is a communicable disease which would pose a serious danger if introduced into the United States. The designation of such areas of contagion and regulations prohibiting the importation of property from those areas are subject to the approval of the President (*46*).

Some Comments on the State of the Law

When the Subcommittee on Health Standards for International Shipment of Laboratory Animals expressed the opinion that "the present involvement of several Government agencies in the regulations of importation of animals without clearly defined jurisdiction leads to confusion" (*47*), the members must have felt the need to express themselves conservatively. The present situation leads to much more than confusion. It should be pointed out that despite the fact that this paper is concerned with primates, much of what follows is equally applicable to the importation of many if not most of all other wildlife.

An examination of the history of just one current statute in this area reveals the extent of jurisdictional confusion that exists today. The legislation preceding the amended Lacey Act had read as follows:

> No person shall import into the United States or into any Territory or District thereof, any foreign wild animal or bird except under special permit from the *Secretary of the Interior*. . . . The *Secretary of the Treasury* is authorized to make regulations for carrying into effect the provisions of this section. [Emphasis added] (*48*)

The House and Senate Reports on amendatory legislation in 1948 recognized the confusion of jurisdiction in the old law. They pointed out that the Secretary of the Interior was given no discretion to refuse or grant a given request for a permit with the result that permits were always granted. It was decided that the provisions as they then read were only yielding a small amount of statistical data and that the permit requirement should be abolished. The Reports concluded:

> The net effect will be to *eliminate duplication of effort and to lodge in one agency*, the Bureau of Customs, the Administration of the importation requirements and enforcement activities as distinguished from general prohibitions which will remain within the jurisdiction of the Department of the Interior. This meets with the approval of the Customs Bureau as well as the Department of the Interior. [Emphasis added] (*49*)

If that effect had been achieved, at least some clarification of the roles of each agency would have been accomplished. But the legislation actually enacted in 1948 was not what the House and Senate had intended to enact, possibly as a result of confusion at the end of the session. The law enacted still required the Secretary of the Interior to issue permits for the importation of wild

animals or birds and the Secretary of the Treasury to issue regulations to effectuate the permits (*50*).

In 1949 the recommendations of the House and Senate made the previous year were enacted to some extent into law. The new statute provided that the Secretary of the Treasury would prescribe regulations and issue permits for the importation of wild animals while the Secretary of the Interior would be left with the rather minor role of declaring animals injurious to the interests of agriculture and horticulture as well as designating what museum specimens could be imported. Criminal penalties of up to a $500 fine or six months imprisonment were added to the statute (*51*).

It is somewhat amazing that the current version of the Lacey Act has come full circle and has even added to the jurisdictional confusions that Congress wanted to eliminate in 1948. Now the Secretary of the Interior again has the responsibility of issuing permits for the entrance of animals considered to be dangerous (*52*). The Secretary of the Treasury is given the responsibility of issuing regulations and permits to secure the humane and healthful transportation of imported wildlife (*53*). And, what must be the most impressive development in the promotion of confusion in this area, both the Interior and the Treasury are given the responsibility of enforcing the Lacey Act in its entirety, and the officers of each agency are given powers of arrest over violators even if the violations are not within the area of their responsibility under the Lacey Act (*54*).

The failure to "lodge in one agency . . . the administration of the importation requirements and enforcement activities" (*49*) is more extreme than is reflected in the above history. Not only the Treasury and the Interior may require permits for the importation of wildlife but the Departments of Agriculture and Health, Education, and Welfare as well—and the permits may all be technically required by law for the same animal and to achieve identical purposes (*29*, *37*, *39*, *45*). The Treasury, Agriculture, and Health, Education, and Welfare (HEW) all have explicit inspection powers with respect to every vessel arriving at ports of entry (*33*, *39*, *46*). The previous discussion of the state of the law shows many other instances of duplication which need not be repeated.

The result of this situation is one which would seem quite predictable. Informal working arrangements have been established to some extent in the higher levels of the agencies, and the officials at the ports of entry have operated in the dark (*53*). Primate importation in particular has been left almost entirely in the hands of HEW personnel at ports of entry, and this has come about primarily by a process of default. Discussions with officials of each of the four agencies at the Port of Boston disclosed the following working arrangements.

1. An HEW quarantine inspector makes an investigation of sorts, i.e., he will try to look at the primates that have arrived. This usually means the ones that are visible through the cages. He will check to see if the yellow fever regulations have been met, but will not check cage specifications beyond what is required to make them mosquito-proof. If he admits the primates, which he will usually do, he stamps "Passed" on the Customs entry permit. The inspection thus described is apparently considered a high standard of compliance with the current regulations by the officials interviewed. It is unlikely that there is very much more than a cursory examination of the animals, their cages, or containers. No instances of reporting shippers to Customs for Lacey Act violations were mentioned. It should be added that the officials interviewed

found it necessary to find a copy of the regulations and read from them to inform this writer of what they did. This cast even graver doubt on the degree of enforcement of the regulations.

2. The officers at the Import Specialist Section of the Customs Bureau in Boston were totally unfamiliar with any aspect of primate importation. After some time, an officer was found who knew that "primates" meant "monkeys" and who said that if the Public Health people stamped "Passed" on the entry permit, Customs was satisfied. Satisfaction of the Lacey Act requirements for the humane and healthful transportation of wildlife was most unlikely since the officers seemed to know nothing about the subject. As one officer put it, "we don't have anything to do with that."

3. The officers of the Department of Agriculture's quarantine and inspection facilities said flatly that primates were none of their business.

4. Officials at the Fish and Wildlife Division of Control said they had not been told specifically to do anything about primates, but that if they were, they would certainly carry out the regulations given them. One official of Fish and Wildlife who had been with the Port of New York for many years responded to a question put to him by saying that he used to wonder what they did in New York with all the dead monkeys, but he never found out.*

There is no evidence that the situation at Boston is atypical. Indeed, it seems reasonable to suggest that larger ports with much heavier traffic might well give even less attention to incoming primates. It is true that the yellow fever regulations are generally enforced, but there is reason to question the value of such enforcement. One basis for question is the meaningfulness of the designated yellow fever areas. These are supposed to be revised every two weeks. On the basis of the above interviews, the most recent one at the writing of this paper listed the following countries: Angola, Congolese Democratic Republic, Ghana, Liberia, Nigeria, Sierre Leone, Sudan, Brazil, Colombia, and Peru. It might well be asked how meaningful it is to designate such massive land areas as infected with yellow fever, when in reality the disease is probably limited to regions within those countries. It also seems fair to question the significance of the yellow fever regulations in light of the fact that the diseases discussed earlier in this paper are totally unregulated. Why should primates be checked at all if only one of many serious diseases is to be looked for and that one disease may well be the least dangerous in terms of reliable treatment and fatalities? It should further be asked how meaningful it is to check all primates coming into the United States from areas where there is evidence that not all species carry the disease (*18*). A final reason for questioning the value of the yellow fever regulations is based upon a recent paper which found that the yellow fever vaccines are of low potency and that a number of animals vaccinated for yellow fever are entering the country without antibody to this virus (*21*, pp. 560, 566).

Even if the regulations were carried out in their entirety and with a high degree of skill, there remains the fact that many diseases remain unknown or undetectable. But, if we were to assume total knowledge of all dangerous primate diseases or all carriers, a myriad of practical problems would prevent the present system from working. Under HEW regulations alone, each primate would have to present "no evidence of a communicable disease" (41). To make a certification to this effect, medical officers would have to perform an un-

* Each of the officials interviewed in Boston on 21 and 23 February 1968 was in a position of responsibility in this area and requested that his or her name be withheld.

doubtedly large number of examinations and tests on each animal. But the evidence available is that they are hard pressed to find the time to look for such things as emaciation, lesions of the skin, nervous system disturbances, jaundice, or diarrhea which are indicated as part of the officers' responsibilities under the current regulations (*55*). Furthermore, even if there were some way of testing for all serious primate diseases, and the personnel were available to carry out such a program, the animals might well have to be in quarantine for very long periods of time to discover latent infections. An example of what such a program could entail was given indirectly in a paper which found that positive B virus antibody titers did not diminish in frequency among individually caged, closed colonies of primates for a period of 20 months (*56*).

If HEW were capable of carrying out the program hypothesized above, the considerable expense in time and money which it would entail would be borne by the owner under the present system. If the medical officer in a given case found evidence of a communicable disease, the owner would face the alternatives of having the animals either exported or destroyed on the one hand, or of calling in his own veterinarian to make tests and examinations on the other. The latter alternative would produce greater expense, and the medical officer would only be required to "consider" the findings of the private veterinarian. During this period the animals would be detained at the owner's expense, and the end result might be exportation or destruction anyway. If exportation is used, the owner must continue to bear the expense of detention until the animals depart (*57*).

It should be clear that the present system working at its best would be expensive and time-consuming and that it would inevitably result in a large decrease in the numbers of all primates imported into this country. That this would be a serious blow to research institutions, pharmaceutical houses, zoological societies, and to the public served by them is unquestionable. Furthermore, once animals were at last admitted into the country, the present system would be satisfied; its job would be completed. There is no responsibility to report to any of the agencies the subsequent fate of imported primates. There is no requirement to report to the Federal agencies cases of primate-caused human disease or death.

The present system also requires no meaningful certificate of origin. The individual or institution acquiring primates, will, along with the Government, receive shipping documents or health documents from other countries. These documents generally state the port of departure of the animals, which is of comparatively little value for epidemiological purposes. One study using *Cercopithecus aethiops* gave details on the acquisition of the animals which demonstrate the virtual worthlessness of knowing the port from which the animals were sent. It was pointed out that, among others, there were three dealers in Nairobi (all of whom were used) who collected the primates from Kenya, Tanzania, and Uganda, depending upon trapping, political, or weather conditions (*58*). Yet all of the monkeys would be shipped from Nairobi Airport, and that would be the consignor's sole information on their origin. What is especially telling about this lack of definite information was pointed out in a study of the behavior of *Cercopithecus aethiops*. These primates, which have an immense range of distribution (greater than the territory of continental United States), live in what were described as relatively stable and *closed* communities. These communities varied in number but had a mean of 24 individuals. Their home ranges were found to vary from 0.071 to 0.037 square miles and their home territories from 0.067 to 0.30 square miles (*59*). Similar

observations have been made with regard to *Macaca mulatta* (*60*). Acquisition of animals which live in such limited territorial colonies could surely be more specific with regard to actual origin than the airport from which they were flown. While other species may be far-ranging and less communal, the importance of the data which could be collected on the origin of imported primates is the basis of the following recommendations.

A PROPOSAL

Transportation

Despite the legislation previously discussed, which had among other goals the assurance of humane and sanitary transportation of wildlife, it is clear that with respect to primates this problem has not been eliminated. Perhaps because of this, some institutions have examined the process of primate acquisition from capture to arrival at the final destination and have experimented with systems of acquisition which they devised. One such study was conducted with *Macaca mulatta*, put into individual cages which had been carefully designed to prevent contact between individuals and to maintain nutrition at the time of capture. The primates traveled in these cages, under careful supervision, from India to New York. The conclusion of the consideration of this method presents a convincing argument for requiring it in the transportation of all primates:

> Observation of these monkeys, when compared with monkeys housed in gang cages or isolated only on arrival, indicates a marked decrease in enteritis and pneumonia, and an improvement in general health and condition. (*61*)

It has been pointed out above that other diseases increase in frequency in overcrowded traveling conditions (*15*,*21*).

It is proposed that all primates entering the United States arrive in individual cages which have been constructed in a fashion to permit supervision and maintenance of nutrition while preventing contact between individuals. This method will not only result in healthier primates arriving in this country; it is also necessary for the implementation of the rest of this proposal. Violations of this requirement will be detectable by simple inspection of the facilities together with their certificates which will be discussed below. The penalty for violation will be the same as under current law; the animals will either be exported (preferably) or destroyed (*44*).

Certification

Without accurate information on the true place of origin of imported primates, it is not possible to carry out the responsibility of designating areas of contagion and regulating importation from such areas which is already imposed by law (*46*). Obtaining that information together with other data could accomplish much more than enabling current statutes to be viable; the benefits to be derived from the following program will be elaborated after the proposal has been set out.

It is proposed that every primate entering the country bear an individual certificate. The certificate should contain the following information: (1) a statement of the place of capture of the animal; (2) the name of the port from which the animal was shipped and the names of all places where the vessel carrying the animal stops; (3) the names and addresses of the broker, intermediary dealers, and consignor of the animal; (4) the common and scientific names of the animal; and (5) a statement to the effect that the animal has been shipped in accordance with the method described in this subsection of the proposal;

the statement is to be signed by an agent of the shipper.

The required information is only slightly more than is already required by Fish and Wildlife Declarations of Importation (*36*), and could be placed on compact data processing type cards like these used by the Internal Revenue Service and Customs. The cards would be placed into a central data processing system, each card having its own identification number. Falsification of certificates would be subject to criminal sanctions.

Information and Reporting

It is proposed that each animal arrive at its final destination with the identification number assigned it through the certification procedure. Upon receipt, public or private institutions, dealers, or individuals will all be required to report the acquisition within 10 days. If the animal dies or escapes, a report must be made within 24 hours. This procedure is of the sort already required by the Fish and Wildlife Service for animals imported subject to its permits (*62*). In addition, a report will be required in case of outbreaks of disease within a colony of primates or instances of human disease or death believed to have resulted from contact with primates. This report must also be given within 24 hours of the discovery of such conditions, even though it has not been possible to make a complete diagnosis of the disease or diseases involved. Fines for violations should be set at comparatively high levels, and unannounced spot checking by field investigators could be used to implement the reporting requirement in cases of institutions or individuals that have been uncooperative (*63*). The data received in the reports will be fed into the central data processing system.

Administration

It is proposed that the administration of this entire program be the responsibility of the Department of Health, Education, and Welfare.

The above proposal obviously rests upon the conclusion that the most urgently needed and most effective method for dealing with the problems of primate disease is a comprehensive system of data collection. Quarantine procedures would be left to the institutions or individuals receiving the primates. Recipients would be subject, however, to the same investigation of the quality of their facilities and personnel that is now carried out by Fish and Wildlife (*64*). Procedures will probably vary from one institution to another depending upon the species used and the purposes for which they are intended. This method will permit elimination of the possibility of double quarantine. As has been discussed above, there is reason to doubt the effectiveness of current public quarantine measures with respect to primates (*18*, *21*, *41*, *55–57*). Furthermore, since the facilities in which the animals are detained must be paid for by the owner, and since the owner at that stage is often a broker who is seeking to keep his costs as low as possible, the unsanitary conditions in which the primates are often held would be replaced by the approved facilities of the owner who has a stake in maintaining the health of the animals and not merely keeping them alive until delivered.

The certification procedure is the heart of the program, and if properly carried out it could solve several problems simultaneously. The certificate would help to enforce the transportation regulations. It would provide the data which would be centrally collected by the most advanced and rapid processes. When such detailed information is collected, it will become possible to almost pinpoint

areas of contagion—the more complete the information, the greater will be the accuracy of epidemiological determinations of primate disease areas (*65*).

The information and reporting requirement will allow individuals and institutions to be warned when they have animals which came from the same dealer, broker, or capture areas as animals reported to be infected or causing infection. Those warned could then take steps to prevent the occurrence or spread of the conditions in their own colonies and institutions. In cases of severe outbreaks, the information feedback would allow determinations to be made and carried out with some assurance of success under the power to halt importation from certain areas entirely (*46*). It would be possible to keep an almost daily log of the state of primate importation and disease control through the use of data processing techniques. The central system could be tied in to the regional primate centers' biological data storage and retrieval system (*5*, p. 1486).

This system would require the reporting of information which in the past has been reported only when some individual or team felt like publishing an article upon a particular occurrence of primate disease. For example, Powers *et al.* (*66*) stated in 1966 that hydatid disease, at least in the United States, was rarely reported in nonhuman primates. The system would also provide a means of protecting owners of primates as pets by allowing dealers informed of disease conditions in stock they have sold to warn owners by tracing them through the registration number of the animal. Great Britain is currently confronting this last problem and may well require pet primates to be licensed under the same system used for laboratory animals (*67*).

Placing the job of administration in the hands of the Department of Health, Education, and Welfare seems warranted for many reasons. In the first place, it is the only agency of the Federal Government that is primarily and continually involved with health matters and the collection and dissemination of health information (*68*). That HEW's National Center of Health Statistics is the most appropriate institution for the central collection of data as proposed in this plan is strongly suggested by the following:

> The National Center of Health Statistics is the Federal Government's general-purpose statistical organization for the collection, compilation, and dissemination of vital health statistics to serve the needs of all segments of the health and related professions. *The Center stimulates optimal use of technical and methodological innovations in collecting, processing, and analyzing demographic and health statistics*, and provides a source of technical assistance in these areas. [Emphasis added] (*69*)

Also of significance to the choice of HEW for the implementation of the proposal is the following:

> The Division [of Foreign Quarantine] seeks to expand its epidemiological information program so as to acquire, analyze, and disseminate information concerning the geographical locations, incidence, and short-term variations of quarantinable and other dangerous diseases. By providing this information to the appropriate local, State, Federal and international agencies, the risk of spreading such diseases will be minimized by speedily allowing for appropriate immunizations and other specific control measures. (*70*)

While primate quarantine would be eliminated under this proposal, the above statement indicates the desire and experience to carry out this type of a plan.

It is submitted that this program would allow for the speedy entry of primates into the United States so that they could be quickly transported to their owners while providing the most badly needed tool for effective primate disease control: a comprehensive central data collection and dissemination system.

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NONHUMAN PRIMATE COLONY

CONSTRUCTION AND OPERATIONAL COSTS

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The ultimate in nonhuman primate husbandry is to provide the best possible housing, food, veterinary care, and colony management commensurate with the state-of-the-art at any given time. Each of these factors will be influenced by the type of facility provided. With the enormous increase in popularity and demonstrated value of nonhuman primates in biomedical research, it is incumbent upon management and investigators to insist that these extrinsic factors be given full consideration. To do otherwise would contribute many artifacts to the research data derived from animals in a marginal state of physical or mental health.

The complex social characteristics and level of intelligence of nonhuman primates necessitate serious consideration in housing to provide for their physical, social, and psychological welfare as well as for the physical protection of the personnel. Proper handling and restraint functions also require appropriate facilities and equipment.

The design, construction, and operation of a nonhuman primate facility, irrespective of the species concerned, should not be stereotype in character. Conversely, facilities must be designed to meet the requirements of the species to be housed, the local climatic conditions, and the needs of the investigators using them.

It has been shown to be very expensive and myopic to build a facility to meet only thoses known requirements of the scientists to be served as of the date the new building is to be completed. Thus, flexibility of design and functional features must be constantly kept in sharp focus. Proper size and design features, including flexibility and expansion capability, should be incorporated. It would seem appropriate, therefore, that the following factors should be utilized as a basis for determining needs at the onset of a facility-planning program:

Species of animals to be housed.
Approximate number of each species to be housed at any given time during the first three years of operation.
Caging method (e.g., single-animal or gang cages).
Type of investigations to be performed.
Approximate duration of the studies involving a given animal.
Type of waste material, including exhausted air, requiring special disposal equipment (e.g., infectious and radioactive wastes).
Method of liquid and solid waste disposal (e.g., manual or automated).
Cage cleaning methods.
Methods of water and food dispensing.
Environmental factors (e.g., ambient air temperature and humidity, air changes per hour, light intensity, odor control).

* Director, Animal Resources and Facilities, Southwest Foundation for Research and Education, San Antonio, Texas.

The recommendations of a veterinarian experienced in the day-to-day operational problems associated with a nonhuman primate colony (consideration of such recommendations should be an integral part of the planning-phase activities).

In view of these requirements, some generalized statements can be made that should prove useful to those planning a nonhuman primate colony.

BUILDING DESIGN

It is not sufficient to select at random an architectural engineer to design an animal building. Within the past five years the design of nonhuman primate facilities has become a new subspeciality within the architectural-engineering profession.

The design of a building to house noninfected, infected, or gnotobiotic animals will differ in specific features. Nonetheless, certain concepts will be applicable to each. Such factors as room size, ventilation system, personnel and materials flow, and the relationship of the animal room to sick bay, surgery, treatment room, etc., must be given ample consideration. The objectives should be to (a) provide housing commensurate with the needs of the species concerned, (b) minimize the possibility of cross contamination, and (c) reduce manpower requirements within practical limits. A properly designed ventilation system will assist greatly in preventing the distribution of airborne contaminants from one room to another. Consequently, each room should be provided with 100 per cent fresh conditioned air. Depending on the species requirements and the experiments to be conducted, the air should be maintained in the range of 70°–85°F (21°–29°C) with a velocity of 12–18 changes per hour.

