World Animal Health Problems

***W. Ross Cockrill,** *F.R.C.V.S; Dr. Vet. Med, (Zurich)*
591 Vale do Lobo, Almansil 8100
Algarve, Portugal

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Introduction

The Economics of Livestock Disease

In recent years a number of countries, among them Britain, Sweden and the United States of America, have made serious attempts to assess disease in terms of understandable economic figures. Often-quoted statements are made to the effect that internal parasitism in livestock costs the U.S. 400 million dollars annually; or that, if we could reduce the incidence of disease by 50 percent we would increase the output of animal protein by 25 percent; or that losses caused by disease in developing countries may range between 30 and 40 percent of total livestock production.

The true cost of disease in hard cash terms is incalculable; Every country in the world loses incredible amount of money through disease losses in domestic livestock.

In this modern world in which production is far outpaced by reporduction we could certainly go a long way toward meeting the food needs of greatly expanding human populations if we could eliminate the wastage which occurs in production, or after production and before the food gets to the consumer. Disease is one of the greatest of all wastages, and it need not be the spectacular epizootics like rinderpest or African swine fever or foot-and-mouth. The insidious pathological conditons which have a continuously subtractive effect impede productivity in every land under the sun, but particularly in those countries which are referred to sometimes euphemistically, as developing. Consider the costs of the wide spectrum of parasitism, the universal problem of mastitis, and immense losses caused by infectious infertilities, and the uncountable deaths in your livestock between conception and weaning. Australia, which has been engaged in mass sheep rearing for longer than any other country, loses an estimated 10 million lambs every year.

Many of the problems of waste relate to disease and parasites or to pests other than bacteria. For example, it has been estimated that there are 10 rats to every human being in India, and that they eat or destroy about 27 millions tons of food annually, over a quarter of the total production. As polluters and as vectors of a variety of diseases they make an important contribution to the world's economic problems as well as to disease in both animals and man.

Veterinary services are an excellent investment for any country. Their cost is fractional by comparison with the money which they save through disease control and prevention, and the capital which they generate in improved breeding, nutrition and management. None of the "developing" countries can afford to be without a strong and efficient veterinary service, and yet animal health is often low on the list of government priorities.

A Shrinking World

In terms of time and distance we live in a contracting universe. Ever since the invention of the wheel, man has tended to travel faster and further. His journeyings have been facilitated first by steam and then by gasoline and similar natural or mineral fuels. Other fuels and wider horizons are constantly materializing. Conventional transport by road, rail, and sea has been speeded up, while the past few decades have seen a great extension of air travel.

Twenty years ago we recognized the aptly named if rather ill-defined group of infections called the emergings diseases. They included diseases which were acquiring a greater relative importance as others came under a measure of control. An example of this area was the emergence of the importance of brucellosis in several countries, following the effective control of tuberculosis.

The emerging diseases included these conditions which were appearing in certain world regions for the first time. Some were breaking out of the relatively restricted areas to which they had traditionally been confined, and had begun to appear in parts of the world where they had never before occurred, sometimes thousands of miles from their classic locations. Among these diseases were listed African Swine fever, African Horse Sickness and bluetongue. In the course of the past two decades these diseases have continued their emergence on an vast and truly horrifying scale, creating a number of national livestock disease catastrophies which had their roots in the fact that greater numbers of people, animals and animal products are being moved about the earth's surface at higher speeds than ever before. Man and his possessions now flow swiftly about the world and provide unprecedented means for the transference of a wide range of disease agents.

To such an extent has the world shrunk that a few giant strides can connect active centres of foot-and-mouth disease, rinderpest, African swine fever and other virus epizootics with the earth's main staging points which include New York, Cairo, London, Tokyo, Peking, New Delhi, Sydney, Bangkok and Rio de Janeiro.

**Formerly, consultant; Animal Production Protection & Health, Food & Agriculture Organization. Rome, Italy.*

One prominent airline reported that it carried about 140 animals every day representing an annual revenue of one and a half million dollars. Most of these passengers were dogs and cats. Other air travelers include farm animals, zoo animals, snakes, tortoises and exotic fish, all capable of transferring infections. Many diseases, of course, can be conveyed without actual movement of the host animal. This has special relevance to certain of the virus infections.

Among the most virulent, invasive and persistent viruses are those of foot-and-mouth disease (FMD) which has frequently exhibited its remarkable capacity for rapid spread. This disease, which is caused by seven known, immunologically distinct types of virus, is of international importance. In spite of its current quiescence in some world regions it can certainly be numbered among those conditions which cause the greatest economic losses to the world's livestock industry. There can be no guarantee that foot-and-mouth disease will not reappear, for example, in Britain and cause yet another disease emergency like the national disaster of 1967-68.