There are very few scientifically established criteria available for describing optimal environmental conditions in nonhuman primate housing facilities. Such factors as temperature and humidity ranges, air changes per hour, and light intensity are found to vary considerably, and the size and configuration of the cages often vary with the whims or desires of institutional directors and/or investigators. Until scientifically established environmental and design criteria are available for housing and caging, guides by experienced veterinarians or other scientifically oriented personnel should be used as basic criteria. These should be modified to meet the special requirements on an individual colony basis.

In 1967 the U.S. Government published minimum standards for the housing of nonhuman primates. If the emphasis is placed on the word "minimum," these standards will serve as a useful guide. Additionally, the Institute of Laboratory Animal Resources of the National Research Council is currently printing a new set of "Standards and Guidelines for the Breeding, Care, and Management of Nonhuman Primates." This guide, devised by persons having considerable experience with the housing of nonhuman primates, should also be helpful to the planner.

CONSTRUCTION COSTS

One can only gereralize as to the cost of construction of a facility without being specific as to the species concerned, type of experiments, geographic location, the numbers of animals involved, etc. As shown in Table 1, construction costs of colonies located in different sections of the United States vary as much as 400 per cent.

To illustrate types of facilities as well as construction costs we will briefly discuss the buildings at the Southwest Foundation for Research and Education (SFRE), San Antonio, Texas, and at the New York University Medical Center.

SFRE FACILITIES

Group Caging

The outdoor facility shown in Figure 1 contains 9 cages, designed to house 28 adult baboons per cage. Each cage provides 37½ square feet of floor space per animal. The facility is of concrete construction with 8-guage galvanized iron wire used to form the domed enclosure. The individual cages are 50 by 21 feet; the wire dome is 25 feet high in the center. Each cage contains a hutch (Figure 2) with a radiantly heated floor. The cost of the section, constructed in 1967, was $10 per square foot.

TABLE 1. Construction costs of U.S. facilities.

Facility	Region	Cost (*dollars per sq. ft.*)
1	Northeast	50.00
2	South	25.00
3	East	29.50[a] 50.90[b]
4	East	35.00
5	West	65.00
6[c]	Northeast	20.00
7	Northeast	11.00
8	SFRE (Southwest)	8.75–15.75

[a] Small primates.
[b] Large primates.
[c] Built in 1964

Individual Caging

One method of housing individually caged baboons is to use a building wherein a large number of individual cages can be conveniently handled.

The building shown in Figures 3 and 4 has proven especially useful in the San Antonio climate. The four sides can be opened completely. This is accomplished by using garage doors as side walls. These are closed in cool weather and opened in warm weather. The roof is a structural steel truss system with metal deck and 3 inches of light weight insulating concrete covered with built-up gravel. In the winter the doors are closed, and the air is heated by the radiant heating system built into the floor.

The construction cost of this building was $8.79 per square foot. It has a capacity of 110 cages and contains 5,000 square feet.

The cages are suspended from overhead pipes. Each cage contains an automatic drinking fountain (Lixit), feed bowl, and refuse pan. The rear wall of the cage, which is mounted on brass casters, is moved with a hand-activated gear. Thus, each cage is in essence a squeeze cage.

When it is desirable to house individually caged animals in smaller groups, a building containing several small rooms can be designed. A convenient configuration for such a building is shown in Figure 5. This building includes three bays of 24 cages each, an infant infirmary, and examination room. The cages face the service aisle, while the backs are suspended over a refuse gutter. This arrangement facilitates handling the animals and also simplifies waste disposal.

The windows are 7 feet high and extend the full width of each bay. These are opened in the summer time, and with the aid of exhaust fans installed in the ceiling a comfortable temperature is maintained. Heating is accomplished by a gas-fired furnace with a forced air distribution system.

The structural features of this building include a concrete slab floor supported by concrete piling. Cinderblocks are used for the walls and partitions, while the roof is poured concrete. The cost of this 3,500-square foot building was $15.00 per square foot.

Quarantine Building

Associated with the operation of a non-human primate colony is the function of receiving, isolating, and conditioning new

FIGURE 1. Outdoor baboon facility, Southwest Foundation for Research and Education, San Antonio, Texas.

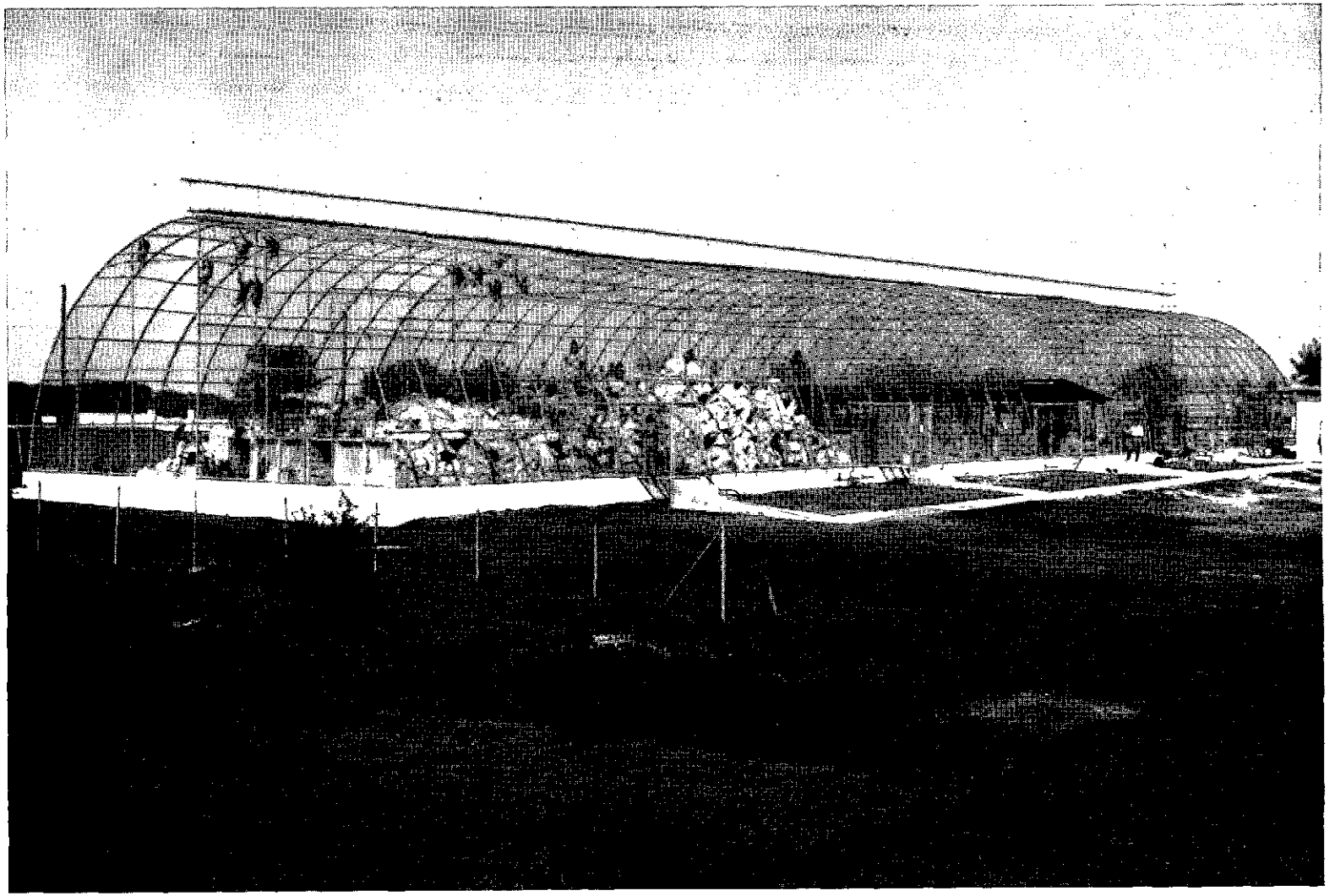


FIGURE 2. Detail of concrete hutches in facility shown in Figure 1.

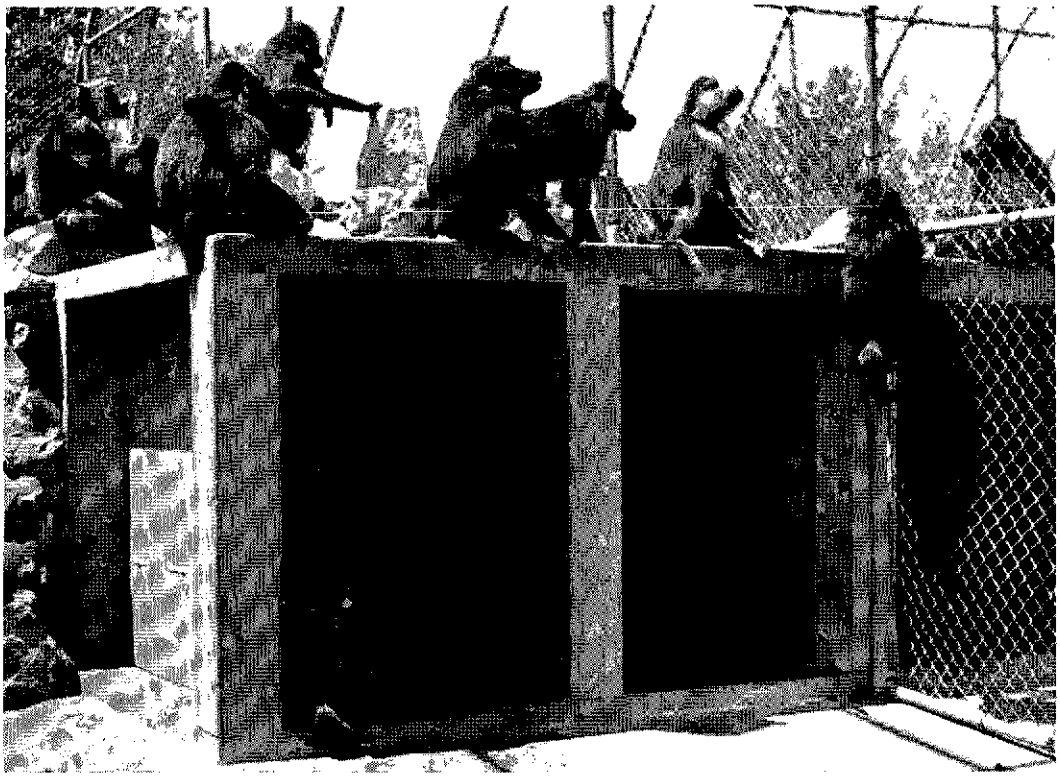


FIGURE 3. Facility with garage-door side walls, opened in warm weather, Southwest Foundation for Research and Education.

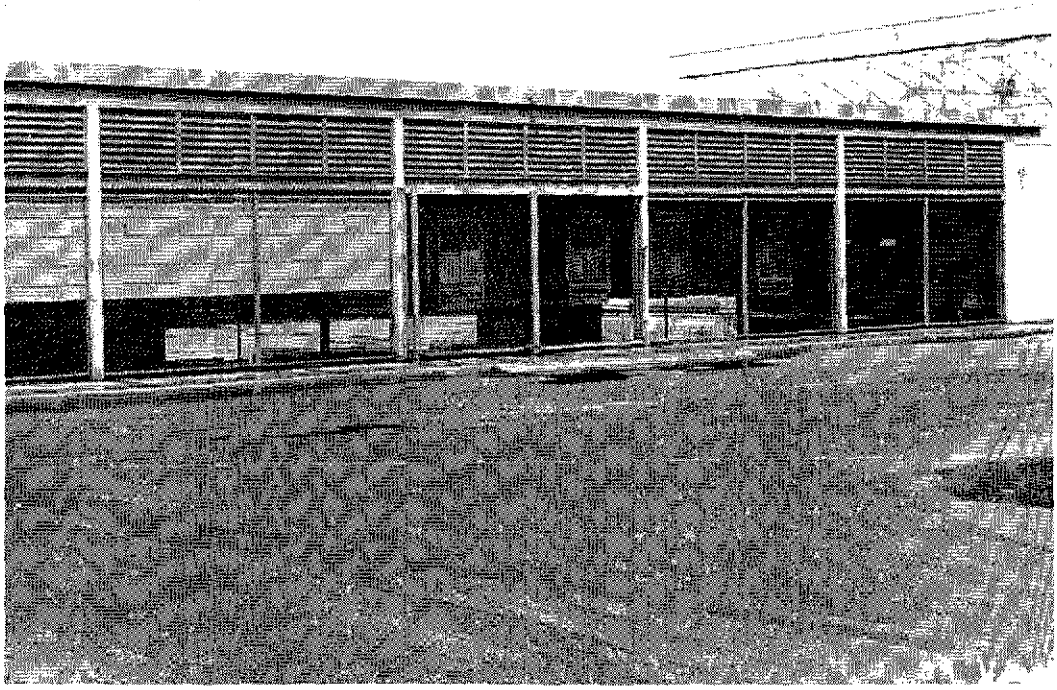


FIGURE 4. Cages in facility shown in Figure 3.

FIGURE 5. Design for an indoor facility to house individually caged animals in small groups.

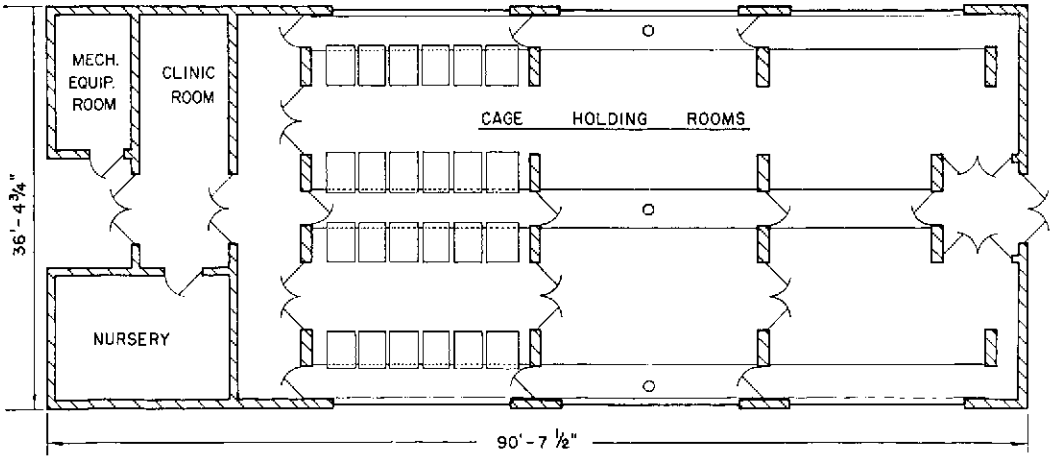


FIGURE 6. Animal room in quarantine building, Southwest Foundation for Research and Education.

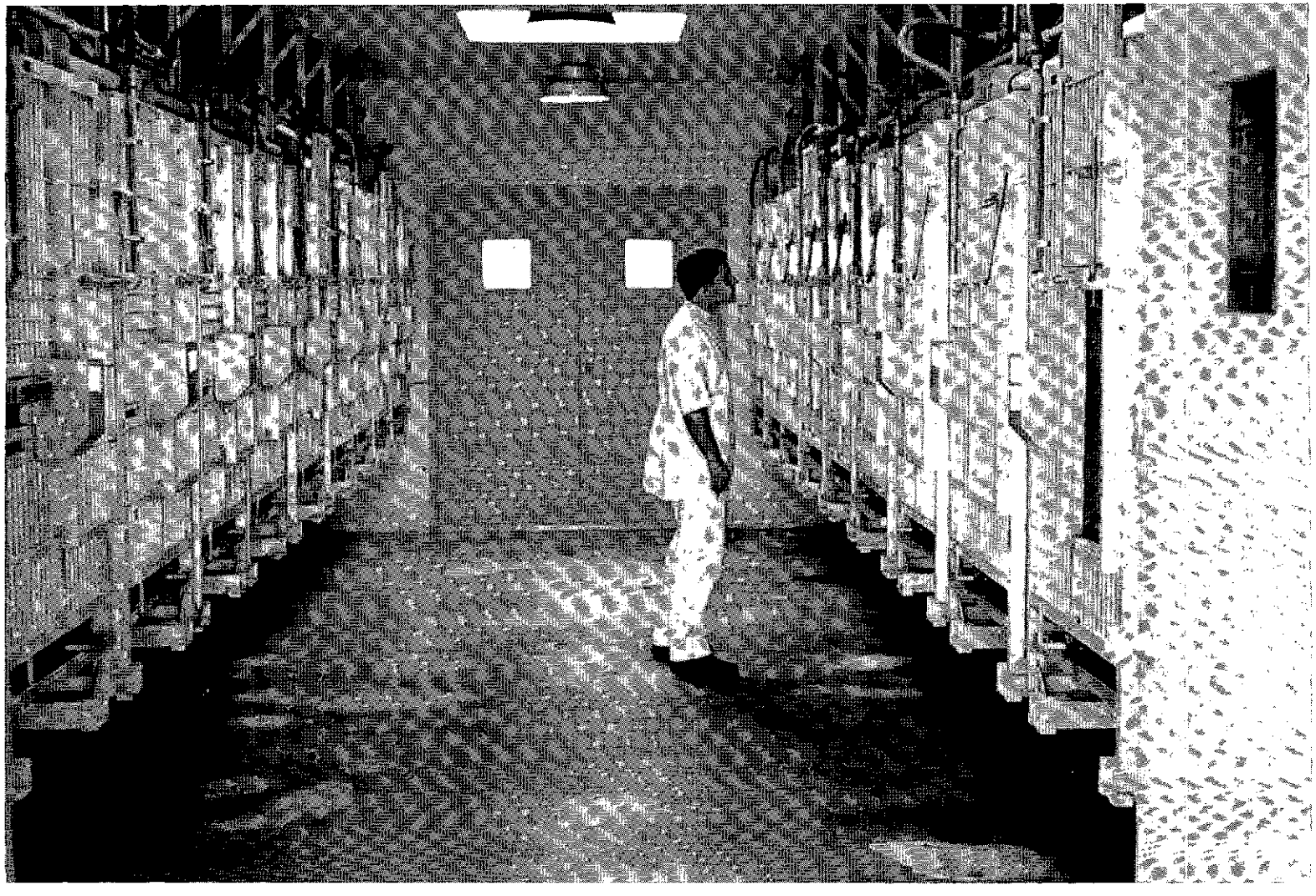


FIGURE 7. Chimpanzee facility, Southwest Foundation for Research and Education. 1—Sliding gate (woven wire); 2—sliding solid metal door; 3—guillotine solid metal door; 4—hinged gate (woven wire); 5—concrete sleeping pallet with radiant heat.

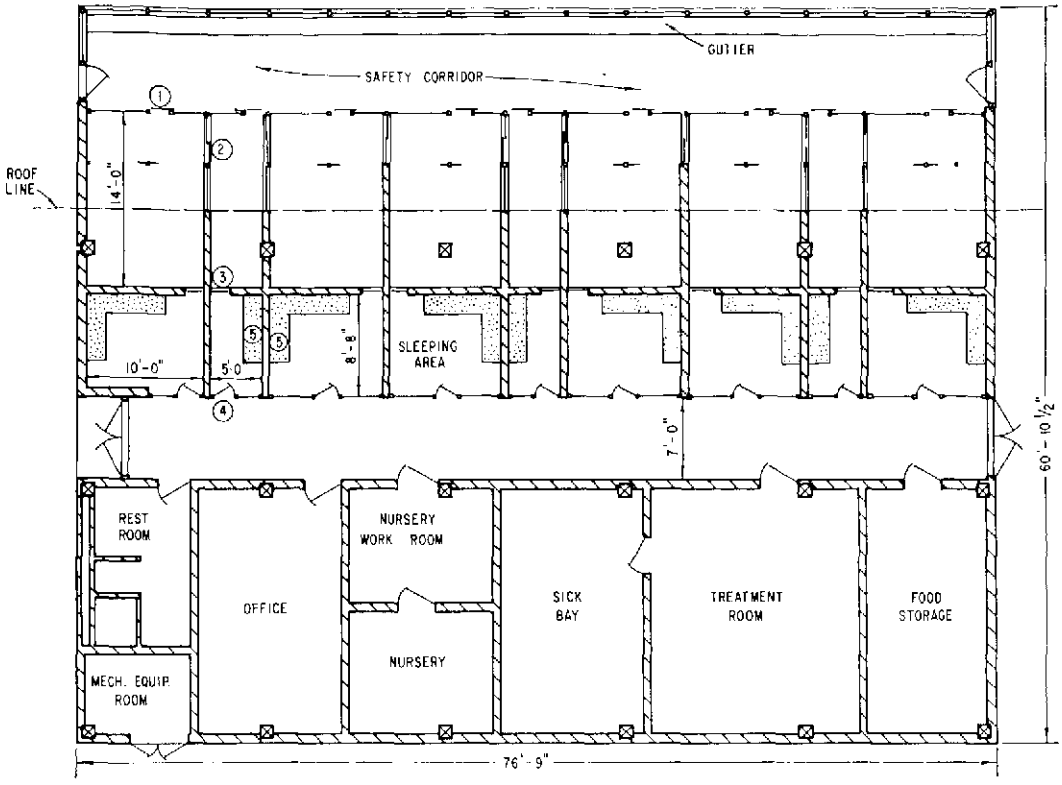


FIGURE 8. Radiantly heated concrete resting pallet in chimpanzee facility.

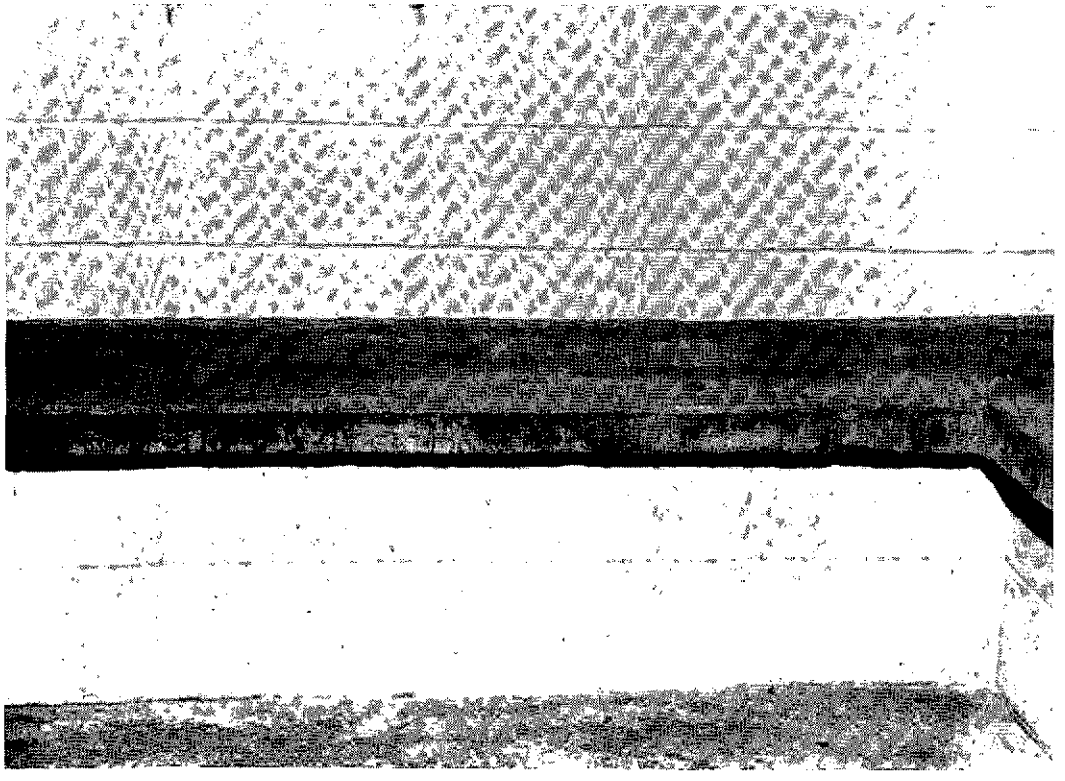
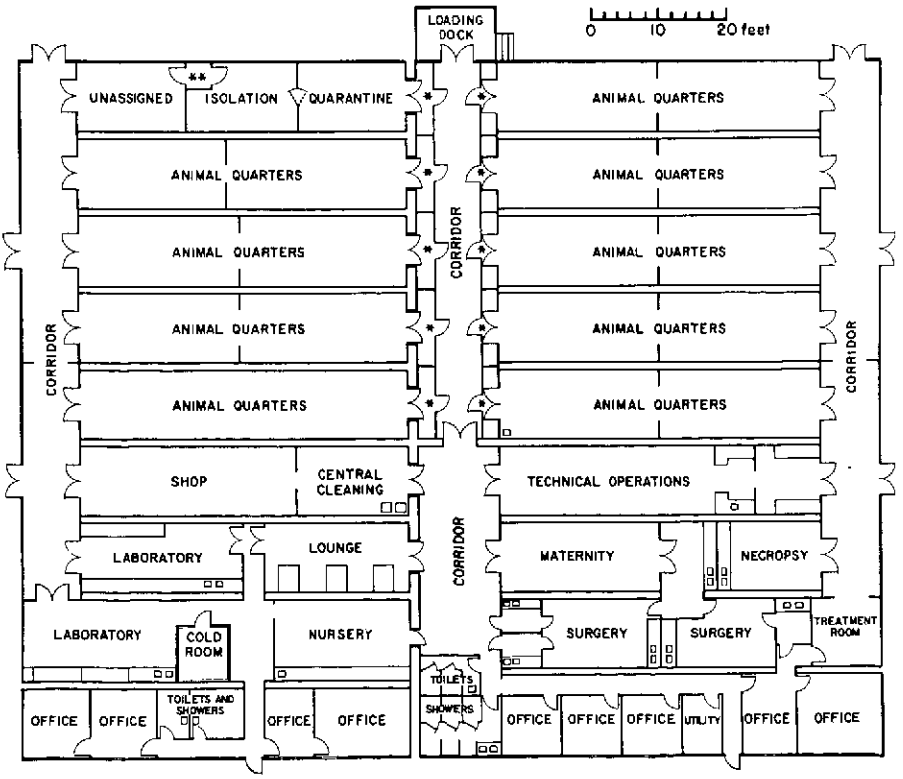


FIGURE 9. Animal housing in mobile vans on permanent foundations, New York University Medical Center facility.

FIGURE 10. Plan of facility shown in Figure 9. Single asterisk indicates anteroom acting as airlock; double asterisk indicates airlock.



arrivals. Consequently, provision must be made to house these animals, preferably isolated from the main colony, in order to determine their health status and prevent the introduction of infectious diseases into the main colony. This building is also used to condition the animals so that the minimum physiological standards required for specific research efforts can be accomplished.

This facility includes, in addition to the animal rooms, clinical bacteriology, histology, and necropsy laboratories. The animal rooms (Figure 6) were designed on the same general basis as the three-bay building previously discussed. However, since animals are received from Africa in shipments of 20 each, it was considered desirable to quarantine all animals in one shipment in the same room. Consequently, four rooms with a capacity of 20 animals each were constructed.

In view of the quarantine function and the inherent possibility of cross-contamination, individual air-conditioning and heating units, providing 100 per cent fresh air, are available for each room. The remainder of the building is serviced by separate units.

This building is of concrete slab construction with cinderblock walls and partitions. The roof is of poured concrete with hot-mopped tar topping. The cost of this 10,800-square foot building, including laboratory benches only, was $15.75 per sq. ft.

Chimpanzee Housing

The physical features of a facility to house chimpanzees are different from those for smaller nonhuman primates. Chimpanzees are exceptionally strong and prefer to be housed in small groups. Ideally, they should be afforded more floor space per animal than the others. Whenever possible, an indoor-outdoor caging arrangement should be provided.

The SFRE chimpanzee building, measuring 76 by 60 feet has cinderblock walls. The floor is smooth-troweled reinforced concrete, and the roof is poured concrete. Its outdoor exercise areas face south.

Figure 7 shows the floor plan of this building. The animal quarters are adequate for chimpanzees of all ages. They are comfortable, durable, easily cleaned, and inexpensively maintained. The inside access door and the front of each cage are made of 6-gauge galvanized iron woven wire, which permits maximum visibility of both the animals and their quarters.

Within each of the indoor cages is a concrete resting pallet (Figure 8), which permits the chimps to rest off the cool floor and away from wastes; in the winter they are warmed to a maximum of 70°F by radiant heat.

Each indoor cage joins an outdoor exercise area through an opening with a guillotine-type metal door. Part of the cage ceiling is woven wire that allows the animals adequate exposure to direct sunlight. The remaining concrete portion of the ceiling creates shade where the chimps may seek protection from the sun's rays. A two-way safety lock system controls each remotely operated guillotine door. This system enables the attendants to lock the chimpanzees in either the outdoor or indoor compartments while they clean and inspect the quarters. The men can lock the door from either compartment to prevent the accidental release of a chimp into the quarters where they are working. Sliding panel doors in the walls of the outdoor cages permit easy and safe transfer of chimps between compartments. This 4,000-square foot building costs $15.25 per square foot.

NEW YORK UNIVERSITY MEDICAL CENTER FACILITY

A new approach to animal housing has recently been conceived. This is the use of

TABLE 2. Operational costs (per animal) of U.S. facilities, by regions[a]

Animals	NE	South	East	East	West	NE	NE	SFRE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rhesus	$0.86	$1.10	$1.00	$1.50	$0.79/1.15	$0.60	$1.17	
Squirrel monkey	$0.50	$0.90	$0.50	$1.25	$0.51		$1.17	
Marmoset	$0.30			$1.25			$1.17	
Baboon	$1.00	$1.10		$2.80	$1.15		$1.17	$1.15
Chimpanzee	$4.00	$3.42	$3.50	$3.50	$3.50		$1.17	$4.68

[a] Numbers in parentheses refer to facilities listed in Table 1.

mobile vans placed on permanent foundations (Figures 9 and 10). These vans afford all of the features of permanent type buildings, including air conditioning and heating, plumbing, storage, etc. The animals in each van can be considered as a physically isolated colony subject only to the cross-contamination factors generated by the personnel working in them.

This concept merits serious consideration, especially where the animals are required continually to be housed indoors. It is conceivable, however, that an outdoor cage could be built adjacent to each van. Furthermore, it appears to be ideal for a new colony started with limited funds, inasmuch as its flexible and expansive capability is quite apparent. The cost of this facility was $11.00 per square foot, including the air-conditioning and heating system and all utilities.

OPERATIONAL COSTS

Certain basic costs will be applicable to all colonies, e.g., costs of personnel, supplies, services, etc. Other costs, such as utilities, amortization of the real property, taxes, and insurance, are seldom prorated for each operational section within an institution. Frequently these are considered as basic to the total operational cost and are commonly referred to as general and administrative (G&A) expenses.

To arrive at a realistic figure for operational purposes, one must include all categories of expenditures other than G&A. At the Southwest Foundation for Research and Education the cost per day for one baboon is $1.15, while the cost per day for one chimpanzee is $4.68. The great disparity in costs is of significance to management. In all business ventures there is a so-called "breakpoint," above which the cost per item is reduced as the number increases; conversely, the same mathematics is applicable. The Foundation's chimpanzee colony consists of 15 animals, attended by three animal technicians and one-third of one veterinarian's time. It is recognized that this same staff could very adequately care for at least 45 chimpanzees, which would reduce the average daily cost to $1.56. Nonetheless, considering the 7 day per week requirement, the 40-hour work week, and the safety factor of having two persons in the building when animals are worked, we consider this staff to be optimal.

Table 2 indicates that maintenance costs per animal vary with the species and institution. As illustrated by the SFRE chimpanzee colony, the larger the colony the fewer animal handlers per given number of animals will generally be required. This factor will vary considerably, depending upon the nature and duration of the experiments in progress.

When a manning document is to be devised, the prudent manager/planner will

determine all functions to be performed by the animal handlers, including the extent of participation in research support. With this information available, the following manning averages on a 7 day per week basis can be used as a guide:

	Animals per handler	*Min. handlers for colony*
Chimpanzees	10–15	3
Baboons	25–30	3
Rhesus	60–80	3
Marmosets	80–100	3

The labor costs per man will vary with the position requirements and the local prevailing wage for this category of employee. At SFRE untrained new employees are paid the Federal minimum wage rate of $1.60 per hour for a 40-hour week. In some cities and at remotely located facilities this minimum wage is not sufficient to attract suitable employees, and the minimum rate per hour might have to be increased to $2.50 or more.

HEALTH PROBLEMS RELATED TO THE IMPORTATION-EXPORTATION OF RODENTS FOR RESEARCH

HENRY L. FOSTER, D.V.M.*

Surveys conducted on the use of laboratory animals indicate that laboratory rats and mice are utilized for medical research in greater numbers than all other species. If my information is correct, in the United States alone some 37 million mice and rats are reared and used annually by industrial, academic, and Government institutions. It is certain that some of these animals are exported to laboratories outside the continental United States, and conversely significant numbers of rodents are imported. Therefore, it is important that users of these species understand some of the epidemiological implications when shipping or receiving laboratory rats and mice so that precautions can be exercised when preparing for transport or receipt of animals.

It has been my good fortune to have visited many research laboratories and breeding institutions in different parts of the world to observe their methods and facilities. This experience has drawn to my attention the fact that each area visited seems to have learned to live with diseases commonplace to that country. However, for some reason they do not seem overly concerned with the introduction of new diseases from the outside nor the export of their animal diseases to other laboratories. Then, of course, there are specific situations in individual research institutes where the nutritionist, endocrinologist, or biochemist, for example, not specifically trained in animal husbandry and pathology, is completely unaware and unsuspecting of the consequence of bringing animals into his laboratory from undefined sources. Actually, this risk is also present when animals are introduced from an unknown domestic source into a stabilized environment containing animals from a proven supply. The principles are the same, the difference being that on one hand, when importing and exporting across borders, the hazards are international in scope, whereas, in the case of domestic transport within the United States, the chances are that the risk is localized. If we follow this thinking through, major airport gateways can act as reservoirs and dissemination depots for disease whether animal transport be local, national, or international. Of course, this necessarily will always be a problem to some degree until all laboratory rodents shipped are free of pathogenic life or are germfree animals.

Let's explore some of the specifics relative to health problems. There is the very difficult situation created by the fact that health status cannot be fully determined by physical appearance and clinical examination alone. Only in severe, debilitating disease does the animal's general appearance suffer. If one is to rely on the demonstration of obvious physical abnormalities, gross miscalculations can be made. For example, one group of rats is seen to have stained hair

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coats evidencing some sort of gastrointestinal disorder such as salmonellosis, severe gastrointestinal parasitism, or protozoan infection, to mention only a few. Quite surely the veterinarian or lay person asked to pass on the health status, based on these gross findings alone, would in all likelihood brand these animals as unhealthy. These rats, however, are in fact germfree animals, absolutely microbiologically sterile. They are free of all bacteria detectable by currently known techniques. In addition, they have serologically been tested and are negative to 10 common murine viruses. Their gut tract has been extensively examined and they are free of intestinal parasites. The reason that their hair coats are soiled is that germfree rats, devoid of an intestinal flora, (unlike the mouse) have loose, poorly formed stools on standard fortified diets. In a second instance, a group of rats appear to have clean coats and to be in good flesh. They are active and vigorous and therefore would, in general, be considered healthy. These rats have been experimentally infected with several murine viruses, oxyurids, *Pasteurella*, *Pseudomonas*, *Proteus*, and *Mycoplasma*, all capable of producing clinical signs under the proper conditions. However, ostensibly these rats appear healthy, and, if their status were to be determined on purely physical appearance, in all likelihood they would be deemed completely healthy, whereas in fact they have been experimentally infected.

Let us speak a moment of the common murine viruses. With the exception of a few of these viruses, such as ectromelia, mouse hepatitis, and infant diarrhea, most of these agents do not produce clinical signs under normal conditions. Routine complement fixation (CF) and hemoagglutination-inhibition (HI) tests are available and easy to perform for most of these agents. There are also commercial testing laboratories that perform these tests for laboratories not equipped, and training programs at the Communicable Disease Center, Atlanta, are available for those desirous of learning the technology. Therefore, I personally would encourage all to know the status of the animals they are working with or propose to bring into their laboratories whether they be imported or obtained domestically.

As for common bacterial infections, simple methods have been described in the literature for most of the common diseases, both on the living and the sacrificed animals. In addition, there are many stress tests available utilizing steroids and environmental stress chambers which make bacterial isolation easier after the pathogen has taken hold of the weakened host.

I point out the above to alert those who may not regularly work with small laboratory rodents to the fact that the tools are at hand for practical and reliable laboratory and clinical diagnoses of diseases common to the species. In addition to the in vivo tests, the utilization of the germfree rat and mouse provides the perfect in vivo test system since they are the natural sterile hosts of most agents to be tested.

There are special situations when animals known to carry infections must be transported from country to country in order to continue vital research in progress and to re-establish populations of specific strains where source material is limited. To elaborate, many valuable tumor lines are being carried in mice and rats in many instances irrespective of the animal's microbiological status. Research programs being conducted throughout the world among oncologists necessitate the exchange of tumor lines across national borders routinely. It is my guess that little attention is paid to the physical state of these animals, since one could rationalize that the animal's poor condition is a result of physiological damage from the tumor growth rather than from infections which concurrently occur. In any event, the point is simply that secure measures are in

order when transporting these animals, since medical research dictates they must be shipped and also that the receiving laboratory must use isolation techniques when introducing these donor animals into their quarters.

The same rationale applies to seemingly healthy—or even known infected—special strains developed at a particular institution. In order to propagate this strain in another laboratory, transportation of breeding stock across borders is required. Therefore, the same safeguards already described for tumor bearing animals and known infected animals should be applied here.

What can we do about these problems of animal transport? We certainly would not want to totally restrict the traffic in these valuable biological research tools. This would, of course, impair vital research. With the continual movement of research scientists to different laboratories throughout the world, it is essential that the basic tool of their research, the laboratory rodent, be readily available to them. Ideally, as mentioned previously, we should ship only germfree animals or animals free of pathogenic and parasitic life. This is not possible or realistic at this time, so reasonable compromises should be sought.

Might I make a few suggestions along these lines? Firstly, it should be the primary responsibility of the shipping laboratory not to knowingly send out animals clinically exhibiting symptoms or latently carrying rodent diseases. Such determinations are practical and possible. Secondly, improved shipping devices restricting the airborne dissemination of microorganisms have been developed and tested and have proven successful.

Standard shipping containers incorporating ⅜-½ inch of fiber glass over the ventilation openings have proven effective for many years. The classical example is the shipment of pregnant mice into a laboratory infected with the highly contagious airborne virus of infant diarrhea. The shipping of pregnant animals in a standard shipper, without a protective covering over the screened opening, results in clinical symptoms of infant diarrhea in newborns 7-10 days after parturition. We have, in numerous situations, successfully shipped near-term pregnant mice in filtered shipping cartons, enabling the researcher to make his inoculations on one-day-old mice and subsequently to use the filtered container to house the mice for the duration of a 2-3 week experiment. In almost all situations, where reasonable care and precautions were taken, the infant diarrhea with its very high morbidity and moderate mortality has been completely by-passed, enabling the successful completion of studies on newborn mice, heretofore impossible in that laboratory. This type of shipper is only slightly higher in cost than the standard shippers; however, because of restricted air circulation, fewer animals must be accommodated in the same size container, which in turn increases the transportation cost per animal. This added cost must not preclude the use of filtered containers, which greatly reduce the hazard of infection transfer when the situation dictates their use. As you well know, I'm sure, the research animal is the smallest cost in the total cost of biological research. The example I have used many times to illustrate this fact is information furnished me by a large industrial toxicology laboratory. They state that a two-year lifespan feeding study on rats may run as much as $200,000 including the final histopathology, statistical analysis, write-up, and presentation to the Food and Drug Administration. The 400 rats purchased at the onset cost the laboratory about $500. Relating the cost of the rats to the total study makes it obvious that, in fact, another 10-20 per cent in the initial cost of the animal for filtered protection in transit is insignificant.

One must also consider protective shipping containers to afford protection to high-quality animals in transit against exposure to contamination in public carriers, transport terminals, and receiving and quarantine areas in the user institution. To afford complete sterility and safety, shipping devices commonly used in the shipment of gnotobiotes provides the ultimate in protecting healthy animals from externally caused contamination as well as preventing infected animals from contaminating the environment around them. Tens of thousands of germfree rats and mice have been shipped throughout the world in this lightweight, disposable shipper while maintaining the microbiological integrity of the gnotobiotic animals. When it is essential to maintain microbiological security, this type of shipping device is recommended without reservation. This ultimate method of transporting special strains is the method we have employed for many years in supplying breeding stocks to research laboratories, as well as in stocking our own European facility. Our laboratories in Wilmington, Massachusetts shipped some 10,000 mice and rats to our facility in Elbeuf, France, two and a half years ago, utilizing this method without contamination.