Transference of Infection

It is possible for a human traveller to be in active contact with stock infected with foot-and-mouth disease and within 12 hours to be handling cattle in the United States, or New Zealand, or France, or Japan. Anything that moves can carry the virus. Animate and inanimate carriers and even the wind can be incriminated. Man himself is perhaps the most dangerous agent. Almost 30 years ago a peripatetic immigrant carried the foot-and-mouth disease virus into Canada from the infected farm on which he had been working in Germany.

The occurrence and spread of any infectious disease is of concern not only to contiguous countries but also to others far distant from the infected centers.

It is interesting to note the rise and fall of epizootics from year to year, the emergence of diseases which have been quiescent - perhaps for many decades - and the changes in the *relative* importance of a wide range of infections. When a disease occurs for the first time in any part of the world it may challenge a highly susceptible livestock population and may encounter a large and eager population of insect and other vectors. Among the infections of livestock which during the past few years have extended their areas of influence are rabies, FMD, African swine fever, swine vesicular disease and Newcastle disease of poultry.

In the few years following 1959 we witnessed the loss of many thousands of horses, donkeys and mules and the widespread disruption of agriculture throughout almost the entire Near East region, by African horse sickness. The countries affected were heavily dependant upon the working equine. This was a classic picture of an epizootic in countries where it had never previously been recognized.

Another example is the Asia I type of FMD virus which jumped some thousands of miles to appear in Israel and Jordan. South African Territories Type One (SAT I) FMD virus appeared in Bahrein in 1961 and rapidly spread through Syria, Iraq, Jordan and Israel. Turkey was over-run and the defences of Greece were penetrated. A full-scale control campaign prevented the disease from spreading into Europe but when, after some three years of intensive effort, SAT I began to yield, another type of virus made its appearance and this Near East strain of Type A FMD became epizootic in Turkey and threatened the livestock industry of Europe. In the years 1974 to 1977, FMD occurred intermittently in Belgium, the Netherlands, Italy, Malta, Spain, France, Austria and the USSR. Subsequently an "unconventional" A Type virus appeared in Morocco and presented another formidable threat to Europe. An exotic A virus sub-type also occurred in Saudi Arabia and other Middle East countries. The tendency of the disease to spread toward the west of the African continent continued.

In Latin America, the Central American republics have continued free from FMD but there is still a great deal of it in South America where Argentina, Brazil, Colombia, Paraguay, Uruguay and Venezuela continue to suffer in varying degrees.

All South American countries have national control programs, based on a strategy of systematic mass vaccination. The United States and the Panamanian and Colombian Governments have cooperative arrangements for control when and if a challenge is made. A buffer zone 40 klm.wide, where there are no ruminant animals, was established along the Colombian border stretching from the Atlantic to the Pacific. The Pan-American highway is not a single trunk road stretching in a line from extreme south to extreme north. It is a complex network of road systems ranging from the Antarctic to the Arctic and posing many new problems of disease transfer.

Buffer zones can be highly effective, but so-called disease-free zones are vulnerable and can seldom be recognized as truly disease-free for long periods. In the Far East a severe Type O outbreak occurred in Peninsular Malaysia in 1978 and was controlled in 1979 following the destruction of over 14,000 affected and in-contact animals. In Thailand a Type O outbreak occurred in the southern statutory disease free zone in 1978. In Chile Region X comprising the provinces of Valdivia, Osorno, Llanquihue and Chiloo, was officially declared disease-free in 1977.

The years since 1977 have been remarkable for the appearance of diseases in completely new areas. One of these outbreaks was that of FMD in the United States on 15 September 1978. It occurred in cattle on Plum Island in Long Island Sound, New York State, on which is located the Animal Disease Research Center. Leakage of virus had taken place from the laboratory and cattle in a holding area had become infected. All cattle, swine and sheep on the island were killed and incinerated and all areas cleaned and disinfected. No infection was found elsewhere in the United States and, with justification, the country was considered to remain free from foot-and-mouth disease.

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The Present Epizootic Picture

Foot-and-Mouth Disease.

We may perhaps look upon FMD as the classic epizootic caused by a virulent, invasive, highly infectious, durable versatile virus. Much progress is being made in the control of this costly and damaging disease and, at the present time, the disease is completely controlled, or is of low incidence in a number of countries where, until quite recently, outbreaks were occurring frequently.

However, when considering FMD we can begin to appreciate the tenuous nature of defence against disease invasion. In the epizootic which began in Great Britain in October 1967 and which did not begin to fall off until March 1968, 2,343 individual farms were affected and, in pursuit of the "stamping out" policy, a total of 423,127 animals were destroyed; this total was made up of 208,966 cattle, 113,423 pigs, 100,699 sheep and goats. At the peak of the epizootic on 24th November 1967 there were 81 individual outbreaks in one 24 hour period. Few countries can afford to follow the "stamping out" policy and fewer still have the means to carry it out. Vaccination policies have been adopted, for example in South America. There are more and better vaccines now than there were 25 years ago, and they can be produced much more quickly in greater bulk and more cheaply than the classic Waldman and Frankel vaccines. They are mostly still not very good vaccines in terms of the level and duration of the immunity which they induce but their widespread and repeated use undoubtedly results in an overall reduction in the incidence of the disease. In some countries, where previously the disease was enzootic with regular and widespread flareups, the diligent use of vaccine has reduced the incidence to a level which renders the application of the stamping-out policy economically viable. The price which has to be paid by such countries must be reckoned in terms of eternal vigilance. Freedom from FMD once achieved can only be maintained by means of an efficient and alert veterinary service, supported by the legal powers to apply all the intricacies of police sanitary actions including the enforcement of slaughter and destruction.

Early in 1981 foot-and-mouth disease continued its advance northwards in France, despite a slaughter and vaccination campaign. Cases were confirmed on the channel island of Jersey and on the Isle of Wight. Circumstantial evidence points to prevailing winds and migratory birds as carriers.

One of the essentials in controlling FMD as for all infectious diseases, is finding where the infection has come from and erecting adequate barricades thereafter. It has long been realized that the two most notable sources of infection for Britain are the Continent of Europe and the developing meat exporting countries of South America. When the disease is widespread in Europe it can reach Britain through a variety of vectors of which man and his vehicles are among the most important. Migratory birds, especially gulls and starlings, are among the likely carriers. In the past there has been very strong circumstantial evidence incriminating birds, especially in East Anglia. Aerosol spread is also possible, for anything that moves can carry the virus, including the wind.

The lessons of the 1967-68 FMD epizootic in England must be learned very carefully by all countries which, like the United States, are free from the disease and which hope to remain free. In maintaining that freedom it is important to have a full and current appreciation of the situation in countries where the disease exists. Many of these countries are making very determined efforts to control foot-and-mouth; sometimes because they have or hope to have, an important trade in meat and meat products; sometimes because they have at last realized that this is one of the greatest causes of economic loss to any livestock industry.

Most so-called new diseases are old diseases occurring for the first time in an unfamiliar environment. However, swine vesicular disease (SVD), which first appeared in Europe and was recognized as a disease entity in 1972, may be a "new" disease. In 1966 two outbreaks of a disease similar to FMD occurred in the Po valley of Italy. The causal agent was found to be a porcine entero-virus. The disease ran its course and there was no spread. No other occurrence was reported from any other part of the world and it was concluded that this did not represent the appearance of a significant emerging disease. The disease appeared in Hong Kong in 1971 and again in 1972, 1973, 1974, 1975, 1977, and 1979, but has not apparently become enzootic. Japan has been infected. Spread occurs through infected pork and pork products and the feeding of infected garbage to swine. Countries free from the disease can, in theory, protect themselves by banning the importation of pig meat from countries where the disease occurs. The meat trade, however, is highly complex and there are backdoors through which meat can enter most countries. Not all countries may report the occurrence of disease; sometimes because it is not recognized, sometimes one suspects that the information may be deliberately suppressed in view of the adverse effect on trade which would result if the presence of the infection was admitted. SVD is not yet of any great epizootiological or economic importance, but since it is clinically indistinguishable from FMD, it complicates the problems of control. The complexities of the meat trade may be illustrated by the fact that when the disease occurred in the U.K. in 1972, it was noted that meat and meat products were imported from China by Italy, France and Poland and from Poland by Austria and the U.K. The disease was found in Austria in 1972 in pigs imported from Poland. It is tempting to regard China as a vast reservoir of infection, but China has an outstanding record in controlling and eradicating virus epizootics in the last 30 years and denies the existence of SVD at any time.

SVD and another relative newcomer, African swine fever, are of special importance in the many developing countries, such as those of South America and much of the Far East, where pig populations are enormous and the major source of

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animal protein for human consumption.

The cost-benefit evaluation of FMD control justifies for most countries, both advanced and developing, the enormous expenditures involved in the funding of disease control operations. The European Commission for the Control of FMD, an influential and executive body whose activities nowadays are worldwide, has noted that, where conditions of under-development prevail, the factors which contribute to inactivity in disease control include the incapacity of field veterinary servies to control the movement of large animal populations, the pressure of ecomonic interests ranging from livestock exchange to the production and marketing of vaccines, the reluctance to notify and admit to the presence of the disease, and the masking effect of vaccination on the clinical manifestation of the disease. Public opinion, as a result, tends to ignore or under-estimate the dangers and the economic effects resulting from the widespread presence of the virus in the world. While a number of countries may have good reason for not worrying unduly about the possibility of introducing FMD from overseas, either because of their powerful vaccine production facilities for their proven ability in organizing eradication campaigns, the fact remains that the majority of countries are not even prepared to meet emergency situations with much probability of success. There is also the case of "advanced" countries which, thanks to their geographic position are able to maintain freedom from the disease in the absence of provision for the procurement of vaccines or plans for emergency action. The disease has, in fact, remained overt or latent in 3 continents and the possibilities for the virus to spread from infected developing countries has increased.