In summary, I have tried to outline the problems of animal health in the export and import of laboratory rodents. Hopefully, I have offered some constructive suggestions to combat the problem within practical limitations. In fairness to the general veterinary practitioner, I feel that whenever and wherever possible the utilization of the services of a veterinary specialist trained in laboratory animal medicine be considered. Most national and international regulations on the importation of laboratory animals simply require certification of a veterinary doctor stating that the animals to be shipped are free of clinical signs of disease and that the animals are in good health. Last week I had the interesting task of certifying that some germfree animals we shipped from our laboratories in Oslo, Norway, were free of foot-and-mouth disease. This pointed out to me that general agricultural regulations have been applied to small laboratory rodents in absence of specific recommendations for laboratory animals. I am confident that the veterinary profession generally and the veterinarian trained in or concerned with laboratory animal medicine will eventually refine the measures and practices currently in existence so that the transmission of unwanted diseases across national borders will be greatly reduced and hopefully eliminated. The organizers of this Symposium are to be congratulated for facing up to this real problem and helping to disseminate information which we all hope will be beneficial in finding some solutions.

PUBLIC HEALTH ASPECTS OF U.S. QUARANTINE OPERATIONS

JOHN H. RICHARDSON, D.V.M., M.P.H.*

The U.S. Public Health Service of the Department of Health, Education, and Welfare has the statutory responsibility for the protection of the United States against the importation of the six internationally quarantinable diseases (smallpox, yellow fever, cholera, plague, epidemic typhus, and louseborne relapsing fever) as well as other communicable diseases of epidemic potential. The Foreign Quarantine Program of the Public Health Service's National Communicable Disease Center implements this function at ports of entry by the inspection of arriving persons, conveyances, and certain animals and things, including etiological agents and vectors.

The Foreign Quarantine Program, which became administratively and physically a part of the National Communicable Disease Center in 1967, employs over 330 full-time field employees to accomplish its assigned mission. In addition to Program headquarters, personnel are assigned to 54 permanently staffed quarantine stations in the continental United States, Hawaii, Alaska, Puerto Rico, and the Virgin Islands and at 12 stations in Europe, Asia, Canada, and Latin America. Program medical officers are stationed in London, Naples, Athens, Paris, Mexico City, and Hong Kong.

In addition, personnel of the Bureau of Customs, the Immigration and Naturalization Service, and the Plant Quarantine Division of the U.S. Department of Agriculture provide primary health inspection services at ports not manned by Public Health Service personnel.

In order to gain a maximum utilization of inspectional personnel and to expedite the handling of arriving international passengers, a multiagency inspection procedure was instituted at all ports along the United States-Mexican border in 1963. In June 1968 the international airports in New York City and San Antonio became major test sites for the evaluation of a multiagency "one-stop" inspection program. A personnel pool from all participating agencies performs "primary" inspection services. Specific problems are referred to "secondary" inspection by appropriate agency personnel for final evaluation.

At the present time this one-stop procedure is applicable to arriving international passengers. Hopefully the advantages of one-stop handling of certain research and experimental animals and materials may be considered in future planning by inspection agencies.

QUARANTINABLE ITEMS

Public Law 410 of the 78th Congress provides the statutory authority for the Public Health Service Foreign Quarantine regulation. The Code of Federal Regulations, Title 42, Chapter 10, Subpart J, "Impor-

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tation of Certain Things," lists specific requirements which govern the importation of a variety of quarantinable items, including psittacine birds [Section 71.164(c)], felines and canines [Section 71.154(c)], monkeys [Section 71.154(e)], and etiological agents and vectors [Section 71.156(a)]. Only those sections of Subpart J applicable to the importation of research and experimental animals will be discussed in detail.

Psittacine Birds

Psittacine birds may be imported into the United States for medical research without prior quarantine and medication against psittacosis infection provided the following conditions are met:

Permit. The birds must be accompanied by an import permit issued by the Surgeon General of the U.S. Public Health Service. Application for the permit shall be submitted by the person seeking to import the birds for medical research purposes and shall contain such information and assurances as the Surgeon General may require concerning use of the birds in the proposed research.

Scientific use. The scientific basis for the use of untreated birds is established to the satisfaction of the Surgeon General.

Protection against disease. The birds are imported under conditions prescribed by the Surgeon General to minimize the risk of introduction of communicable disease into the United States.

Disease-free appearance. They appear to the quarantine officer at the port of entry to be free from evidence of communicable disease, unless otherwise specified in the permit, or admission is authorized pursuant to paragraph (a) (3) of Section 71.164(c)

Dogs and Cats

Domestic and wild canines and felines may be imported into the United States for medical research provided they are free of evidence of infectious diseases when examined at the port of entry and the following conditions are met:

Domestic dogs. Vaccination against rabies may be waived if the owner or importer submits evidence, satisfactory to the quarantine officer, that the dog is destined for a research establishment and that vaccination against rabies would seriously interfere with its use for scientific investigation.

Wild canines. The owner or importer shall restrict wild members of the canine family to a building or other enclosure in isolation from other animals and from persons except for contact necessary for their care for at least six months.

Monkeys

Subhuman primates may be imported into the United States for medical research and for other purposes provided they are free of evidence of infectious diseases when examined at the port of entry and the following conditions are met:

Measures regarding yellow fever. Subhuman primates arriving from or having passed through a yellow fever infected local area shall be admitted only if inspection reveals no sign of yellow fever and there is evidence satisfactory to the quarantine officer that:

a) At least nine days have elapsed following their departure from the last such area contacted, or
b) they arrive in a mosquito-proof structure and have been kept in such a structure for at least nine days immediately before arrival, or

c) they have been immunized against yellow fever. (Recommended dosage for nonhuman primates is 0.25 ml of 17D vaccine administered subcutaneously; period of immunity is at least 6 years beginning 10 days after vaccination.)

Etiological Agents and Vectors

Etiological agents and vectors of human disease shall not be imported into the United States or distributed after importation unless accompanied by a permit issued by the Surgeon General. Examples of imports requiring permits include:

a) Any living arthropods known or suspected of being infected with any disease transmissable to man.
b) Any animal known or suspected of being infected with any disease transmissable to man.
c) All live bats.
d) Unsterilized specimens of human and animal tissues when known or suspected of being infected with any disease transmissable to man.
e) Any living culture of microorganisms known to cause, or suspected of causing, human diseases.
f) Any snails capable of transmitting schistosomiasis.

A summary of selected quarantinable items inspected for importation into the United States for research and for other purposes during a recent one-year period is presented in Table 1. The majority of the dogs entering the country during this period were imported as pets and were admitted along the United States-Mexican land border. In contrast, the majority of nonhuman primates were imported for research purposes or vaccine production and entered by chartered or regular flights of commercial air carriers. The limited number of cats and psittacine birds entering the United States were imported primarily as pets rather than as experimental animals.

TABLE 1. Selected quarantinable items inspected for importation, by mode of arrival, 1 July 1965–30 June 1966.

Item	Vessel	Aircraft	Land carrier	Total
Dogs	6,249	22,224	66,704	95,177
Psittacine birds	2,999	3,753	944	7,696
Nonhuman primates	352	109,103	407	109,862
Cats	1,273	4,830	1,458	7,561
Etiological agents and vectors	5	2,590	279	2,874

DISCUSSION

The broad responsibilities of the Foreign Quarantine Program are emphasized by the cited excerpts of the importation regulation as well as by the numbers and varieties of quarantinable items entering by various conveyances at many ports of entry. Import regulations and operational procedures must undergo continuous evaluation in order to meet the changing patterns of disease and increasing international traffic. Disease surveillance activities must continue to provide up-to-date data on the incidence and geographic distribution of communicable diseases throughout the world.

Tuberculosis (*1*), enteric diseases (*2,3*), B virus (*4*), and nematode and protozoal parasites (*5*), are long-standing and continuing disease problems of imported macaques and other nonhuman primates. In the past decade a number of previously undescribed diseases have been reported in imported nonhuman primates and their human contacts. These include Yaba virus (*6*), contagious pox disease of monkeys (*7*), and African green monkey disease (*8*).

African green monkey disease, one of the

more recently described zoonoses of primates, is of special interest to the Foreign Quarantine Program because of the high mortality in infected humans and because of the reported lack of clinical illness or pathognomonic lesions in the *Cercopithecus* species associated with human cases.

Measures to reduce the risk of human exposure and infection to African green monkey disease and other zoonoses of subhuman primates should include postentry quarantine by the importer or user, and disease screening procedures, physical examination, and necropsy by qualified professional personnel to define existing disease problems. Perhaps if all imported wild-caught experimental animals were handled as if infected with virulent microorganisms transmissable to man until proven otherwise, the actual risk of human infection could be reduced to an absolute minimum.

Importers and users of all wild-caught animals must assume an increasing responsibility for the collection, transport, quarantine, and meaningful use of these exotic experimental and research species.

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HEALTH ASPECTS OF THE MOVEMENT OF DISEASE ORGANISMS AND VECTORS

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Animal-disease-producing agents, such as bacteria and viruses, are used in research of both human and animal diseases. This research and the need for such agents has reached major proportions in the United States today. In many instances these agents originate in countries other than the United States.

The Animal Health Division of the United States Department of Agriculture has the responsibility of regulating the importation and interstate movement of these agents so that they are handled in a manner that does not endanger the health of domestic livestock and poultry.

The authority for regulating such movements is contained in Part 122 of Title 9, U.S. Code of Federal Regulations. This regulation defines organisms as "all cultures or collections of organisms or their derivatives, which may introduce or disseminate any contagious or infectious disease of animals (including poultry)."

The regulation states that no organisms or vectors of such organisms shall be imported into the United States or transported from one State or Territory or the District of Columbia to another State or Territory or the District of Columbia without a permit issued by the Secretary of Agriculture and in compliance with the terms thereof. As a condition of issuance of permits, the permittee shall agree in writing to observe the safeguards prescribed by the Department of Agriculture for public protection with respect to the particular importation or transportation.

The Secretary may issue, at his discretion, a permit for the importation of any organism except for the virus of foot-and-mouth disease. A law prohibits the live virus of foot-and-mouth disease from being introduced for any purpose into any part of the mainland of the United States except coastal islands. At the present time, the only laboratory in the United States that has the virus of foot-and-mouth disease is the U.S. Department of Agriculture's Plum Island Animal Disease Laboratory off the coast of Long Island, New York.

Although foot-and-mouth disease virus is the only agent whose entrance into the country is absolutely prohibited, there are several other agents for which permits are not issued. These are agents causing diseases exotic to the United States and whose introduction could cause a devastating epidemic in our susceptible animal population. Examples of these include such agents as rinderpest virus, African swine fever virus, African horsesickness virus, and the *Mycoplasma* causing contagious bovine pleuropneumonia.

It will be noted that the permit requirements apply both to the movement of organisms within the United States and to

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the importation of organisms. However, in the practical application of the regulation, the Department does not ask that scientists obtain permits for the movement within the United States of those agents which are naturally found throughout the country unless the agent causes a disease for which an eradication program is being conducted, such as hog cholera.

Of course researchers often wish to obtain agents that are infectious for man as well as animals. This involves obtaining a permit from the Public Health Service as well as from the Department of Agriculture. To provide effective service to laboratories, universities, and others who import materials, the two agencies work closely to provide these permits with a minimum of delay and confusion. A person requesting a permit for an agent infectious for both man and animals makes application to only one agency. The request is then relayed to the other agency concerned. Often only one permit will be issued for agents infectious for both man and animals. One agency, after gaining the concurrence of the other, will issue the permit, which will be honored by both. Cooperation of this type has been maintained between the Public Health Service and the Department of Agriculture for many years. This liaison will be preserved and, where possible, improved in the future.

There are several reasons for regulating the movement of disease agents. The most important, of course, is to prevent the entry of agents causing dangerous animal diseases not present in the country or to prevent the entry of more virulent strains of diseases already present. We also hope to minimize the possibility of cultures normally considered to be of a relatively innocuous nature being contaminated with an exotic disease agent. One of the foot-and-mouth disease outbreaks that occurred in the United States was the result of a contaminated culture used to produce smallpox vaccine. This is a primary concern when examining requests to import cultures: What is the possibility of this culture being contaminated?

Also important is that our permit system keep us informed of who is working with what and where the work is being done. The Department of Agriculture maintains an emergency disease eradication organization in each state. There is a core of veterinarians specially trained in the diagnoses of foreign animal diseases. These veterinarians are frequently called upon to investigate outbreaks of strange and unusual diseases. Much of the defense of the United States in preventing a widespread epidemic of a foreign animal disease is dependent upon a rapid and early diagnosis so that control measures can be initiated immediately. Knowing the agents being studied in an area assists these diagnosticians by pointing directly at an agent that must be eliminated as the cause of the condition. The laboratory escape of a disease agent in veterinary medicine in the United States apparently is very rare. However, an outbreak of fowl plague in the 1920's did occur as a result of just such a happening, so this possibility must be constantly kept in mind.

To prevent such an occurrence, each request for a permit is thoroughly studied and handled on its individual merit. Each request must include the name and description of all material to be obtained, the nature of the research work to be conducted, and the exact location where such work will be carried out. Applications must be signed by individuals who will assume full responsibility for handling the infectious agent and any material derived therefrom, and who will agree to abide by any restrictions that may be imposed on the work.

When considering requests, our only concern is that the agent can be handled in a manner that will ensure the safety of our nation's livestock and poultry. To do this we must evaluate the agent, the person

making the request, and the facilities where he will do his work. Proper facilities are most important. There may be need to require that facilities be isolated from other livestock or poultry, or that they be constructed to prevent the entrance, or exit, of insects or rodents, or that provisions be made for showering, change of clothing, etc., by personnel in the unit to assure they do not disseminate the infectious agent.

Increasingly, visits are being made to laboratories before permits are issued. These visits serve two purposes. We have an opportunity to observe the facilities and discuss with the scientist his proposed plan of work and, secondly, we can impress upon the scientist our concern that the agent not escape into the domestic animal population. This is particularly important with people not working in the veterinary field, as perhaps more than half of our permit-holders are not. Incidentally, our people visiting laboratories often gain new insights into these agents from just talking with the scientists, many of whom are world authorities in their fields.

It will be recalled that the regulation indicates the permittee shall agree to observe the safeguards prescribed for the use of the agent. The permit which is issued contains nine standard restrictions, any number of which can be made applicable depending upon the situation. These restrictions are a very important part of the permit and provide us with additional safeguards after the material has entered the country. The restrictions are:

1. Adequate safety precautions shall be maintained during shipment and handling to prevent dissemination of disease. [This restriction is always in effect and serves as a reminder to the researcher to be careful. The remaining restrictions are optional (although all are printed on the permit form) and any can be placed in effect when the permit is issued as the situation warrants.]

2. Work shall be limited to *in vitro* laboratory studies only. [This restriction is often altered by striking out the words "*in vitro*," thereby limiting work to the laboratory but permitting animal inoculation.]

3. This permit does not authorize direct or indirect exposure of domestic animals, including poultry, cattle, sheep, swine, horses, etc.

4. All animals shall be exposed and held only in isolated insect and rodent proof facilities.

5. All equipment, animal pens, cages, bedding, waste, etc., in direct or indirect contact with these materials shall be sterilized by autoclaving or incineration.

6. Packaging materials, containers, and all unused portions of the imported materials shall be sterilized by autoclaving or incineration.

7. Materials shall be shipped by Registered Mail or by Railway Express or Air Express. Please acknowledge their receipt by completing and mailing the enclosed post card, which requires no stamp.

8. This permit is valid only for work conducted or directed by you in your present facilities. (MATERIALS SHALL NOT BE REMOVED TO ANOTHER LOCATION, NOR DISTRIBUTED TO OTHERS, WITHOUT USDA AUTHORIZATION.)

9. On completion of your work, all permitted materials and all derivatives therefrom shall be destroyed and the USDA promptly notified by completing and mailing the attached post card, which requires no stamp.

10. [This is a blank space which allows us to indicate any special instructions which might be needed.]

Animal-disease-producing agents entering the United States not accompanied by a permit are seized and held pending clearance, destruction, or return to the country of origin.

Permits are issued only to the recipient of the material—a scientist located in the United States—because he is the individual who is responsible for the material's safekeeping. When a permit is issued for the importation of organisms, a shipping label is also issued. The permit-holder is instructed to send this label to the scientist in the country from which the material is coming. This label should be attached to the outside of the package. The label indicates to Cus-

toms the package contains perishable animal quarantine material authorized for entry by the U.S. Department of Agriculture. All packages containing such material not bearing this label will be detained. It can be seen that to prevent the possible destruction or return of the material, or the material dying or becoming worthless while being detained, it is imperative that each package carry the label.

No doubt there are unauthorized entries not detected by existing inspection procedures. We believe the vast majority are due to the fact that researchers are not aware of our requirements. We are striving to inform the research community of these regulations. That more and more people are becoming aware is indicated by the almost yearly increase in permits issued. In fiscal year 1959, 90 permits were issued, in 1966 there were 331, and in fiscal year 1968 over 400.

Although the Department of Agriculture has no requirements regarding the export of organisms and vectors, all Department scientists, as well as non-Government workers inquiring about export requirements, are instructed to ascertain that the scientist in the country who will be receiving the material possesses an import permit from the responsible Government authorities of his country. We hope this helps prevent United States scientists from inadvertently violating the import requirements of other countries.

We hope that the reverse is also true—that scientists of other lands are advised by their officials that material is not to be sent to the United States unless the proposed receiver of the material possesses a permit from the United States Government authorizing him to receive the material. We believe such cooperation will foster greater understanding between scientists and will produce smoother and easier transfer of materials between countries to the greater benefit of all concerned.

It is important that we have the understanding and support of the scientific community in this regard. Our primary concern is not in saying "No" but in knowing what agents are being worked with, and where they are being worked with, and whether they are being worked with in a manner that does not unduly expose the domestic livestock population to economically costly diseases.

We believe our permit system is an effective means of fulfilling our responsibilities with respect to the adequate but yet practical regulation of these agents.

Part III

INTERNATIONAL MOVEMENT OF EXOTIC ANIMALS

KEYNOTE ADDRESS

DR. HAROLD VAGTBORG*

The importation into the Americas of exotic animals has been in progress for many years. Historically, these importations have been made almost exclusively for the populating of zoos throughout the Hemisphere. Within the last 10 years or so, there has been an increasing interest and activity in the propagation of these animals for the purpose of affording sportsmen the opportunity to hunt them outside their native land. Consequently, the raising of exotic game has become a cash crop for ranchers and landowners. How extensive this practice is in other countries in the Hemisphere I do not know, and it would be interesting to get some information on this subject from participants from other countries attending this Symposium. I do know that in the United States several Southern States with mild climates have been involved in this movement. The greatest activity has been in Texas, and I would therefore like to review the development in this State as a case history.

Records indicate that individuals on private lands in Texas acquired exotic game as early as 1930. These were acquired from zoos with excess stock by individuals primarily motivated by the novelty of having a few of these animals on their lands. In 1963, when the first State-wide census was conducted by Texas Parks and Wildlife personnel, the count indicated a total of 13,000 of these animals outside of zoos. A second census, taken in 1966, indicated that this number had grown to close to 30,000, comprising 13 species. Most of the increase has come from self-propagation, although new introductions continue to be made through zoos and through U.S. Department of Agriculture approved quarantine facilities.

The large majority of these animals are located on grazing lands with high fences but there is a growing number of free-roaming animals, primarily escaped animals, which likewise continue to propagate.

The regulations of the State of Texas provide that the fenced animals on private lands may be hunted as determined by landowners who have State licenses to breed and maintain stock of this kind. In many instances, the landowner permits are for year-round hunting, and for this privilege a fee is charged, depending on the species taken. The free-roaming animals are under the jurisdiction of the State game laws and there is some variance in these regulations from county to county within the State.

The landowners are generally satisfied with this arrangement and, with some exceptions, have conducted their operations with care so as not to overpopulate grazing areas. They usually have their programs supervised by wildlife experts under the watchful eye of doctors of veterinary medicine.

Although there are obviously many advantages in permitting developing numbers of exotic game in Texas, there are two basic

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areas of concern to all involved about which little is known and on which scientific studies are being initiated in increasing numbers. These concerns apply to all of the regions and nations of the Hemisphere, as well as to any region in the world where non-indigenous animals are imported. The nutritional health of exotics, native game, and domestic animals can be seriously affected by competition for grass and browse and other necessities of life. Lack of proper food can seriously affect reproduction and can weaken these animals so as to severely reduce their natural resistance to disease. This matter of balanced ecology, a subject in itself, is directly related to exotic game welfare. On one of the ranches that I visited—with over 1,000 exotic animals and a substantial population of native deer and several thousand head of cattle and sheep—I found that the practice was to separate the cattle and sheep from the exotic animals and to pasture the exotics in such a way that their grazing and browsing habits were in harmony and maximum feed for the several selected species was provided from a given pasture. This was possible because of careful observation of the selected feeding characteristics of the exotics. When this type of attention is extended and becomes general practice, the problem of feed availability will be considerably reduced. In spite of an improved practice here and there, we really know very little in this area and much research is needed.