It has been estimated that the introduction of FMD into the U.S.A. could cause losses of up to 3.5 billion dollars.

Despite the progress made in FMD control especially in Europe, alertness is today more necessary than ever and preparations for emergency action, however expensive, are fully justified.

Rinderpest

Cattle plague, or rinderpest, a disease which has been enzootic in Asia and Africa for at least two thousand years, affects cattle, buffaloes, camels, sheep and goats, giraffes and other cloven-hoofed ruminants. Historically the disease has occurred in cycles, sweeping from East to West and often initiating the widespread famines which began with the loss of vast numbers of working animals.

Thirty years ago it was being confidently forecast that the total eradication of rinderpest was no more than 5 years distant. Today, there is as much rinderpest in the world as there was then, and the danger of sudden and rapidly spreading outbreaks with high mortality is just as great. The disease now, as for many centuries past, tends to flourish in the disruption of war. It still flares up periodically in Africa and the Far East and challenges the control which has been so painstakingly established over the years. Some 5 years ago India faced a severe setback in her extensive and continuous vaccination campaign, and serious immunity breakdowns occurred with both the lapinized and lapinized-avianized vaccines.

Rinderpest was enzootic in China for centuries causing heavy losses over vast areas when periodic epizootics erupted. In 1947 and 1948 FAO gave assistance to China in the control of rinderpest through expert guidance in the production and testing of vaccines, the training of technicians and the development of plans for a large-scale control programme. The all-out rinderpest eradication campaign began in 1949, the year of Liberation. Stations were set up for prophylaxis and treatment and a network of check-points for inspection was established. The Government sent teams to the provinces to train and supervise the workers. Bulk production of vaccine was begun. Buffer zones from which all livestock were removed were established on the northern frontier. The efforts continued for 6 years, the primary objective being the vaccination of all cattle, buffaloes, yaks and yak hybrids. China was declared free from rinderpest in 1955 and it has remained free ever since - perhaps the most outstanding achievement in the field of livestock disease control in this century.

Many countries report continuing low sporadic incidence, or state that the disease is much reduced but still exists, or report a moderate incidence as in Pakistan. Others like Nepal, report a continuing high incidence. The disease can smoulder for years and suddenly explode into a major epizootic. We have not heard the last of it, by a very long way.

Control measures against rinderpest are often hampered by the increasing incidence of rinderpest-like diseases of the mucosal complex, which clinically may closely resemble rinderpest. They appear to be occurring more commonly in recent times, both in the east and in the west, and differential diagnosis can often be difficult. The true nature of the syndromes remains to be determined and further work is required to isolate and identify the causal agents. It is possible that most such manifestations are of virus etiology. Mortality is generally but not invariably low, and water buffaloes appear to be more susceptible than cattle in areas where both species are maintained. To the veterinarian working in a rinderpest area, perhaps several days journey from any laboratory diagnostic facilities, the question of differential diagnosis can be extremely difficult. It can be a crucial matter when such a condition appears in a rinderpest-free area.

"Rinderpest-like diseases" have been reported from many geographical locations in the past 15 years, and not all of the diagnostic designations are decisive; most of then are plausible but lack credibility. For example, "Purwokerto disease" in Indonesia was described as a mild form of cattle plague, a status comparable to classifying the Biblical flood as a state of climatological dampness. The increasing incidence of such conditions, ill-defined and lacking in specifity though they often may be, raises serious

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epizootiological questions. Where rinderpest occurs in an area in which it has previously been unknown, or where it has not occurred for many years, the ready acceptance of a diagnosis "rinderpest-like" disease will induce a false sense of security. This may have happened in Bali, Indonesia, in 1964 with a condition which came to be called "Djembrana disease", after the location in which it first appeared. Some 26,000 buffaloes and cattle are thought to have died in 1965; The Djembrana district alone may have lost over 19,000 cattle and buffaloes in that year, more than 60 percent of the total. By August 1965 the disease had spread to all parts of the island. The name given to it masked its real identity and, in spite of well-advised warnings by the veterinary service, its true nature was not officially accepted. The existence of a serious epizootic of what, in hindsight but on strong circumstantial evidence, was undoubtedly rinderpest, was never reported. The vast area covered by the thousands of islands of the Indonesian archipelago, amounting to almost 2 million square kilometres, is highly vulnerable to the introduction and subsequent spread of infectious diseases of livestock. A repetition of the Djembrana incident could occur at any time, in any of the many islands, large and small, where there are substantial populations of cattle and buffaloes, or where thousands of pigs are raised for export. Constant vigilance, a pessimistic inclination to fear the worst, and the ability and determination to take early and drastic action may avoid further catastrophies.

It is suggested that the time is ripe for the inauguration of an all-out international campaign aimed at the final eradication of rinderpest. The indications are that this could be accomplished within 20 years.

Rabies

The development of sylvatic rabies in Europe and elsewhere continues to constitute a problem which has now become one of major dimensions. Its main animal vector is the red fox. In the last ten years the disease has spread across Europe into countries which have long been free from it. Spain, which had been free from rabies since 1965, reported cases in dogs and cats in 1975, 1976, and 1977. France and the Federal Republic of Germany report a high incidence in wild fauna. In Belgium, Luxemburg, Austria, Switzerland and Italy the incidence in wild life seems to be increasing.

In 1969 Britain, which had been free from rabies since 1922, reported 3 cases in imported dogs, 2 in quarantine and one shortly after release from the required 6 months quarantine. There is no cause whatever for any relaxation of the strict quarantine regulations imposed by such countries as Australia, New Zealand and Britain. In 1978 the owners of 55 dogs and 27 cats were caught smuggling their pets into England. Imprisonment and heavy fines were imposed and the animals were destroyed. The law nowadays, with consciousness of the disasters which could result from such contraband movement, tends to throw the book at offenders, "pour encourager les autres".

In a number of countries in the Far East, among which are Thailand and Burma, control measures introduced and pursued as government policy include the capture and destruction of stray dogs, but are seriously impeded by the Buddhist prohibition against the taking of life in any form. Rabid dogs are of common occurrence and enjoy the protection afforded by the sanctity of life. The result is that the incidence of rabies both in man and his animals is high. In 1968 the disease was found to be prevalent in some species of rodents and bats in Thailand where, once again, wildlife forms a reservoir of infection.

In China a rabies epizootic was reported in Peking (Beijing) and also in the southern province of Guangdong in 1980. Five people died of rabies in August 1980 and 500 were said to have been bitten rounding up strays. A regulation prohibiting the private ownership of dogs in cities has been revived and is being strictly enforced. Two human cases of rabies occurred in Hong Kong in the latter part of 1980; 35,000 dogs were destroyed, and 80,000 vaccinated within two months, an impressive exhibition of efficiency on the part of the veterinary service.

In Mexico and other Latin American countries there is the ominous problem of derriengue - dumb rabies in horses and cattle - transmitted by the vampire bat. In Mexico alone it was officially estimated in 1970 that 100,000 cattle and 10,000 horses die from derriengue every year. In 1971, bat-transmitted paralytic rabies in cattle was reported in Peru for the first time, and it was recognized that the disease was on the increase in Latin America, especially where new cattle raising areas were being established in previous forest regions. By 1976 bat transmitted rabies was widespread and among the 16 Latin American countries affected were Argentina, Paraguay and Venezuela. Nicaragua alone suffered an annual loss of 2.4 million dollars.

The disease is now coming under some measure of control as a result of widespread vaccination of cattle and through bat eradication programmes which, in some areas, are proving to be successful. Anticoagulant drugs introduced into bat populations in a paste smeared on the fur spread rapidly due to the bat habit of preening and grooming, and cause heavy mortality. Few if any methods of reducing or eliminating wild species have been so successful.

Newcastle Disease

During the years 1971 to 1978 the worldwide increase and dissemination of Newcastle disease in poultry continued, the disease being confirmed for the first time in such widely separated areas as Finland, Hungary, Uruguay, Chile, Paraguay, Panama, the Caribbean, Switzerland, Swaziland and Namibia but it is notable that by 1976 Rhodesia was reporting a greatly decreasing incidence; by 1971 Barbados was free and has so continued; by 1973 Denmark was free; Finland reported no cases since 1971, France since 1976, and Poland and Hungary since 1974; while in 1973 the whole of Scandinavia was considered to be free. In November 1972 an emergency was declared in California and extensive compulsory slaughter and other measures were introduced. Some 12 million birds were killed. These drastic stamping-out methods succeeded. There were no cases in the U.S. from

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June 1974 to February 1975, when Newcastle disease appeared in New York. The disease occurred again in Texas in July 1975. Eradication measures were again applied and eradication was achieved in 1976.

Trypanosomiasis

The group of protozoan diseases caused by *Trypanosoma* species are important on the world scene from the economic, public health and veterinary points of view. In one form or another the disease affects horses, cattle, buffaloes, camels, sheep, goats, pigs, dogs and man. The trypanasomes are transmitted in Africa by the tsetse fly (*Glossina* spp.) and elsewhere by other biting flies, such as *Tabanus* spp.

Forty-three countries in Africa are affected: 10 South American countries; 15 in the Far East and 7 in the Near East. The principal area affected is an enormous block of the African land mass totalling over ten million square kilometres, of which over 6 million square kilometres, nearly one quarter of the entire continent, is closed to settlement and denied to almost all domestic animals. This is the area, greater than the United States of America, which has been aptly described as the Kingdom of the Fly. The whole structure of African life has been influenced in very great measure by the tsetse fly and the typanasomes which it carries.