The other problem, and the one that must be given much more urgent attention, is that of the introduction of exotic disease agents to a susceptible population. The introduction of such agents, whether it be to man or animal, must be considered as a threat to the health of those persons or animals exposed, inasmuch as they will have neither a natural nor an acquired immunity.

In the Americas, health authorities are constantly on the alert for the introduction of smallpox and other human diseases which are not normally present. Likewise, the United States Department of Agriculture, in conjunction with the Public Health Service and the individual State health agencies, have set up an extremely effective policing mechanism to prevent the introduction of exotic disease organisms into this country. Nonetheless, even with these precautions, blue tongue, a disease of sheep, has been introduced into the United States. While it is impossible to estimate accurately the economic loss to the livestock producers as a result of this one exotic disease, the importance of continuing vigilance against the introduction of all animal diseases cannot be over emphasized.

This Symposium is dedicated to the exploration of the problems generated by the international movement of all types of animals. The following discussions will pertain to those disease problems associated with the importation of exotic animals for use in zoological gardens or on exotic game animal farms. The importance of this subject cannot be overemphasized. In the event several exotic diseases were introduced into the beef herds in the State of Texas, for example, a tremendous loss in dollars would result, and, furthermore, an important source of much needed protein would be in jeopardy.

We are all aware of the stringent regulations enforced by all the regulatory agencies concerned with the importation into the United States of all animals, including exotic animals originating in countries in which certain diseases exist, and we are also aware of the additional restrictions that are placed upon the importers of exotic game animals. Several such diseases which do not occur in this country but which from time to time have been prevalent in some other countries and are of concern to the regulatory officials of the United States and other countries in the Americas are rinderpest, Nairobi sheep disease, African horse

sickness, African swine fever, and foot-and-mouth disease. It is because of these diseases and their potentially devastating effect when introduced to a susceptible population such as the domestic animals in the United States that it has been deemed necessary to rigidly control their entry. The exotic animals, as you know, are consigned only to approved zoological gardens or through quarantine facilities approved by the U.S. Department of Agriculture. Furthermore, under certain conditions, such animals may never be released to exotic game farms, while, in other instances, their offspring may be released to exotic game farms to serve as breeding stock. This regulation I feel has aided considerably in the prevention of the introduction of exotic diseases into the United States through the medium of imported animals. Nonetheless, a constant vigil must be maintained to prevent their introduction. In the event new problems are presented in the following papers, I trust that those in Government positions of authority will institute appropriate corrective action as soon as possible.

I am sure that we are all interested in a freer movement of animals from one country to another, whether they be domestic or exotic, and that we will leave this Symposium with a realization of the great amount of scientific work which remains to be done on disease problems before we can have confidence that animal movements are not going to introduce another "blue tongue episode" in the native livestock of the receiving country.

DISEASE EXPERIENCE ASSOCIATED WITH ZOOLOGICAL PARK IMPORTATIONS

LEONARD J. GOSS*

To my knowledge no statistics have been assembled on the incidence or frequency of animal diseases resulting from animals imported for zoological park exhibition in North America. Further, I am not aware of any major outbreaks or epidemics of disease in zoological park imports, or of diseases in animals established in zoos resulting from diseased imports.

Several factors may account for the absence of major disease problems in importation of zoo specimens:

1. The United States Department of Agriculture enforces strict quarantine regulations for all wild ruminants and swine imported into the United States. The primary purpose of the regulations is to protect the livestock industry of the United States. These precautions vary from total restriction to 60 days supervised quarantine in the country of origin or in a foreign country followed by a 30-day domestic quarantine after arrival in the United States. The quarantine includes a thorough examination for ectoparasites and other procedures to prevent introduction of diseased or carrier animals or disease agents.

The same department imposes a 30-day postentry quarantine on all wild birds with domestic counterparts (i.e., Galliformes, Anseriformes, and Columbiformes).

In deference to Dr. Claude Smith of the Department of Agriculture, whose paper concludes this volume, I will not further detail the Department's pre- and postentry requirements for the importation of wild mammals and birds for zoological park exhibition. Suffice it to say that the precautions have been so effective that there has not been a single recorded case of entry into the United States of a zoo animal infected with an exotic contagious disease.

2. The surveillance and regulations of the United States Public Health Service have likewise been effective in controlling zoonoses in zoo animals.

3. Zoo animals are not imported in great quantity or large numbers in a single shipment. Most zoo animals are procured through domestic animal dealers rather than directly from the country of origin. As an example: It is not economically practical for a zoo to import a single elephant, but it is practical for a dealer to import 10 or 20 for distribution to as many different zoos. The same is true for other mammals, birds, and reptiles. The larger dealers have domestic holding compounds where the imported animals are detained and given varying degrees of acclimatization and conditioning before they are transferred to their destined zoo. Under these conditions disease-infected animals are less apt to introduce disease into a zoo than if they went directly from their country of origin to a zoological park.

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4. Zoo animals imported into the United States are costly commodities. Transportation costs are high and zoos will not accept or pay for animals not received in good condition and healthy. Exporters therefore are reluctant to risk shipment of animals to zoos that have not been acclimated or do not appear in good condition at the time of shipment. This is not to say that all specimens shipped to zoos are prime ones. It is well known, however, that zoos have refused to accept for exhibition purposes otherwise sound specimens on the basis of defects such as damaged horns, ears, or other relatively minor disfigurations. Hence, there is an awareness on the part of the vendors to supply zoos with healthy, disease-free animals.

5. Zoological parks recognize the importance and value of their animal collections. They further have a dedicated interest in exhibiting only prime specimens and building up breeding herds in the interest of conservation of wild species. Consequently, they carefully process and "screen" animals after arrival at their zoo. This includes quarantine, thorough veterinary examination, execution of necessary vaccinations, freeing the animals of ecto- and endoparasites, acclimatization, and providing necessary and proper dietary requirements before imports are added to the zoo collection.

6. Zoo animals are "collector's items" to the better zoos. They therefore get preferential and protected treatment.

7. Family or species specificity for disease agents is also a barrier to the spread of disease in zoos. Most zoos do not maintain great numbers of a single species nor do they import large numbers of a given species at a time. If they do maintain flocks or herds in appreciable numbers, this is indicative of a disease-free breeding group that seldom needs imported additions.

8. Compilation of records on the incidence or prevalence of disease in imported zoo animals is probably complicated by reluctance of animal dealers to exploit disease occurrence in their imports. The presence of disease in animals being held by dealers before they are forwarded to zoos can be beneficial in preventing the introduction of diseases to zoological parks. Animal dealers soon learn that if morbidity or mortality rates are high in a shipment from a given area or from a particular vendor, the best remedy is to change supply sources. This alone may be a strong factor in controlling disease spread or introduction of diseased animals to zoos.

This discussion is confined to zoological park importations. A sharp distinction has to be made between: (a) animals imported for laboratory use; (b) animals imported for the pet shop trade; (c) animals imported for general use (i.e., circuses, roadside shows, and "traveling zoos"); and (d) animals imported for recognized, approved zoos ("recognized" refers to major zoos, generally accepted by the American Association of Zoological Parks and Aquariums as proper, recognized zoological parks, operated by zoological societies or capable and responsible governmental agencies; "approved" refers to zoos approved by the U.S. Department of Agriculture.)

It is recognized that animals in the disease or carrier state of many diseases or conditions could gain entry to the United States. It is also recognized that disease vectors could be introduced via animals imported for zoological park exhibition. While there have been no major introductions of diseased animals to zoos in the United States, there have been occasional incidents of interest.

In 1959 the Brookfield Zoo (Chicago) lost a blesbok (*Damaliscus albifrons*), an African antelope, four days after it was released from Federal quarantine. *Aspergillus fumigatus* was isolated from lung tissue.

The New York Zoological Park in 1963 (*1*) lost three Indian cattle (*Bos frontalis*)—the sire, dam, and one offspring—from malignant head catarrh. This sporadically occurring virus disease of bovines is known to occur in asymptomatic carrier African antelope (*Connochaetes gnou*) imported 12 months previously. There was no further spread of the disease. This is probably a reflection of family or species disease specificity, since the cattle and antelope were housed in the equine exhibit area of the zoo where there were no other susceptible species.

Viral hepatitis has occurred on a number of occasions in zoo personnel having direct contact with recently imported chimpanzees and gorillas.

Ringworm has been observed in recently imported monkeys. In one instance it spread to three animal attendants and nine animals of five different species.

Salmonella infections have been diagnosed in many zoo animal species. Both recent imports and animals of long residence in zoos have been involved.

Canine distemper and feline panleukopenia have occurred in recently imported zoo specimens in all the various species susceptible to these diseases. The extent of spread of the diseases in the zoos involved has seemingly been directly related to: (a) prophylactic precautions taken by the zoo receiving the imported animals; (b) the state of susceptibility of the existing vulnerable species; and (c) the proximity of the susceptible animals to infected animals.

Aspergillosis is common in penguins and usually fatal. It is directly related to stress. Mortality in penguin shipments has frequently been high. Infected imported birds, when placed with healthy established birds in zoos, rarely cause spread of the disease.

Avian malaria has been observed in several species of birds in zoological park collections. The epidemiology and pathogenicity, however, have been obscure.

In an attempt to assemble current information for this presentation, a questionnaire was sent to members of the American Association of Zoo Veterinarians, asking for their experience with diseases in their collections that were related to imported animals. One veterinarian reported scabies in a shipment of eight dromedary camels from Australia. One of the eight died from extensive eczema. The condition did not spread to any other animals. The same zoo reported ticks on 12 zebras with no deaths and no spread to other animals.

Erysipelothrix insidiosa caused fatal septicemia in two of six bottle-nosed dolphins (*Tursiops truncatus*) shipped to the Brookfield Zoo (Chicago) from Florida. (*2*)

Eurytrema brumpti (*3*) were recovered in great numbers (1,028) from the hepatic and pancreatic ducts of a 30-pound male lowland gorilla (*Gorilla gorilla gorilla*) two months after its arrival in New York City from the Congo in Africa.

In the nine years from 1958 to 1967 an average of 11 zoo mammals were imported per month for zoological park exhibition following quarantine by the United States Department of Agriculture. This small number is in sharp contrast to the thousands of mammals and birds imported for the pet shop trade or for research purposes. Animals imported for zoological park exhibition and breeding are more carefully selected, fewer in number, and more highly regarded than commercial commodities.

The conditions under which animals are kept prior to export to zoos, the duration and conditions or their transport period, and the facilities provided them at their destination very directly affect their disease status.

Sensible, sound import regulations, combined with proper transport accommodations and proper acclimatization and prophylactic measures on arrival, will continue to assure the exhibition of healthy, disease-free animals in zoological parks.

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DISEASE ASSOCIATED WITH THE IMPORTATION OF WILDLIFE

FRANK A. HAYES, D.V.M.*

Numerous hazards are associated with intercontinental transportation of wildlife species, and movement of zoo or game animals between neighboring countries or even states and provinces must be approached with extreme caution. Infectious diseases of man and animals potentially introduced through relocation of wildlife include rabies, psittacosis, hemorrhagic fever, heartwater disease, foot-and-mouth disease, rinderpest, contagious bovine pleuropneumonia, lumpy skin disease, blue tongue, African swine fever, louping ill, Nairobi sheep disease, sheep pox, Rift Valley fever, Teschen disease, equine piroplasmosis, African horse-sickness, dourine, glanders, duck virus enteritis, and others too numerous to mention.

Arthropod vectors of viral, rickettsial, and protozoan diseases of major veterinary significance also comprise a major consideration for preventing introduction of diseases indigenous to domestic or game animal hosts in foreign countries. Recent accounts show that domestic and wild animals presented for import into the United States at various ports of entry were found to harbor 37 species of ticks. Even with stringent inspection procedures, two dangerous exotic ticks have been introduced into the United States within the past decade.

Dermacentor nitens, the vector of equine piroplasmosis, was established in Florida during 1960. The source of entry was never disclosed, and the first case of equine piroplasmosis in a native horse was diagnosed less than a year later. A second tick, *Rhipicephalus evertsi*, was established temporarily in Flordia during 1960, but fortunately these vectors of bovine piroplasmosis and other foreign diseases were confined to a zoo compound and eradication was accomplished promptly. Apparently *R. evertsi* was imported with zebras and elands, since subsequent examination of these zoo animals at ports of entry revealed the organisms.

Amblyomma variegatus, which recently appeared on St. Croix of the U.S. Virgin Islands, is the vector of heartwater disease and constitutes another threat to the continental United States. Eradication of this tick presently is in effect, but even on a relatively small island this endeavor may prove to be very costly. The ever-present possibility of bovine piroplasmosis reintroduction via *Boophilus spp.* provides a matter of grave concern for cattlemen and deer management specialists alike throughout the southeastern United States.

Preventing introduction of new intestinal protozoan and helminth parasites indigenous to wildlife hosts in foreign countries also presents a continual challenge. However, additional citation of disease-causing agents would be redundant here, in the light of the existing wealth of information on this subject.

Although introduction of one or more foreign diseases or vectors could precipitate a

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problem of awesome magnitude for a previously unaffected nation, rigid inspection procedures and adequate quarantine facilities minimize risks associated with movement of wild animals to relatively inconsequential proportions. Eternal vigilance must be maintained, however, and regulatory measures kept abreast of an ever-increasing public demand for relocation of exotic animals. Importation of wildlife species must not be allowed to exceed financial limitations imposed upon organizations charged with the responsibility of guarding against disease introduction. It also behooves responsible governmental agencies to refrain from yielding to minority pressure groups on these and related matters which may be detrimental to the national welfare. This paradox therefore comprises a major element of danger associated with relocation of foreign animals. Further elucidation on today's wildlife traffic as a threat to human health and livestock interests seems somewhat superfluous.

Greatly accelerated military, tourist, and business travel, increased demands for importation of meat and meat by-products, worldwide use of biologicals, etc., pose a greater chance for *accidental* foreign disease introduction than the comparatively small number of wild animals received by any country. Also, we cannot ignore the *purposeful* introduction of a devastating pathogen (i.e., foot-and-mouth disease, rinderpest, African swine fever) which could severely cripple vital segments of a nation's entire economy.

A more pressing problem today stems from a country's native wildlife fauna, which must be considered as an internal situation that remains dormant until proper ingredients are made available from outside sources. Precipitating factors include: (a) presence of susceptible wildlife hosts, (b) introduction of a virulent pathogen, and (c) adequate means for resultant spread of a contagious disease. For exampe, a population in excess of 10 million wild Cervidae in the United States currently affords one essential aspect for establishment of a foreign animal disease in this country; jet air travel greatly enhances the likelihood for introduction of a pathogen, and adequate means of transmission are already available for many highly infectious entities.

Game and fish officials throughout the southeastern United States fully recognize the ever-increasing threat of foreign animal disease introduction, which may work havoc with the nation's multibillion dollar game animal resources and have a subsequent catastrophic impact upon the entire livestock economy and associated industries. During October 1966, the Southeastern Association of Game and Fish Commissioners adopted a resolution which afforded a merger of efforts between wildlife and domestic animal interests for minimizing the consequences of a national emergency of this type.

The essence of this resolution reflected a joint interstate concern for the increasing possibilities of accidental or deliberate foreign disease introduction. It furthermore was recognized that the tremendous expansion of white-tailed deer throughout the region would afford an unbroken chain of susceptible hosts capable of serving as unrestrained carriers of a foreign disease transmissible to similar big game animal species and domestic livestock. Early detection was considered absolutely mandatory. The Animal Health Division of the Agricultural Research Service, United States Department of Agriculture, offered to provide essential training and immediate diagnostic services for game and fish personnel in early detection. It therefore was resolved that the Southeastern Association of Game and Fish Commissioners would support an exotic disease surveillance training program in cooperation with the Animal Health Division.

This vital alliance between game animal and domestic livestock interests was officially enacted July 1967. At that time the Animal Health Division sponsored a conference for the purpose of implementing a regional Foreign and Emergency Disease Surveillance Training Program in response to the previously adopted resolution. The conference was coordinated by the Southeastern Cooperative Wildlife Disease Study of the University of Georgia's School of Veterinary Medicine and held at the Georgia Center for Continuing Education. Game officials, biologists, and law enforcement personnel from the following 15 southeastern States participated in this meeting: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Virginia, and West Virginia. The program was conducted by internationally recognized specialists from the U.S. Department of Agriculture and Department of the Interior. Objectives of the conference agenda were as follows:

1. To relate and emphasize to southeastern game and fish field personnel the full ramifications of possible foreign disease introduction into the Southeast.

2. To describe the position white-tailed deer and feral swine now will occupy in the event of foreign disease introduction into the Southeast.

3. To familiarize game and fish personnel with the elaborate nationwide emergency disease eradication organization of the Animal Health Division of the Department of Agriculture and specify the vital role wildlife interests hereafter may play in that program.

4. To train game and fish personnel to immediately recognize and report evidences of a possible foreign disease outbreak.

5. To establish liaison between attending game and fish personnel and the veterinarian-in-charge of the Animal Health Division in their respective states for inaugurating exact reporting procedures for all suspicious cases.

6. To provide basic information and visual aids with which attending game and fish personnel can return to their respective states and relay to co-workers instructions received during the training program.

Following two days of intensive lectures with accompanying visual aid sessions, a test exercise was conducted which involved all Animal Health Division veterinarians-in-charge of the 15 states represented. Game management specialists and law enforcement personnel from each state actively participated in this exercise, which concerned the hypothetical introduction of foot-and-mouth disease into wild deer of the Southeast and which proved most informative to all parties present.

As follow-up of the regional program, each southeastern state has completed—or is in the process of planning—similar training sessions at the state level. These conferences encompass the full complement of technical and law enforcement personnel, which essentially adds up to 150–250 trained people per state. These men now are well versed on the full ramifications of foreign disease introduction and the necessity for immediate reporting of any suspicious case involving wildlife or domestic animals. Game biologists and conservation officers also have direct communications with Animal Health Division officials. Liaison with state veterinarians and diagnostic laboratories is excellent.

As a result of these cooperative efforts, southeastern wildlife interests now are in position to make paramount contributions in the eventuality of foreign disease introduction. Major regrets today are that these activities have been restricted to the southeastern United States. It is hoped that

within the near future similar courses of action will be adopted by game and fish associations representing each region of the United States, with wildlife and domestic animal interests ultimately combining forces on a national front.

Some other countries of the Western Hemisphere also might consider this approach, which will afford invaluable insurance for the preservation of countless thousands of big game animals, will save millions of head of domestic livestock, and circumvent losses which can amount to billions of dollars. Such an investment today will pay unprecedented dividends tomorrow.

DISEASES OF THE AUCHENIDAE

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Of the four species of Auchenidae, the alpaca (*Lama pacos*) and the llama (*Lama glama*) were domesticated by the settlers of the Altiplano two centuries before Christ, while the other two species, the guanaco (*Lama guanicoe*) and vicuña (*Vicugna vicugna*) are still practically untamed.

Peru has 3,200,000 alpacas and 800,000 llamas, Bolivia some 300,000 alpacas and 2,500,000 llamas, and Chile approximately 30,000 alpacas and 70,000 llamas. Auchenidae of these species are also found in Argentina and Ecuador but in smaller numbers.

The vicuña and the guanaco are on the way to extinction. There are approximately 25,000 vicuñas in the world, of which 20,000 are in Peru. Most of Peru's vicuñas are wild, although there are various reservations and one vicuña ranch (Cala-Cala, in the Department of Puno) with 700 animals. Bolivia has some 3,000 vicuñas, and the remaining 2,000 are in other countries. Guanacos are considered a nuisance in Argentina, where the greatest number exist. The other countries have very few. Peru has approximately 2,000 guanacos, of which 1,000, in the wild state, are in the Caripuy Ranch in the northern Department of La Libertad.

Of the four Auchenidae, the most important economically is the alpaca because its wool is of excellent quality and sells for three times as much as lamb's wool. The flesh of the Auchenidae is highly nutritious and palatable, and the hide is much in demand. The alpaca has a gestation period of 11.5 months. Ovulation is induced, and the female never brings forth more than one offspring at a time. The offspring are born in the rainy season (December to February), and mating occurs at that time. There are two breeds, Suri and Huancaya, of which the former is more in demand because of its relative scarcity. Alpacas of the Suri variety may be of different colors, the white specimens being preferred because they bring a higher price.