The key to control of the disease in Africa lies in control of the vector, the tsetse fly. This has been appreciated for almost a century-and-a-half, long before the causal organisms were identified, and for almost as many years, man has attempted to control the tsetse fly. Control measures have multiplied and diversified. During the last 40 years there has been a growing intensification of effort leading on from bush clearance, simple fly-trapping and game elimination, to the widespread application of modern insecticides of the organophosphorus and carbamate groups, and the use of trypanocidal drugs, both curative and prophylactic. The multi-national pharmaceutical industry has provided chemotherapeutic remedies and increasingly potent insecticides.

Although only relatively limited areas have been freed from trypanosomiasis, and have remained free, progress in control of the disease is accelerating and the density of cattle stocking is increasing. In some quartes Africa is seen as the world's meat ranch of the future.

The picture in South America is somewhat different. It seems that the disease was brought in originally around 1830 by Zebu cattle exported by Senegal to Guadelope, Martinique and French Guiana. It spread to Panama, Colombia, Venezuela, Surnam and Guiana, and on to Brazil. Its incidence and the area affected have not be been precisely charted. In some areas 20 percent of the cattle harbour trypanosomes in the blood. The clinical manifestations of the disease are similar to the chronic trypanosome infections of Africa: progressive anaemia, loss of condition and low productivity. As in Africa, if the disease can be brought under control, the supplies of animal protein so urgently needed by expanding human populations will be enormously increased.

African Swine Fever

A highly contagious and usually fatal disease for which there is no cure, no recognized prophylaxis and no defense other than quarantine and slaughter. Until 1957 African swine fever was confined to Africa, but in that year it suddenly appeared in Portugal and rapidly assumed the characteristics of an epizootic. It recurred in Portugal in 1960 and spread to Spain where it created an economic problem of national dimensions. It broke out in France in 1964 and in Italy in 1967. Drastic eradication methods in France and Italy eliminated the disease from these two countries but it suddenly occurred in Cuba in 1971. It was eradicated by the drastic but effective method of destroying all swine in affected and adjacent areas. The presence of African swine fever only 90 miles from Florida Keys was regarded as a matter of significant concern to every swine producer in the United States. In 1978 outbreaks followed by rapid spread occurred in Sardinia, Malta, Haiti, the Dominican Republic and, most drastically, in Brazil where by September 1978 there had been a total of 171 outbreaks in 16 states and the disease showed every indication of spreading throughout the country.

In Malta the entire population of swine, about 80,000, were slaughtered; in Sardinia, 35,000 pigs were destroyed between March 1978 and July 1979.

New outbreaks occurred in Angola and the Cape Verdi Islands in 1979 and the disease continued to spread in Brazil. By October 1979 300,000 pigs had died of African swine fever in Haiti. In February 1980 African swine fever again broke out in Cuba and the slaughter policy was again applied.

The economic impact of the disease in these developing countries has been considerable. The national swine herd of Brazil number about 40 million, and employs some 2 million workers.

The total pig population in Cuba is 1.5 million. The latest foci of infection were in the southern provinces of Guantanamo, Holquin and Santiago de Cuba where about 120,000 swine have died of the disease or have been slaughtered.

Only swine are naturally susceptible to African swine fever. Feral pigs and wild pigs are susceptible and may be both carriers and a reservoir of infection. The disease is readily transmitted by direct and indirect contact. The feeding of uncooked garbage to pigs is a common means of infection. The virus is exceptionally resistant; infectivity can be retained for 18 months at ambient temperatures. Processed hams and smoked sausage can retain infection for 6 months. The initial outbreaks in Portugal and Brazil may have been caused by feeding to swine pork scraps in garbage from international aircraft. Maritime and riverine ports are points for the importation of live animals, meat and meat products and, with airports, for the dumping of garbage. The latest introduction of the disease into Cuba appears to have been illegal immigrants from Haiti, many of whom

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brought with them live animals, water and pig meat products. It might be noted that no more than 80klm. of ocean separate the two countries, and also stressed once again that Cuba is no more than 90klm. from the United States of America.

African swine fever is a disease on the move and it seems likely to move into occupation in a number of countries in the course of the next few years, for where it has become enzootic in one country the chances are that neighbouring countries will sooner or later be infected. In many cases there is contraband trade in pigs and pig meat products across common frontiers. The human traveller, the unscrupulous trader, the pig farmer who feeds untreated garbage may all contribute to the introduction and spread of this devastating disease. The virus has been deliberately introduced into some predominantly Muslim countries in attempts to control wild pig populations, a highly dangerous and not very successful procedure.

The disease can hop-skip-jump from an infected country to appear in locations thousands of miles from the source, as a result of feeding pork products in airline or ships' food scraps. Prevention-of-entry programs, which should be applied by all countries, are based on rigid inspection at air and sea ports and at road, rail and river entry points, to ensure that no pigs or pigmeat or garbage enter from infected areas.

The key to control is the application of draconian measures based upon early diagnosis by an efficient and alert veterinary service, and the rapid destruction of infected, in-contact and exposed swine. The developing countries are likely to be the hardest-hit and pig production can well become totally unprofitable.

Directions in Disease Limitation

Epidemics, Endemics and Eradication

The alarum bells which are sounded by invasive incidents in the world of livestock disease are echoed in the fields of human medicine and public health.

The incidence of plague, which has natural foci outside of man, is on the increase in some areas. Cholera has caused many thousands of deaths in recent years: The 1973 epidemic in Italy was a salutary experience and a reminder that western countries are not immune to such occurrences. Yaws is still a major public health hazard in much of the tropical and sub-tropical world. Lack of knowledge is impeding progress in the control of such widespread diseases as bilharziasis and filariasis. Gastro-intestinal disorders are among the outstanding causes of morbidity and mortality among infants and young children. Diarrhoeal diseases, transmitted by the faecal contamination of food and water, are the greatest killers of infants and young children in the developing and underdeveloped countries. At least 5 million children die annually in Asia, Africa and Latin America. Tuberculosis is still widespread and the incidence of syphilis and gonorrhoea has actually been increasing in many countries.

Ten years ago it was thought that malaria was on the way out and that total eradication could well be attained within a decade . In the past 5 years the number of malaria cases has more than doubled. In some areas there has been a forty-fold increase. The recent epidemic in Turkey has caused alarm in European countries long free of malaria. In Canada 7 cases were reported in 1972, 25 in 1973, 52 in 1975, 91 in 1976 and 100 in 1977. It is estimated that 1000 million people are directly threatened by malaria, more than by any other disease. In some countries the anopheline mosquito which spreads the disease has grown resistant to DDT and other chemical insecticides while the disease agent itself has become more resistant to anti-malaria drugs.

In 1977 smallpox was thought to be within months of complete eradication when it exploded once again in Somalia. Since then the eradication programme, which is a triumph of international cooperation in preventive medicine, has progressed to the stage that after 13 years of all-out effort by hundreds of thousands of health workers, the World Health Organization announced in 1980 that the final eradication of smallpox had been achieved. It is thought to be the first disease to be eradicated by man's efforts.

One tends to be sceptical of such claims. It is difficult to prove that a disease no longer exists upon earth but the carefully compiled evidence is convincing.

As smallpox diminished, the need for laboratory diagnosis became more acute. While the disease was widespread it could easily be diagnosed from typical clinical data, but rare outbreaks require specific attention that could only be provided in the laboratory. Vaccination against smallpox is justified now only for laboratory personnel who are directly engaged in work that involves handling variola virus or related viruses. It must be remembered that there are laboratories where such work continues and that, as in the case of foot-and-mouth disease, leakages can take place and have taken place from such institutes.

It is interesting to note that WHO has pointed out that it cost 24,000 million dollars to put the first two men on the moon and to bring them safely back to earth, while between 1967 and 1980 the intensified Smallpox Eradication Programme cost only 300 million dollars. Epidemiologists and epizootiologists alike ponder wistfully on what they could do to further disease eradication programmes if they were given the funds represented by the development of one new long-range bomber, or one new aircraft carrier, or one new atomic-powered submarine.

Monitoring and Reporting

The Director-General of the World Health Organization has pointed out that undernotification of disease is a chronic problem, and that information at the national level is often incomplete, especially in the developing countries. Continuous disease monitoring for epidemics and epizootics is necessary as new problems arise, "new" diseases appear, and emergency situations occur. Countries must be

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convinced of the urgent need to report outbreaks to a central agency, quickly, accurately and comprehensively. The deliberate suppression of information, the withholding of information for reasons of trade or security, and the sheer inability to conduct continuous monitoring must all be made impossible. These can become things of the past only when there is in every country an adequate, trained, mobile and efficient veterinary service.

There are two central agencies at the present time. Both FAO and L'Office International des Epizootics (OIE) provide Disease Intelligence Services and relay to member countries notifications of disease. Any system of disease reporting, however, can only be as good as the information fed into it. We are progressing, however slowly, to the point at which such reporting will be done by all countries for all the important diseases both of men and of his animals.

Every year since 1956 FAO has produced a report on the world livestock disease situation in the form of the Animal Health Yearbook. One hundred and seventy countries contribute to the Yearbook reporting on the presence, incidence and methods of control of over a hundred diseases of domestic and wild animals and birds. Each issue reports in detail on major changes in the livestock disease position during the preceding year, particular attention being given to the major epizootics. WHO and OIE cooperate with FAO in the production of the Yearbook.