In Peru there are many ranches with 5,000 to 20,000 alpacas, which are grazed in the high Sierra at altitudes of more than 4,000 meters. An alpaca consumes as much food as 1.2 to 1.5 sheep, since its digestive capacity is 50 per cent greater than that of sheep.

The llama and the guanaco are the heaviest of the Auchenidae, weighing between 120 and 150 kilograms. The next in size is the alpaca (60 to 80 kilograms), and the smallest is the vicuña (40 to 50 kilograms). In most ranches alpacas are shorn every two years and yield five pounds of wool. In ranches using improved techniques they are shorn every year and the average yield is three pounds of wool per animal per year. Vicuñas yield only 11 ounces (330 grams of wool every two years). Llama wool and guanaco wool have very little commercial value.

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For more than 15 years the School of veterinary Medicine of the Universidad Nacional Mayor de San Marcos has been investigating the diseases of the Auchenidae, both at the school itself in Lima and at the following laboratories it operates in the Sierra: the Principal High Altitute Station of the Veterinary Institute for Tropical and High Altitude Research at Huancayo, 3,000 meters above sea level, and the Model Auchenidae Ranches at La Raya Puno, 4,000 meters above sea level, and at Macusani Puno, 4,400 meters above sea level. The information contained in this paper is mostly based on the results of research conducted at those laboratories.

MAJOR ECONOMIC PROBLEMS IN REGARD TO ALPACAS

The three most important economic problems presented by the Auchenidae are low fertility, a high mortality rate in the newborn, and mange.

In most alpaca ranches, the fertility rate is 50 per cent at the most, owing to the fact that proper management methods are not used and there is not sufficient pasturage for the number of animals. However, when the mates are properly selected—fertile adult males of more than three years and females which have completed a period of eight days after parturition without metritis—and kept on pastures of a size sufficient for the number of animals, fertility can be raised to 85 per cent. There is strong evidence of the existence of infectious agents capable of killing the embryo at an early stage and of causing loss of fertility in the male. However, it has not been possible up to now to isolate any microorganism which can be blamed for these effects.

The high mortality among the young is mainly caused by infectious diseases, including, notably, enterotoxemia, which can destroy 80 per cent of the best young animals in a herd. This disease, caused by *Clostridium perfringens*, attacks only in the years with abundant rainfall, when there is more grass and the milk output of the alpacas is greater. It can be controlled through proper preventive measures (vaccination of females and administration of antibiotics).

Mange is a very serious problem, as it reduces the crop of wool. It has been noted that the virulence of *Sarcoptos scabiei* var. *aucheniae*, which causes mange, is greater when the animals are taken to lower regions. This condition has been controlled with baths and tropical treatments.

In addition to these three conditions there are others that can in certain cases result in very serious losses. To facilitate the study of the diseases affecting Auchenidae, we have grouped them in various categories in Tables 1-6.

SUSCEPTIBILITY OF THE VARIOUS AUCHENIDAE TO DISEASE

A study has not yet be done on the susceptibility of the Auchenidae to diseases. It has been noted, however, that vicuñas are the most susceptible to infection and that alpacas have the most resistance to infection.

All the diseases of major importance described for alpacas have also been observed in llamas and, in some cases, in vicuñas.

There are many problems still to be solved, which explains the emphasis laid on alpaca research in the programs of the Veterinary Institute for Tropical and High Altitude Research, an agency of the School of Veterinary Medicine of the Universidad Nacional Mayor de San Marcos established under an agreement between the Peruvian Government and the United Nations.

TABLE 1. Infectious diseases of alpacas of greatest economic importance.

Disease	Causative agent	Animals most affected	Source or cause of infection	Morbidity	Mortality	Control
Enterotoxemia	*Clostridium perfringens* types A and C	Mostly fat young animals up to 40 days old	Digestive tract; dirty corrals	High	High	Sound management; vaccination of mothers; antibiotics
Necrotic stomatitis, necrobacilosis, or diphtheria	*Spherophorus necrophorus*	Young animals 4–5 months old and alpacas 1 year old	Through lesions of the mouth and pharynx caused by hard grass	Sometimes high, usually low	High in advanced cases	Preventive treatment of mouth lesions
Rabies	Rabies virus	Adults	Bites by rabid dogs and foxes; no transmission between alpacas	Low (only those bitten)	High	Rabies control in dogs
Alpaca fever	*Streptococcus zooepidemicus* or *S. animal; pyogenes*	Young animals 1–2 years old or adults subjected to stress	Germ lodges in mucosa of alpacas and strikes unexpectedly	Low	Medium	Avoidance of stress; antibiotics
Braxy or sudden death, malignant edema	*Cl. septicum*	Wounded or very fat animals	Mouth wounds; bruises	Low	High	Vaccination; proper management
Atypical diarrhea	*Escherichia coli*	Young animals kept in dirty corrals; mothers with insufficient milk	Increased virulence of strains present in intestinal tract	High in some instances	Medium	Animals kept in clean corrals
Keratitis	*Corynebacterium pyogenes; Colesiota* sp.	Young animals	Drought with considerable dust	Low	Rare	Antibiotics
Otitis	*Corynebacterium pyogenes; Staphylococcus aureus*	Animals 6 months or over	Susceptibility, induced by blows in the ear, mange, and baths	Medium	High in the absence of treatment	Antibiotics; surgery

TABLE 2. Infectious diseases of alpacas of less economic importance.

Disease	Causative agent	Animals most affected	Source or cause of infection	Morbidity	Mortality	Control
Listeriosis	*Listeria monocytogenes*	Animals more than 5 years old	As in sheep	Low	High	Destruction of infected animals
Osteomyelitis of lower jaw	*Actinomyces* sp.	Usually adults; rare in young animals	Lesions in the mucosa of the mouth	Low	Low	Local treatment; destruction of infected animals
Tetanus	*Clostridium tetani*	Any age	Wounds	Low	High	Destruction
Mastitis	*Escherichia coli*	Alpacas in lactation	Blows to the galactophorous tract	Low	Low	Ointment; antibiotics; avoidance of blows
Abscesses	*Streptococcus zooepidemicus; Staphylococcus aureus*	Adults and young alpacas	Blows	Low	Low	Surgery and antibiotics
Ecthyma	Ecthyma virus	Young animals 2–4 months old	Cutaneous	Low	Low	No need to vaccinate

NOTE: Research has been done to determine the presence of brucellosis, tuberculosis, and leptospirosis. All findings are negative. In a United States zoological park a suspected case of Johne's disease has been observed.

TABLE 3. Parasitic diseases of alpacas of greatest economic importance.

Disease	Principal causative agent	Site	Life cycle	Animals chiefly affected	Control
Mange	*Sarcoptes scabiei* var. *aucheniae*; *Psoroptes communis* var. *aucheniae*	Skin	Direct	Various ages	Baths
Gastro-intestinal parasitic diseases	*Graphinema aucheniae*; *Trichostrongylus axei*; *Spiculopteragia peruvianus*	Abomasum	Direct	Young animals less than 2 years old	Rotation and periodic doses
	Lamanema chavezi; *Nematodirus lamae*; *Trichostrongylus columbriformis*; *Cooperia* sp.	Small intestine	Direct	Young animals	Rotation and periodic doses
Bronchitis verminosis	*Dictyogaulus* sp.	Bronchial tubes	Direct	Young animals	Rotation and doses for gastro-intestinal parasites
Coccidiosis	*Eimeria lamae*; *E. alpacae*; *E. punoensis*	Small intestine	Direct	Young animals less than 1 year old	Under investigation
Sarcocystiosis	*Sarcocystis aucheniae*	Esophagus; heart and muscles (neck and chest)	Direct	Adults more than 2 years old	Under investigation

TABLE 4. Parasitic diseases of alpacas of less economic importance.

Disease	Causative agent	Site	Life cycle	Animals chiefly affected	Control
Taeniasis	*Thysaniezia giardi*; *Monieza* sp.	Small intestine	Indirect (intermediate hosts: arthropods)	Young animals	Doses
Hydatidosis	Hydatid cyst; larvae of *Echinococcus granulosus*	Liver and lungs	Indirect (adult form in dogs)	Any age, but rarely observed	Medication in dogs and extraction of viscerae
Distomatosis	*Hepatica fasciola*	Bile tract	Indirect (intermediate hosts: snails, Lymnaea)	All (rarely observed)	None
Pediculosis or lice	*Microthoracius pro elongiceps*; *M. minor*; *Damalinia aucheniae*	Wool	Direct	Young animals	Baths
Cysticercosis	*Cisticercus tendicolis*	Peritone cavity	Indirect (adult form in dogs)	All	Medication of dogs

TABLE 5. Diseases of alpacas of other than infectious or parasitic origin.

Disease	Cause	Occurrence
Abortion, premature delivery expulsion of fetus at full term	Trauma (alpacas abort easily through fifth or sixth month of gestation period)	Rarely observed except in cases of improper management
Balanitis	Copulation in dirty corrals	Rarely observed
Rejection of young by mother	Disinfection of navel with iodine before the young animal suckles; dogs in herd	Observed only in certain poorly managed herds
Malnutrition	Lack of food (complicated by gastrointestinal parasitosis)	Very frequent
Diarrhea caused by grass	Regrowth of grass as a result of rains after a mild drought	Rarely observed
Dystocia	Use of very young or very old mothers; poor management	Observed only in poorly managed ranges
Cold	Animals born after 12 months and not dried (alpacas do not lick their young or shorn in winter)	Observed in poorly managed ranches; mortality can be very high
Congenital malformations	Failure to bring males from other ranches (too much inbreeding)	Malformed legs are rather frequent; other malformations (missing upper palate, only one eye, etc.) rarely observed
Pneumonia	Administration of parasiticides or antibiotics through the trachea	Rarely observed
Death as a result of insufficient milk in the mother	Mothers giving less than 100 ml of milk every 12 hours	Observed in ranches where mothers giving little milk are not eliminated (an Alpaca can give up to 800 ml of milk in 12 hours)
Anaphylactic shock	Heterologous serum prepared in equines	Rarely observed
Tympanism	Exposure to the sun of young alpacas fed with cow milk	Rarely observed
Tumors		Rarely observed

TABLE 6. Infectious diseases induced only experimentally in alpacas.

Disease	Severity	Transmission from one alpaca to another through cohabitation
Anthrax (*Bacillus anthracis*)	Septicemic symptoms induced by parental inoculation; fairly resistant to buccal entry	None observed
Symptomatic carbuncle (*Clostridium chauvoei*)	More resistant than sheep; microbes die 72–96 hours after incubation	None observed
Vesicular estomatitis (virus)	Benignant lesions induced only by intradermical inoculation in the tongue	None observed
Foot-and-mouth disease (virus)	Slight lesions in the tongue and hooves	60% of the alpacas infected through cohabitation; llamas not infected through cohabitation
Tuberculosis (*Mycobacterium tuberculosis; M. bovis; M. avium*)	*Mycobacterium tuberculosis* resulted in death, *M. bovis* and *M. avium* in localized lesions	Investigation not concluded

NOTE: In Peru anthrax does not occur at altitudes of more than 2,000 meters above sea level. The only outbreak reported at a high altitude (2,700 meters) was in bovines.

WORLD REPORTING SERVICE ON THE STATUS OF EPIZOOTICS

R. VITTOZ, D.V.M.*

RECEIPT AND DISSEMINATION OF ZOO-SANITARY INFORMATION

In the work of the Central Bureau of the International Office of Epizootics—more often referred to by its French abbreviation OIE (Office International des Epizooties)—absolute priority is given to the objective stated in Article 4 of the Internal Statutes of the Organization:†

To collect and bring to the attention of the Governments and their Sanitary Services, all facts and documents of general interest concerning the course of epizootic diseases and the means used to control them.

The Central Bureau depends wholly on official correspondents for obtaining and receiving necessary and urgent information. Each General Conference of the Committee of the OIE emphasizes the statutory duty of member countries to provide such information without delay.

The International Zoo-Sanitary Code (IZSC),‡ Section II (Notifications and Epizootiological Information) makes the following recommendations:

Article 3. That Veterinary Administrations shall send a notification to the Central Bureau of the OIE:

1) by telegram to INTEREPIZOOTIES PARIS, within 24 hours at the latest after the confirmation or suspicion of the primary outbreak of the diseases in List A, with the exception of Anthrax, as well as on the first confirmation of any newly recognized diseases in a country;

2) by letter after confirmation of a new outbreak of Anthrax.

Note: According to the definition of the IZSC an "outbreak of epizootic disease" means an occurrence of a case of one of the diseases enumerated in List A of the OIE in an agricultural enterprise, breeding establishment or premises, including all buildings and all dependent parts.

Where such delimitation cannot be defined, the outbreak shall have to be considered as occurring in the part of territory in which, taking local conditions into account, it cannot be guaranteed that both susceptible and non-susceptible animals have had no direct contact with affected or suspected cases there.

In the particular case of parts of Africa, an outbreak means the occurrence of the disease within a sixteenth square degree; the occurrence is still referred to as an outbreak even although the disease may occur in several places within the same sixteenth square degree.

Article 4. That notifications provided for in Article 3, paragraph 1, shall be promptly followed by complementary information sent by express letter to the Central Bureau of the OIE, on the origin and nature of the disease, the number of outbreaks, cases and deaths in the various species affected, the conditions concerning the spread of the disease and the sanitary and medical prophylactic measures taken.

Article 5. That during the course of the epizootic disease, further notifications and information as provided for by Article 3 and Article 4 shall be sent in the form of regular reports to the Central Bureau of the OIE at least once a fortnight.

That information should be given on the precautionary measures taken to prevent spread of disease, in particular the measures taken to

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† Annex of the International Agreement for the Creation of an International Office of Epizootics, Paris, 25 January 1924.

‡ Approved May 1968 by the 36th General Conference of the Committee of the OIE.

prevent its spread to other territories—by transport of animals, fish, animal products, biological products, vegetable products.

In the case of epizootic diseases transmitted by insect vector, the measures taken against such vectors should also be specified.

Article 6. That the Veterinary Administration of a territory in which an "infected zone" was located shall inform the Central Bureau of the OIE as soon as the zone in question has become free from the disease.

That an "infected zone" may be regarded as having been freed from the disease, after an interval of time has elapsed which is longer then than the accepted incubation period of the disease, and when all the measures of prophylaxis have been taken for the prevention of the reappearance of the disease or its possible extension into other districts.

a) The period which must have elapsed is: Foot-and-Mouth Disease, Rinderpest, Sheep Pox, Fowl Pest or Pseudo-Fowl Pest (Newcastle disease):

at least 21 days since the "slaughter policy" and disinfection have been completed, or six months since the clinical recovery or the death of the last affected animal, if the "slaughter policy" is not practised;

b) Classical Swine Fever, African Swine Fever, Enzootic Porcine Encephalomyelitis (Teschen Disease):

at least 40 days since the "slaughter policy" and disinfection have been completed, or six months since the clinical recovery or the death of the last affected animal, if the "slaughter policy" is not practised.

c) Contagious Bovine Pleuropneumonia:

at least 180 days since the "slaughter policy" has been completed.

Realizing the importance of the prompt transmission of such information to the Central Bureau, OIE regional and subregional conferences and meetings have made several recommendations in recent years. Pertinent passages from these recommendations are reproduced below.

Second OIE American Conference, Caracas, Venezuela, 12–16 September 1966.

That all countries send, without delay, to the Central Bureau of the OIE in Paris, their periodical bulletins on zoo-sanitary information and, in the case of the appearance of serious diseases, they inform this Bureau at once by telegram.

First Conference of the OIE, Commission for Africa, Dakar, Senegal, 6–9 December 1966.

[The Conference recommended] the very punctual sending of the monthly zoo-sanitary Bulletins of the Veterinary Services, for the preparation of the OIE *Monthly Epizootic Circular*, a document which maintains very useful liaison between the Veterinary Services of the countries of the African continent and of the other Regions of the world.

Information and Consultation Meeting on Rabies in Northwestern Europe, Paris, 6 November 1965.

. . . stressed the importance on the international level of informing the Central Bureau of the OIE by telegram about the appearance of new cases or outbreaks of Rabies in animals, stating their exact geographical location.

OIE Information and Consultation Meeting on the Evolution of Foot-and-Mouth Disease in Europe, Paris, 14 December 1965.

. . . again stressed the importance of informing the OIE quickly about occurrences of Foot-and-Mouth Disease and their particular circumstances, so that this information can be distributed to all interested countries, without delay.

The Meeting stressed, particularly, that the OIE should be informed about the finding of subtypes and strains, with characters somewhat different from those of the usual strains, mention being made of their main characteristics.

Emergency Meeting of the OIE Permanent Delegates of Algeria, Morocco, and Tunisia on Horse Sickness, Tunis, Tunisia, 29–30 June 1966.

. . . expressed the wish that all the countries of Africa will send, as soon as possible, to the OIE and the interested International Organizations, a special report on the possible presence of Horse Sickness, on the appearance of the new outbreaks in their territory and, wherever possible, on the types of the virus identified and the prophylactic measures applied, so that this information may be distributed by the OIE in both the urgent *Information Notes* and the *Monthly Epizootic Circulars* of that Organization.

Subregional Meeting of OIE Delegations of Veterinary Services of Western Europe on Horse Sickness, Paris, 21–23 November 1966.

. . . expressed its satisfaction on the exactness, speed and regularity of the information received and distributed by the OIE, and expressed the wish that the countries report at once the ap-

pearance of every new outbreak of Horse Sickness in their territory and, wherever possible, the type or types of the virus identified.

OIE/FAO Regional Conference on Epizootics in Asia, Tokyo, 2–9 October 1967.

Considering with great concern the recent introduction or reintroduction of Rinderpest through movements of animals into some countries of the region which had remained free from it for a considerable time, the Conference recommends that:

For an effective and early eradication of Rinderpest from the entire region and in order to prevent introduction or reintroduction of the infection into countries free from it, the international reporting system should be improved and an immediate notification of outbreak or suspected outbreaks should be made to OIE, FAO and neighbouring countries. Irrespective of the immediate trade interests of the countries concerned, Governments should be requested to authorise notification of new outbreaks in order to create and maintain confidence in the importing countries, promote long term trade interests and help in the safe and healthy development of the livestock industry in the region.

OIE sends particularly urgent zoo-sanitary information by telegram to the countries concerned.

Copies of such telegrams, together with quotations from official letters of permanent OIE delegates and other important communications are distributed by airmail or express letter to official correspondents in two forms: as *Urgent Notifications of Epizootics* or *Information Notes.*

Between May 1967 and May 1968, a total of 224 of these notifications were distributed. The greatest number were concerned with outbreaks of foot-and-mouth disease and the situation regarding rinderpest, contagious bovine pleuropneumonia, horse sickness, African swine fever, and rabies.

The most highly regarded OIE document distributed to directors of veterinary services throughout the world, however, is undoubtedly the *OIE Monthly Epizootic Circular*, released the first of each month, which gives a very complete and exact summary of the status of the principal epizootic diseases in the various epizootiologic regions. The *Circular* is being constantly improved, thanks to active and efficient collaboration by permanent OIE delegates, directors of national veterinary services, and the administration of the OIE.

During the past decade there has been a steady increase in the number of weekly, biweekly, monthly, and quarterly sanitary bulletins received and abstracted by the OIE Information Service. As of January 1959, bulletins were received from 60 countries; by January 1968 the number of countries contributing information had risen to 110.

The resultant increase in the usefulness of the *OIE Monthly Epizootic Circular* could not have been achieved without the cooperation of our colleagues in other international organizations—the Food and Agriculture Organization, the World Health Organization, the International Regional Organization for Health in Agriculture and Livestock (OIRSA), and the Pan American centers for foot-and-mouth disease and the zoonoses—and the reference libraries on specific epizootic diseases recognized by OIE.

Since the approval in May 1964 by the 32nd General Conference of the OIE of List A of compulsory notifiable diseases, the *OIE Monthly Epizootic Circular* has presented in tabular form (in three languages—English, French, and Spanish) the occurrence, by region, of the following diseases:

Foot-and-mouth disease
Rinderpest
Contagious bovine pleuropneumonia
Lumpy skin disease
Anthrax
Sheep pox
Blue tongue
African horse sickness
Glanders
Dourine

Classical swine fever
African swine fever
Teschen disease
Newcastle disease
Rabies

By comparing each new *Circular* with that of the previous month, it is possible to ascertain the development of an epizootic whose presence has been recognized in a country and hopefully its eventual eradication. Whenever possible, information is given concerning the precise geographical location of outbreaks and of areas which remain, or become, free of the disease under consideration.