Quarantine

Epizootic diseases do not recognize political or geographical frontiers and they are no longer subject to the restrictions which formerly were imposed by distance. Modern transport has transformed distance into a time factor. The high seas do not now present an impassable barriers to disease. The time required for the transit of animals, and of their diseases, vectors and fomites does not now invariably exceed disease incubation periods, the lifetime of vectors or the durability of viral or bacterial infectivity.

The question of quarantine needs rational re-examination in the light of changing world circumstances. Quarantine can no longer be defined as "a period usually of 40 days duration, of detention of ships or persons coming from infected or suspected parts"; or as simple "detention or isolation on account of suspected contagion".

Quarantine regulations in most countries have originated as a result of damaging experience in past decades. Their rigid and inflexible application are, for the most part, of a severely restrictive nature. Countries with highly developed and profitable livestock industries take all possible precautions to protect themselves against the introduction of costly and damaging infections. There are many developing countries, however, whose most important natural resource is livestock and who find all markets in the rich and impregnable west immutably barred to them because of the possibility of the introduction of rinderpest or foot-and-mouth disease. Such protection impedes development, especially where the protection is efficient and the development is haphazard.

Tropical countries could become the greatest meat producers and exporters in tomorrow's world. World trade in commodities is increasing steadily, and among the more important exportable commodities are livestock products. Disease provides the reasons for existing impediments, but quarantine regulations continue to ignore the need of something like two-thirds of the world's human population occupying about three-quarters of the earth's land surface for better livestock , new blood and new techniques. Among the many difficult tasks which face the veterinary profession at the present time is the striking of a balance between quarantine requirements and these needs. Our present skills and knowledge are sufficient to enable us to control most if not all of the diseases which are of the greatest economic and public health significance. The mobilization of veterinary manpower; substantial investment in materials, research and development; and the application of these skills and knowledge can enable the costly and damaging diseases to be controlled and eventually eradicated wherever they exist. This is possible, but not upon the present parsimonious scale of international assistance and support for the purpose. If bilateral and multilateral aid in disease control could be increased ten-fold, this would be a far-sighted, long-term investment in the future.

When livestock diseases are adequately controlled an important contribution is made to the furtherance of international commerce in animal products. There is a great and increasing need for this trade, just as there is a great and increasing need for the movement of live animals - and of semen and ova as well - about the world for breeding purposes.

We have not yet begun to realize the full potential of improved breeds adapted to strange environments with high levels of resistance to stress and disease. For many countries this potential will not be realized as long as quarantine remains a locked and bolted door. The fear of epizootics, the power of vested interests, inadequate technical resources and international trade concerns combine to ensure the enforcement of rigid quarantine, but quarantine need not be exclusively of a restrictive nature. Applied rationally, utilizing our existing knowledge and experience expecially of disease testing in conditions of maximum security, it can both ensure disease protection and stimulate, rather than impede, world trade in both livestock on the hoof and in livestock products. This argument is particularly apposite today. The genetic stocks of world regions require imperative attention: some potentially valuable genetic resources are disappearing; sometimes there is a need for the simple introduction of "new blood". Livestock breeds can be improved by means which have been called genetical juggling with genes, looking far beyond herdbook and herd society principles. The urgent need for stock improvement and for increasing livestock productivity is still subservient to quarantine requirements.

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The Effects of War

Control of livestock disease is adversely affected by war which not only creates conditions under which control programmes can no longer be implemented but actively furthers the introduction and spread of infective conditions.

A recent report has drawn attention to the profound effect on the incidence of the major disruptive diseases of livestock. created by the seven-year war in Rhodesia now Zimbabwe. The disruption of veterinary services resulted in serious epizootics of disease. The cessation of the compulsory dipping routine introduced in 1914 and continuously applied until 1974 resulted in the death of an estimated one million cattle from such tick-borne diseases as babesiosis, heartwater, theileriosis and anaplasmosis. Trypanosomiasis, which had been controlled by chemotherapy and the elimination of the tsetse fly, returned with the enforced abandonment of all control measures; at least 30,000 head of cattle died and all the progress achieved so painstakingly over the years has been reversed. FMD caused by SAT 1 and SAT 2 viruses, reappeared and has disrupted the movement and marketing of cattle and the beef export trade. Anthrax vaccination of cattle had to be largely abandoned and the disease spread widely with a dramatic increase in human beings. Rabies has similarly increased with the drastic reduction in the number of dogs presented for vaccination, and there is a high incidence in human beings with 74 deaths diagnosed and reported in the last 4 years against 54 in the preceding 25 years.

In greater or lesser degree a similar resurgence of disease is observed concomitantly with conditions of war in all ravaged areas, among which we may include Indo-China, Korea, Uganda and Mozambique in the recent past. There are several countries in which war at present either prevails or threatens, and we must watch closely Afghanistan, Iran, Iraq and indeed the whole of the Near East as well as a large part of Africa.

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