ANNUAL STATISTICS ON EPIZOOTICS

Since 1959 the International Office of Epizootics has published annual statistics on the health of livestock throughout the world. The *Animal Health Yearbook* for 1966 contains three lists of diseases:

List A—the 15 diseases whose notification is compulsory;
List B—40 diseases that are the subjects of annual reports to the Committee of the OIE;
List C—an additional 68 diseases, which are covered in the zoo-sanitary bulletins of various countries.

The diseases in the three lists are arranged not in alphabetical order but, insofar as possible, in order of epizootiological and economic importance. Diseases are grouped according to the species or zoological groups affected in the following order: large ruminants; equine animals; swine; birds; carnivores; fish; bees.

Diseases in all three lists are presented in tabular form, and the names are given in French, English, German, Spanish, Russian, and Latin.

The 1959 volume of statistics contained 72 tables of "new outbreaks," by country or territory; the 1967 volume had 110 such tables.

Since the adoption of list A in May 1964, several new outbreaks of the diseases in this list have occurred; statistics on outbreaks of these diseases prior to 1964 are given together with current statistics. Special tables show the monthly occurrence of the different types of foot-and-mouth disease virus, by region.

A perusal of the annual volumes of statistics published by OIE since 1959 shows the progress being made in each country in more accurate detection of epizootic diseases and in the development of programs of prophylaxis.

The publication of the *Animal Health Yearbook* is made possible through the cooperation of the Food and Agriculture Organization and the World Health Organization.

COMMUNICABLE ANIMAL DISEASES

In addition to information on animal diseases in List A communicable to man (anthrax, glanders, and rabies), the OIE Information Service collects data on the following diseases: brucellosis, bovine tuberculosis, leptospirosis, vesicular stomatitis of equine, ruminant, and porcine animals, and trichinosis (in List B); and rickettsiosis, botulism, and tetanus (in List C).

The intensified international movement of laboratory animals is also of interest to the OIE in light of the emergence of diseases in which monkeys are involved.

DISEASE EXPERIENCE ASSOCIATED WITH IMPORTATION OF PSITTACIFORMES

PAUL ARNSTEIN, D.V.M., M.P.H.*

Until recently, U.S. Public Health Service regulations did not permit importation of psittacine birds into the United States except by special permits isued in advance for (1) birds needed for exhibit in zoological gardens, (2) birds needed in medical research, and (3) personal pets of travelers entering the U.S. from trips in foreign countries.

Observations on the diseases of imported psittacines are therefore based on small numbers of birds imported under the above legal provisions and on examinations of shipments seized by U.S. Customs representatives for attempted illegal introduction at ports of entry.

Most of the data reported here are based on observations of Psittaciformes imported for research at the Hooper Foundation, during a five-year period, 1962–1967.

PSITTACOSIS

From the public health standpoint, the most important infectious disease of Psittaciformes is psittacosis. There are numerous reports in the medical literature which document the occurrence of human psittacosis associated with severe epornitics in imported psittacines. Many of the human cases acquired during such epornitics tend to be severe pneumonias, probably because of the presence of concentrated bedsonial suspensions in aerosols produced by the diseased birds. Careful scrutiny of histories of epornitics usually reveals that groups of birds in which outbreaks occurred had previously been subjected to prolonged crowding.

Groups of recently captured parrots, cockatoos, and other psittacines tested for evidence of psittacosis show either complete absence of the infection or a very low percentage of infected birds. These same groups may later be involved in an epornitic psittacosis situation as a direct consequence of prolonged crowding in captivity. Most of these recently infected psittacines, if untreated, will suffer a progressive, severe illness terminating in death after two to three weeks. During the period of overt disease when their feces are highly infectious, these animals may expose people associating with them. Many human psittacosis cases may thus result from a shipment which originally had a low rate of infection.

Examination of shipments of parrots and cockatoos imported recently demonstrated well that those groups which were held long at the point of origin (usually crowded) had a high percentage of psittacosis-positives, while groups assembled quickly and received after only a short stay at the point of origin had a very low percentage. Table 1 illustrates this point.

It was particularly interesting to observe that among the crowded birds there were

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TABLE 1. Psittacosis in shipments of birds according to length of stay at point of origin.

	Shipped shortly after assembly	Shipped after prolonged holding period
No. of groups	7	2
No. days between assembly and receipt	2–14	21–60
Total no. of Psittaciformes	348	187
Birds positive		
Psittacosis CF test	10 (2.9%)	36 (19%)
Psittacosis isolation test	1 (0.29%)	47 (22.5%)

more individuals positive by the isolation test than by the serological CF test. This further strengthens the hypothesis that these infections were of recent origin, contracted during the holding period. It can be readily seen that an observation period or a quarantine without treatment would not serve to prevent introduction of psittacosis and may actually be harmful by spreading existing infection.

The tetracycline drugs have been proven highly effective against the psittacosis group infections in man and animals and are definitely practicable prophylactically during importation of psittacine birds. Recently, the U.S. Foreign Quarantine Program issued new regulations which will allow commercial importation of Psittaciformes provided they complete a 45-day treatment period by an approved antipsittacosis chemotherapy. The present method of choice is incorporation of 0.5% chlortetracycline (CTC) in the daily diet for 45 consecutive days under professional supervision. In addition to psittacosis prophylaxis, this holding period should serve to detect the presence of other avian diseases not affected by CTC. If similar regulations ensure treatment of psittacines consigned to other countries, psittacosis may be climinated as a hazard associated with international movement of animals.

NEWCASTLE DISEASE

Newcastle disease may be present in Psittaciformes and become a problem during importation. In a series of imported shipments, two groups of cockatoos arrived from Indonesia via Singapore while in the incubation stage of this infection. The imported viral strain of Newcastle disease was highly neuropathogenic and resulted in the death of all the cockatoos as well as all chickens used as sentinels in the holding rooms. While not a great hazard to human health, exotic Newcastle disease may be economically extremely damaging. The quarantine-treatment period required for psittacosis prophylaxis should be sufficient to detect the presence of this important fowl disease.

OTHER INFECTIOUS DISEASES

Salmonellosis has been observed in imported psittacines but does not appear to be very frequent or very contagious. Only five cases were confirmed among 505 imported parrots and cockatoos; all five were fatal *Salmonella typhimurium* enteritis and no secondary cases occurred.

Aspergillosis is not uncommon in parrots and cockatoos. The cases are sporadic and do not appear transmissible from bird to bird but are probably acquired from the environment. Antibiotic treatment may somewhat increase the mortality due to aspergillosis. There is no known public health hazard in associating with aspergillosis-infected birds.

Other diseases seen among imported parrots were considered due to stresses of capture, crowding, travel and irregular care. Enteritis, nephritis, chronic inappetence, self mutilation, and other uncommon conditions were sporadically observed.

The Psittaciformes tend to be typically vigorous, adaptable animals, not especially problematic as to proper management, either in permanent locations or during travel. The usual hygienic measures—general cleanliness, fresh feed and water, and uniform comfortable temperature will prevent serious losses.

HAZARDS OF LATENT AND SUBCLINICAL VIRAL INFECTIONS IN LARGE EXOTIC MAMMALS

LARS H. KARSTAD, D.V.M., Ph.D.*

Hazards from viral infections in the international shipment of the larger wild mammals stem, basically, from two sources, one known and one unknown. First there is the known susceptibility of many wild mammals to viruses which infect man and his domestic animals; and secondly, there is a great lack of knowledge of the natural susceptibility of many wild mamals to important virus infections.

Most viruses are not strictly host specific. They may infect most species in a taxonomic family, or they may even be capable of natural infections in several families of mammals. Examples of viruses with very broad host ranges are the North American eastern and western equine encephalitis viruses. These amazing parasites are capable of multiplication in insect vestors as well as many different kinds of vertebrates, ranging through diverse classes of reptiles, birds, and mammals, including man. The hosts of greatest epizootiological importance in many viral infections are animals which are naturally susceptible to infection but in which frank disease is not seen. Such animals may constitute "silent" reservoirs of infection, ensuring the enzootic persistence of viruses in certain geographic areas. If by chance such animals are selected for international shipment to a zoo, a wildlife park, or a scientific institution, the disease hazards are obvious.

Greatest potential for the international transport of exotic viruses is present in animals which experience inapparent infections or long-term latent infections, or animals which become healthy convalescent carriers. Animals with overt disease are a lesser risk, since their condition may attract the attention of animal health authorities. Another risk exists in rapid air shipment of animals that may be in the incubatory phase of a viral infection. Such animals may not show signs of disease until they have been in contact with many other animals, both in transit and at their destination.

I propose now to outline, by specific examples, some of the known disease hazards and also some of the areas where great dangers exist in the unknown—our great lack of knowledge the susceptibilities of wildlife species and their responses to viral infections.

FOOT-AND-MOUTH DISEASE

Foot-and-mouth disease is widely distributed on four continents. This, plus the fact that it is one of the world's most important livestock diseases, makes it a continuing serious threat to livestock and game animals in areas now free of the disease. The virus of foot-and-mouth disease has a broad natural host range, including probably

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TABLE 1. Animals reported to be naturally susceptible to foot-and-mouth disease.

Artiodactyla
Bovidae—cattle, buffalo, sheep, goats, African antelopes
Camelidae—camels, llama
Cervidae—deer
Giraffidae—giraffes
Suidae—pigs
Perissodactyla
Tapiridae—Tapirs
Proboscidae
Elephantidae—elephants
Insectivora
Erinaceidae—hedgehogs

all cloven-hoofed animals as well as tapirs, hedgehogs, and possibly elephants (Table 1). This host range includes mammals of at least 4 zoological orders, 8 families and 23 genera. I have not counted the species. This large number of hosts includes wild and domestic animals indigenous to all continents of the world. The potential, therefore, for uncontrolled spread of foot-and-mouth disease throughout the world is almost astronomical.

The signs of this disease in wild game animals are similar to those in cattle. Diagnosis in overt cases is a problem of differentiation from other diseases which cause epithelial vesiculation, e.g., vesicular stomatitis. One must always consider the possible existence of clinically inapparent wildlife carriers of foot-and-mouth disease, since it is known that cattle are capable of carrying the virus for several months after exposure (*3*).

Hedgehogs have been found naturally infected with the virus in Britain, and, experimentally, they have been found capable of carrying it as a latent infection through periods of hibernation (*6*). It is at least possible that some such mechanism is responsible for repeated outbreaks of foot-and-mouth disease in certain areas.

VESICULAR STOMATITIS

Vesicular stomatitis occurs only in the United States and in countries of Central and South America. Besides man, cattle, horses, and swine, its natural host range is known to include several species of wild mammals native to the Americas: white-tailed deer, raccoons, and bobcats (*8*). It so happens that these animals represent the families Bovidae, Equidae, Suidae, Cervidae Procyonidae and Felidae—families which are well represented throughout the world and which contain a great many species. It is probable, therefore, that the greatest danger in vesicular stomatitis as an exotic disease, is our incomplete knowledge of its potential host range and the clinical and pathologic signs to be expected. Further research on the susceptibility of common wild mammals is needed.

Latent or clinically inapparent vesicular stomatitis is not known in large game mammals. Silent infections occurred in experimentally inoculated raccoons, but the animals did not become carriers or shedders of virus (*7*).

BLUE TONGUE

Blue tongue is a viral infection of cloven-hoofed animals in parts of Africa and the Americas. It occurs in Africa in cattle, sheep, and blesbok (all members of the family Bovidae) and in the United States in cattle, sheep (both wild and domestic), and white-tailed deer (family Cervidae). Here again, the complete potential host range of this virus is unknown. Research should be encouraged on the susceptibility to blue tongue virus of many species of wild mammals, the signs of disease to be expected,

and the potential of wild mammals as virus carriers and disseminators.

As an example of how this further knowledge of blue tongue in wildlife may be obtained, we may describe our experience in working with white-tailed deer. Studying the pathologic changes in epizootic hemorrhagic disease of deer (*10*), I was impressed by the similarity to the lesions of blue tongue in sheep (*18*). Noting similar vascular, epithelial and muscle lesions in the two diseases, we postulated similar pathogenetic mechanisms. I suggested to my collaborator in these studies, Daniel O. Trainer, that it might be worthwile to attempt experimental infection of deer with blue tongue virus. The results were dramatic! White-tailed deer injected with blue tongue virus developed a rather acute disease, very similar in clinical and gross signs to epizootic hemorrhagis disease (*21*). I have had the opportunity to study these cases histologically, and there, too, the resemblance to this disease is remarkable (*9*). The question which promptly occurred to us was: If clinical and pathologic signs of these two infections in deer are similar, are there relationships between the two viruses? This possibility has been investigated by Stair (*16*) and by Boulanger and Bannister (*1*). There is, to my knowledge, no conclusive evidence that the two viruses are antigenically related. Perhaps results of current investigations not yet published will clarify this point. We have been unable to induce disease in sheep by inoculation of epizootic hemorrhagic disease virus.

At about the time we began studies of experimental blue tongue disease in deer, Stair *et al.* diagnosed a natural outbreak of blue tongue in a captive herd of white-tailed deer in Texas (*17*). The naturally occurring disease was similar but somewhat less acute than the experimentally induced disease.

Robinson and his associates have diagnosed blue tongue also in wild bighorn sheep (*Ovis capadensis*) (*13*).

The occurrence of clinically inapparent blue tongue disease virus infections in wildlife and cattle makes this an important exotic disease hazard. Infected animals which are apparently healthy may be transported from Africa or Western U.S. to parts of the world where blue tongue does not exist. The natural insect vectors of blue tongue virus, *Culicoides* sp., are so ubiquitous that suitable vectors are present in many parts of the world in which blue tongue does not now occur. It is possible too, that other kinds of biting or blood-sucking arthropods may act as vectors.

EPIZOOTIC HEMORRHAGIC DISEASE

Epizootic hemorrhagic disease has occurred in deer in the United States and Canada (*19*). Its causative virus has only recently been recognized. Thus, its disease-producing potential for many animal species is unknown. It would be natural for animal disease workers in other countries to look upon this virus as a possible hazard to wild ungulates.

RINDERPEST

In 1966, rinderpest was reported to have occurred in domestic cattle and buffaloes in many parts of Asia and Africa (*5*). Game animals were suspected to be infested in Ethiopia and known to be infected in Kenya, Tanzania, Uganda, and seven other countries in Central and West Central Africa. This ancient cattle plague is thus not only still widespread in domestic animals but is entrenched in free-ranging wild ruminants in large regions of the world. In the Serengeti Plains and adjoining areas of East Africa, rinderpest is enzootic in wild game animals and may be maintained there in-

TABLE 2. Animals susceptible to rinderpest.

Artiodactyla
Suidae—pigs
Tayassuidae—peccaries
Hippopotamidae—hippopotamus
Camelidae—camels
Tragulidae—mouse deer
Cervidae—deer, moose, etc.
Giraffidae—giraffes
Bovidae—cattle, sheep, goats, buffalo, bison, African antelopes

definitely, even in the absence of wildlife (*11*).

The host range of rinderpest virus (Table 2) is very broad (*15*). This disease is restricted to cloven-hoofed animals but affects a great many species of eight zoological families. Potential wild mammal hosts in the Americas include peccaries, deer, moose, elk, caribou, reindeer, pronghorn antelopes, bison, muskoxen, mountain goats, and mountain sheep.

According to Scott (*15*), "rinderpest is one of the most 'eradicable' diseases and its continued presence in a country's domestic animal population indicates failures, not because the techniques are unknown but because their application is bedevilled by financial, political and social factors." Rinderpest in wildlife is obviously quite a different problem, and the only practical way to protect wildlife at present is to control the disease in domestic stock (*15*). Live virus vaccines attenuated for cattle may cause disease and death when used on game animals (*2*).

What are the chances that rinderpest virus may be carried by apparently healthy animals? For most species this question remains unanswered. The incubation period in cattle and domestic buffaloes varies from 3 to 15 days, certainly long enough for animals to be shipped by air anywhere on the globe. Similar periods of incubation may be expected in wildlife. Infected animals begin to shed virus in respiratory and oral secretions during the incubation period and continue to shed throughout the disease and into convalescence. Clinical signs in various wild mammals range from subacute to peracute. Species which may experience subacute or inapparent infections are naturally most dangerous as disseminators of virus in international transport. These include the hippopotamus and a variety of African antelope. Although rinderpest has never been recognized in the hippopotamus, Plowright was able to demonstrate antibodies in a high percentage of hippopotami studied in Uganda (*12*). The abundant Thompson's gazelle is said to experience mild or subclinical rinderpest infection (*15*). In view of the above observations, it is obvious that quarantine of wild hoofed mammals after international shipment is essential, unless they come directly from an extended period of residence in a rinderpest-free country.

AFRICAN SWINE FEVER

The virus of African swine fever occurs as a latent viremic infection in apparently healthy bush pigs (*Potomachoerus* sp.) and wart hogs (*Phacochoerus* sp.) in Africa (*14*). Importation of these wild swine for zoological exhibits poses a very serious hazard to domestic swine populations. It is not necessary to describe the devastating nature of African swine fever in domestic swine. Direct importations of African wild swine cannot be risked. It is safer to rely on progeny from captive herds in zoos in countries where African swine fever has not occurred. Even then, it may be wise to quarantine such animals and examine for latent infections by inoculation of blood into test domestic pigs.

Since some domestic swine survive African swine fever, convalescent pigs may carry the virus in international commerce. Probably the European wild boar (*Sus scrofa*)

would react to African swine fever like domestic pigs (most animals suffering fatal infections but some surviving to become convalescent carriers).

HOG CHOLERA

Hog cholera (swine fever) is regarded as a serious exotic disease in some countries, e.g., Canada. I do not know the susceptibility of African wild pigs to the hog cholera virus. We do know, however, that European wild swine (*Sus scrofa*) react to hog cholera much as do domestic pigs. We should regard all members of the family *Suidae* as potential hosts and take precautions to prevent accidental shipments of infected animals. In addition to strict quarantines of all types of swine, I would recommend tests for infectivity of blood and feces by inoculation of filtrates into susceptible pigs. Quarantine should be extended sufficiently beyond the usual incubation period of hog cholera, to be sure that the test pigs will remain healthy.

PSEUDORABIES

Pseudorabies (Aujeszky's disease, mad itch) has not yet been recognized in many countries. Its natural host range is incompletely known. In some animals, e.g., cattle, the clinical signs of mad itch are so characteristic that diagnosis is readily made. Swine can be inapparent carriers of the virus, shedding it in nasal secretions. Some species may not develop any of the clinical signs considered to be characteristic of pseudorabies in cattle. As an example of this, we have recently found several species of wild mammals susceptible to experimental infection, yet the mad itch syndrome did not appear in most of these infections (*20*). Experimental infections were induced in the fox, skunk, cottontail rabbit, muskrat, raccoon, badger, woodchuck, opposum, and deer. This is a good example of our lack of knowledge about susceptibilities of wild mammals to a virus which has long been recognized in domestic stock. We do not know whether some wild mammals may be able to serve as latent carriers of pseudorabies virus, but it seems wise to assume that wild swine, at least, may be capable of acting as healthy carriers of this virus.

RABIES

The long and variable incubation period of rabies, together with its broad natural host range, makes rabies an important disease to consider among the hazards of international shipment of wild mammals. Britain's six-month period of quarantine for imported dogs is well justified. Should not the same long period of quarantine be applied to certain wild mammals? Wild mammal importation is one way in which rabies can cross national and state borders.

LOUPING ILL

There is some evidence that the tick-borne encephalitis virus of sheep (louping ill) infects red deer in Britain (*4*). This disease has not yet been recognized in the Americas. In the event that the disease may be introduced through infected sheep or wild ruminants, it seems reasonable to expect this virus to be able also to infect our American wild ruminants—deer, sheep, and goats. We must remember that since this is a tick-borne virus disease, it is at least theoretically possible for it to be shipped in infected vector ticks on animals which may not themselves be active carriers of the virus. It is probable that Ixodid ticks, which occur on both wild and domestic mammals in the

Americas, are capable of acting as vectors of louping ill virus.

SCRAPIE

There is an obvious need to examine the susceptibility of wild mammals, especially the ruminants, to scrapie. This is certainly one infection which cannot be easily controlled by clinical examinations, tests, and quarantines. Incubatory carriers are impossible to detect by the means we now have. Since the scrapie agent occurs naturally in sheep but experimentally can also infect goats and mice, it seems logical that we should consider infection of wild ruminants possible, if not probable. Eradication of scrapie from domestic sheep flocks has been difficult. Imagine the problem we will face if scrapie gains access to our wild ruminants, animals such as deer, mountain sheep, or mountain goats! Little can be done to ensure that this does not happen, other than continuing all-out efforts to eradicate scrapie from domestic flocks. We should consider infection of wild ruminants possible, pending proof to the contrary. We should proceed to test experimentally the susceptibility of our wild ruminants by inoculation of captives in strict isolation. Facilities must be available to maintain the inoculated wild ruminants in isolation for extended periods, say two or three years.

MAEDI AND VISNA

Similar experimental studies should be undertaken to examine the susceptibility of our native wild ruminants to two other exotic "slow viruses," the viruses of maedi and visna. As in the case of scrapie, long-term trials are needed, carried out in strict isolation. This would provide knowledge valuable for the safeguarding of native wildlife and for avoiding dissemination of these exotic diseases through movements of wild mammals.

CONCLUSIONS

International shipments of large wild mammals carry the serious hazards of spread of viral diseases to wildlife, man, and domestic livestock. The susceptibilities of some wild mammals to certain viruses, the signs of disease which occur and the potential for such animals to carry viruses in international commerce are known. We need to take steps to reduce the hazards in such cases by careful health inspection and appropriate quarantine.

More serious hazards lie in our lack of knowledge of the behavior of many viruses in wildlife. We need to know more about the susceptibilities of wild mammals indigenous to countries where important exotic viruses now occur also the susceptibilities of wild mammals in our own countries in the Americas. We need to know the signs of disease to expect in this variety of wildlife hosts, and the potential of wildlife to act as incubatory carriers, clinically inapparent carriers, and convalescent carriers of viral infections. To be forewarned is to be forearmed.

How can we obtain this necessary information about exotic virus infections in wildlife? In general, we have two methods: surveys for evidence of viral infections in wildlife and studies of experimentally induced infections. Obviously the survey approach is useful only in areas where the virus in question occurs. We can make surveys on the occurrence of foot-and-mouth disease in wild mammals in parts of South America and on rinderpest in Asian and African wildlife. Information from such surveys will allow us to intelligently plan and carry out preventive measures.

In addition to knowledge about the occur-

rence of exotic virus diseases in indigenous game, we must be prepared for accidental introduction of exotic viruses into our own wildlife, both captive and free-living. The only practical means of acquiring information on native wild mammal susceptibilities and signs of disease—and whether or not carriers and virus shedders will develop—is to study experimental infections in captive animals in strict isolation facilities. Such facilities exist in a few State, provincial, and national animal disease laboratories. We must make use of them. For illustration, we have cited a number of studies of wild mammals experimentally infected with the viruses of foot-and-mouth disease, vesicular stomatitis, blue tongue, rinderpest, African swine fever, and pseudorabies.

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POTENTIAL HEALTH HAZARDS OF VIRAL DISEASES OF SMALL MAMMALS

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International shipments of small mammals have increased with the growth of biological and medical research during the past 20 years. For example, the behavior of hedgehogs from Madagascar is under study in Washington, D.C. Much of our knowledge of the anatomy, physiology and behavior of the vampire bat, *Desmodus rotundus*, is based on a laboratory colony maintained for many years in Ithaca, New York. This colony was initiated with a dozen bats from Panama in 1952 and supplemented with about 200 specimens from Mexico collected in 1957, 1958, and 1959. During the past five years, I have personally assisted with the collection of cricetine rodents in Bolivia and Venezuela for shipment to the Panama Canal Zone and with the collection of opossums and cotton rats in Panama for shipment to laboratories in California and Michigan. The continuing quest for new laboratory hosts for microbial pathogens and as subjects for sophisticated physiologic and anatomic studies can be expected to result in an increase in the international movement of small mammals.

What is known of the potential health hazards associated with this traffic in animals? How effective is physical examination as a means of detecting infection with agents known to be highly pathogenic for man? Are new regulatory measures indicated to minimize the hazards associated with importation of small feral mammals? Although the answers to these questions are not altogether apparent at this time, I would like to discuss some of the information currently available on certain virus diseases of small mammals which I believe to be pertinent to these questions.

Among the viral zoonoses, the arthropod-borne virus group has been most frequently isolated from small mammals, including marsupials, bats, insectivores, rodents, and lagomorphs. In rodents, these viruses produce only a fleeting viremia of one to a few days followed quickly by development of humoral antibodies and persistent immunity to reinfection. This short duration of the active infection materially reduces the possibility that rodents collected from the wild will be circulating arboviruses during and after shipment across international boundaries. However, the course of arbovirus infections in small mammals other than rodents is not so well understood. LaMotte (*1*) and Sulkin *et al.* (*2*) reported viremias of one to four weeks in several bat species after experimental inoculation with Japaneses B encephalitis virus. Prolonged infection of bats with long-term shedding of Rio Bravo virus has been reported by Constantine and Woodall (*3*). A captive free-tailed bat (*Tadarida brasiliensis mexi-*

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cana) was infected throughout a period of nearly two years without showing obvious evidence of disease. Rio Bravo virus was isolated from a saliva sample collected on the day the bat was captured and again from the salivary glands when the animal was sacrificed 682 days later. Latent infection of bats with rabies was reported over three decades ago by Pawan (in 1936) when he isolated virus from the brain of a vampire bat (*Desmodus rotundus*) in Trinidad which had been observed in captivity for nearly 5.5 months with no evidence of disease or abnormal behavior. Acha (*4*) lists 52 species of bats as hosts of rabies virus in the Americas. Sulkin (*5*) presented evidence that rabies virus invaded the interscapular gland (brown fat) after parenteral inoculation of two species of insectivorous bats and suggested that this gland provides a "reservoiring mechanism" for storage of the virus during prolonged periods of latency.

The results of recent studies on the hemorrhagic fever viruses in the Americas are pertinent to the subject of this Symposium. At least one member of this group of viruses produces a chronic asymptomatic infection of wild rodents characterized by persistent shedding of virus in a form which is highly pathogenic for man. Special laboratory facilities and sophisticated methods are required for detection of infection in living animals. The hemorrhagic fever viruses are an important human health hazard associated with the international movement of small mammals.

The term hemorrhagic fever was first used in connection with epidemics among Soviet and Japanese military personnel in the Far East during the 1930's (*6*). Since then, a variety of viral agents which produce a hemorrhagic syndrome in man have been described from Siberia from Soviet Central Asia, and from Eastern and Central Europe. In the Americas, the first report of hemorrhagic fever was provided by Arribalzaga (*7*), who studied an epidemic near Junin, Buenos Aires Province, Argentina, in 1953. The disease is known locally as *mal de los rastrojos*, and the causative agent has been named Junin virus. The population at risk consists mainly of adult male workers who emigrate each year from the north to harvest the corn crop in Buenos Aires Province during the months of March, April, and May. The virus has been isolated from man, from the field rodents *Calomys laucha* and *Akodon obscurus*, and from the cosmopolitan house mouse, *Mus musculus* (*8*). Other rodents in the epidemic area include *Oryzomys flavescens*, *Akodon azarae*, and the wild guinea pig, *Cavia pamparum* (*9*).

A disease with similar clinical manifestations was observed in the Department of Beni in northeastern Bolivia in 1959. The high mortality rate associated with this disease (often more than 30 per cent) forced the abandonment of the town of El Mojon by about 600 inhabitants in 1962 and the flight of more than one-third of the population of San Joaquin, a village of about 2,500 inhabitants. Systematic studies of the epidemic were begun in 1963, and the etiologic agent, Machupo virus, was isolated from man and the rodent *Calomys callosus* that same year (*10*). The close association of this mouse-like rodent and man was noted early in the investigation. This animal is a pastoral species distributed through the grasslands and along the forest edges south from San Joaquin, Bolivia, to northern Argentina. It readily invades houses, where it lives in much the same manner as the familiar house mouse, *Mus musculus*. A disease control program aimed at destruction of this and other small mammals in and about houses in San Joaquin was successful and resulted in the dramatic disappearance of the disease from the town in June 1964 (*11*). However, it has been necessary to maintain a continuing program of rodent control to

prevent reinvasion of the town by infected *Calomys callosus* from the surrounding grasslands.

Although field studies in Bolivia established the role of *Calomys* rodents as reservoirs of Machupo virus infection, they provided little or no positive information regarding the mechanisms of transmission from rodent to rodent and from rodent to man. The possibility of arthropod transmission was tested by attempting to isolate Machupo virus from 366 pools, consisting of a total of 28,848 bloodsucking arthropods, but without success. However, laboratory studies at the Middle America Research Unit (MARU) in the Canal Zone established that adult hamsters inoculated parenterally with Machupo virus become chronically infected and continuously shed virus in the urine for more than one year. These observations were extended to *Calomys callosus* by establishing a laboratory colony from 13 adult animals captured in San Joaquin, Bolivia, and transported to the Canal Zone. Viruria was regularly demonstrable in 10 *Calomys callosus* of the third laboratory generation, beginning 15 days after intraperitoneal inoculation with Machupo virus and continued through 153 days without endpoint (*12*). Attempts to induce chronic infection in wild-caught *Mus*, *Rattus* *Proechimys*, and *Oryzomys* rodents were unsuccessful (*13*).

A number of other viruses closely related serologically to Junin and Machupo viruses have been isolated from small mammals in South America. Tacaribe virus was isolated on the island of Trinidad in 1956 from the brains of fruit-eating bats (*Artibeus* sp.) and from mosquitoes (*14*). Amapari virus was isolated from rodents of the genera *Neacomys* and *Oryzomys* and from ectoparasitic mites (*Gigantolaelaps* sp.) collected from infected rodents (*15*). Three additional agents from Peru, Brazil, and Paraguay are under study at the Middle America Research Unit (*16*).

With the exception of Tacaribe virus from bats, the known vertebrate hosts of the Tacaribe antigenic group of viruses include only man and rodents of the subfamily Cricetinae. In the laboratory, chronic infection with Machupo virus could be induced in most cricetine rodents but not in members of the rodent subfamily Murinae (*Mus* and *Rattus*) nor in one member of the family Echimydae (*Proechimys*). This suggests that the Tacaribe group of viruses are well-adapted parasites of the rodent family Cricetinae in tropical and subtropical regions of the New World.

In conclusion, several examples of chronic virus infections of small mammals have been cited. With the expected increase in the international movement of small mammals, it is likely that animals infected with these viruses will be collected from the wild and included in shipments across international boundaries. Perhaps, as a result of this and similar conferences, we can anticipate some of the problems that will arise and take steps to make the medical and scientific communities more aware of their responsibilities in this area.

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IMPORT-EXPORT REQUIREMENTS FOR THE MOVEMENT OF EXOTIC ANIMALS

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History tells us that about 65 million years ago, after the extinction of dinosaurs, primitive forms of mammals as we know them today (horses, rhinoceroses, camels) began to develop on the earth. Grazing animals became more plentiful about 20 million years ago, and early man is believed to have appeared between 2 and 11 million years ago. Man developed as larger mammals became extinct between 10,000 and 1 million years ago. The development of agriculture, the growth of civilization, and the rapid spread of modern man have all occurred within the past 10,000 years.

No doubt some form of quarantine restrictions has been practiced since the contagiousness of diseases was first recognized. The city of Venice adopted the first recorded regulations requiring all vessels from certain ports to be detained for 40 days in the harbor without communication with the land or with other vessels. The term "quarantine" was thus derived from the Italian *quaranta*, which means "forty." The time of the decree coincided with the Lenten season, and it is possible that the length of the quarantine was suggested by the duration of the religious season. Marseilles later introduced a certificate of health to be filled out by officials in ports of departure, a practice which has survived to modern times.

Not too many years ago animals moved from one area of the world to another only under their own power. Mechanical transportation was not yet used for animals, and thus the mixing of species from one area of the world with those from another was limited to species closely related insofar as distance was concerned. Today things have changed. The great distances of the world have yielded to advances in the technology of transportation. Time seems to have shrunk and travel that took weeks and months is today accomplished in a few days or even hours. This transition began with the construction of railroads and highways within and between countries—a vast network over which animals could be transported. Since World Was II land vehicles have been developed that require no network of highways, and with the advent of the jet aircraft exotic animals can be moved from any point in the world to any other location within 36 hours flight time or less.

The development of more speed, greater capacity, and increased volume are constantly changing the problems of transportation and trade. This is in direct contrast to overland movement of animals when they moved under their own power and were required to feed off the land as they were driven from one location to another. Under such conditions, time itself

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solved most of the disease difficulties. While exposure to diseases could and did occur en route, there was generally sufficient time for such diseases to "burn out" before the animals arrived at their destination.

There seems to be no end in sight to progress in modern transportation. Within the past few months, newspapers have carried stories of the successful flight of a plane with a payload of 265,000 pounds. On the drawing board at least, serious consideration is being given to the development of planes with a cargo payload of 1 million pounds or a passenger capacity of 1,000 people. Animals, even now, can be transported halfway around the world without the need for feed, water, and rest en route. Unfortunately, if exposure to disease has occurred, there is usually insufficient time for visible symptoms to develop during this short shipping period.

But why all this concern about animal movements and the resulting problems of possible disease spread? Is there a need for the international shipment of exotic animals? Why is it necessary to expand or even to continue international trade and commerce in such classes of animals?

The world livestock population (sheep, cattle, swine, goats, buffaloes, horses, burros, mules, and camels) is estimated to total between 2¾ and 3 billion head. The human population of the world in 1965 was estimated at 3¼ billion with a projected increase to 3.6 billion by 1970, 4.3 billion by 1980, 5.2 billion by 1990, and 6.1 billion (almost double the present population) by the year 2000. A decade or two ago this country was concerned about food surpluses —but today food shortages appear to be an everyday fact in many countries of the world and malnutrition a relatively common occurrence. International organizations are concerned with the preservation of certain species of animals threatened with extinction. Other scientific groups are concerned with the utilization of exotic animals as possible sources of food for the vastly expanding human population. These two requirements, in addition to the need to educate our population through exhibitions at zoological parks and the desire to increase our recreation capability, clearly establish the necessity for increased international trade in exotic animals.

Basically, seven groups may be involved whenever animals are moved in international commerce. For exotic animals these would be:

Group I—Owner-seller (hunter, trapper, collector)

Group II—Buyer-shipper (or agents for either)

Group III—Animal health officials at origin

Group IV—Personnel of transporting carrier (truck, railroad, ocean vessel, aircraft)

Group V—Animal health officials at country of destination

Group VI—Consignee at destination

Group VII—Conservation and preservation organizations (including humane societies)

How do these seven groups become interrelated with the international shipment of animals? What effect does each have on the handling of exotic animals under import-export controls? What are the responsibilities of each group?

Every effort must be made to insure that economic factors are not the controlling factor insofar as diseases and humane handling are concerned. It is recognized, however, that economic factors cannot be completely ignored. In reality they may govern whether or not international shipment of exotic animals takes place at all. Efforts must be constantly made to prevent these economic factors from adversely affecting the precautionary restrictions relating to animal diseases and humane han-

dling. All necessary requirements must be met, even though such requirements might add to the total cost involved. Animal diseases recognize no national boundaries, and the economy affects diseases and humane handling primarily because better sanitation and humane shipping conditions result when economic factors are favorable; conversely, poor sanitation and inhumane shipping conditions are likely to exist when economic factors are unfavorable.

Certainly Group I (owner-seller) and Group IV (personnel of transporting carrier) have a monetary interest in the international animal shipments either through ownership or custody of valuable animals.

Group II (buyer-shipper) has an economic interest because the ability to stay in business depends upon profit from the transaction.

Group III (animal health officials at origin) and Group V (animal health officials at country of destination) have an economic interest, because such international shipments are profitable to the country of origin and may affect the livestock disease situation within the country of destination.

Group VI (consignee at destination) definitely has a monetary interest in the international shipment of exotic animals, since funds provided by the consignee usually initiates the international shipment in the first place. A shipment can be considered successful by consignees only if the money expended results in the acquisition of an exotic animal that successfully adds to their collection or improves the quality of their breeding group.

Group VII (conservation and preservation organizations) may or may not have a direct economic or monetary interest in the shipment, but in any event people in those organizations are committed to work on behalf of all animals and have a "sympathetic" interest in making certain that such animals are humanely handled. There would be no need for humane societies to be concerned with international shipments of animals if Groups I–VI assume their proper responsibilities.

Too often the owner-seller of animals (Group I) and the buyer-shipper (Group II) are concerned only with the profit from a single transaction. If they can be motivated to consider "repeat sales" potential, they will be inclined to make the proper effort to provide healthy animals of high quality for the price paid and to assure proper care and handling from time of acquisition to delivery.

The animal health officials at origin (Group III) have certain responsibilities if their country is to continue to enjoy the benefits of future international export shipments. The United States was first made aware of this in the late 1800's when Great Britain imposed an embargo against certain domestic animals from the United States because of contagious pleuropneumonia. This generated interest to the extent that a law was passed to establish the Bureau of Animal Industry in the Department of Agriculture in order to promote the exportation of certain animals from the United States. The law granted authority to the Secretary of Agriculture to make special investigations as to the existence of any communicable disease and to "establish . . . regulations concerning the exportation and transportation of [certain animals]."

The transporting carrier group (IV) has an interest in the animals, their health, and their handling. This is because loss of reduction in value of the animals during transit could result in a claim against this group if it could be shown that the cause was carelessness or improper performance of duties. Sometimes the contractual arrangements for transporting the animals may involve a bonus payment for crowding in extra animals or a monetary penalty for failing to take aboard a specified number of

animals, even though the apparent fitness of some is questionable. This is not conducive to good quarantine practice, proper care, adequate sanitation, or humane handling—each of which may contribute to the possibility of disease introduction and spread.

The animal health officials in the receiving country (Group V) assume the most responsibility of any of the groups involved, since they are concerned with precautionary measures against animal disease introduction. They must decide whether or not the animals in question may safely be released for entry into their country. An animal, because of its mobility, and because it may act as a mechanical transmitter of disease or as an inapparent carrier of disease, can become an important method for the introduction and dissemination of communicable diseases. The responsibilities of the veterinary official in the receiving country are based on laws and regulations designed to permit as free a flow of animals as possible, providing their introduction is safe and orderly. Ideally, import laws and regulations must be adequate to prevent the dissemination of disease but never more restrictive than is necessary to accomplish this purpose.

Essentially, each of the first five groups has an obligation to work closely with each other group and to keep in mind the interests and desires of the ultimate consignee (Group VI), since nearly all groups involved are working for, or on behalf of, the consignee. There must be close cooperation between animal health officials in the country of origin and the country of destination. A final determination as to what restrictions are necessary to permit the importation of exotic animals into a given country must rest with the animal health officials in that country. The counterpart officials in the country of origin must provide the necessary assurance that the shipment of animals meets the minimum export requirements. In addition, they must cooperate with appropriate officials in the receiving country to make certain that the all possible import requirements of that country have been fulfilled.

Those concerned with conservation and preservation (Group VII) must cooperate with all other groups. Their responsibilities involve seeing that there is proper space, restraint, sanitation, ventilation, temperature, humidity, feed, bedding, and water and that caretakers are available when necessary.

The process of international shipment involves many stages: proper veterinary inspections, tests, precautionary treatments, and certification at origin; restraint and handling under sanitary conditions with freedom from exposure to disease; movement to the port of embarkation in equipment properly cleaned and disinfected; movement from the assembly point to the port of embarkation without undue delay: embarkation quarantine under appropriate veterinary supervision; final health inspection, identification, and certification by national veterinary officials, who must also supervise the loading aboard the transporting carrier; arrangement by the transporting carrier and shipper for proper care and handling of the animals en route; inspection by veterinary officials of the national government of the country of destination upon arrival at the port of entry; examination of accompanying documents and completion of tests or quarantine, where applicable, until a determination can be made that the animals are potentially eligible for entry; and, finally, because most exotic animals originate in countries where devastating diseases may be prevalent, it is not inconsistent with good quarantine practices to require that such animals be kept under postentry control to safeguard against possible disease spread.

International shipment creates abnormal stresses and strains in animals and may involve protracted periods without feed, water, or rest, drastic changes in accommodations, severe variations in temperature and climatic conditions, confinement in unfamiliar surroundings, and undue excitement because of the physical process of travel.

The care given to an animal at the end of its long journey can be the key to success or failure in international shipment of exotic animals. The resumption of feeding in correct proportions, the availability of fresh, potable water, comfortable surroundings for rest, protection against drastic changes in weather, separation from other strange animals, and the elimination of excess noise and other disturbances, all go a long way toward permitting rapid recovery from the stress and strain of travel. These are responsibilities of all the groups concerned and cannot be overemphasized.

All of us should be concerned with efforts to provide safe and humane handling of animals in international commerce. Our research laboratories should help us to determine safer and better ways to detect and combat animal diseases and more positive ways of reducing the stresses and strains of travel. Future advance in transportation, increased speed of travel, and the greater demands generated by the expanding world population will create still greater problems than the complicated ones with which we have had to wrestle in the past. There must be cooperation among all concerned if the countries represented at this Symposium are to be properly protected against the ravages of animal diseases.

APPENDIX

Appendix

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