AGRICULTURAL HAZARDS

ZOONOSES AS OCCUPATIONAL DISEASES

James H. Steele, D.V.M., M.P.H.

The Zoonoses were defined by the World Health Organization (WHO) in 1959 as "those diseases and infections which are naturally transmitted between vertebrate animals and man." In 1967 WHO classified the zoonoses as those directly transmitted, those requiring intermediate hosts, and the saprozoonoses in which organic matter can be a reservoir of the infectious agent. They can be further broken down into those groups caused by bacteria, fungi, parasites, and viruses, of which there are more than 100 different diseases of animals affecting man. Most of the zoonoses are worldwide in distribution, but many have been controlled both in the United States and abroad. In some regions they have increased, and even new infections have appeared. This report will be limited to a review of the present status of the zoonoses as occupational diseases in agriculture and related industries; it is an up-date of my 1968 paper on a similar subject.

BACTERIAL DISEASES

Anthrax. The first bacterial disease is anthrax, which was the oldest agricultural occupational disease recorded by man. Virgil in the Georgics described the disease in sheep, and pointed out that men salvaging sheep carcasses that had died of a disease that turns the flesh putrid and the fleece dangerous, would themselves suffer disease that affects both limb and lung and they die a fiery death, meaning intense fever. Throughout the Roman Empire anthrax was a recognized serious occupational disease among livestock farmers, because the pustule was quite evident and the people recognized these black eschars that differentiated them from the lepromas of leprosy, which was also common in that period. As late as 1869 Russian literature warned land owners not to feed their serfs dead animals because this would cause a severe disease and kill off their best farm laborers who tried to salvage carcasses that had died of anthrax. Koch identified the organism in the early 1880's. The first attenuated vaccines were made later in the 1880's by Pasteur, whose experiment in vaccinating sheep produced 100% protection of his vaccinated animals and 100% mortality in his unprotected animals, the most perfect experiment ever put together.

This was the beginning of the control of zoonotic occupational diseases. We used those same vaccines as late as the 1930's. We had no effective treatment for human anthrax. Vaccination was a very important way of contending both with an economic and occupational problem. Since the development by Sterne, a South African veterinarian who identified a non-capsulated spore vaccine which was a stable mutant, this Sterne vaccine now is the vaccine of choice throughout the world, used as a live agent. The Sterne vaccine could be made cheaply by most countries of the world. It produced a drastic change in the incidence of both human anthrax and animal anthrax.

Glassman in 1957 reported estimates that there were possibly 100,000 cases of anthrax occurring in agriculture and agricultural associated industries. Ten years later there were probably less than a few thousand cases of anthrax being reported worldwide. By 1974 we have had in the United States only 2, 3 or 4 human cases per year where formerly we encountered many more cases among agricultural workers and rendering plant operators who helped to bring in a dead animal or fed the carcass to pigs. Cases like that have practically disappeared. Industrial cases associated with the carpet industry started to disappear in the early 1950's when synthetic fibers came in and the so-called coarse wools and hair brought from Asia and Africa were no longer used in the American market. The last two cases that occurred in veterinarians were in Louisiana in 1971. This was in connection with the Louisiana outbreak of that year, the first that had occurred in that locality in more than 30 years.

It is always difficult to determine why the disease has these long periods of latency. Last year in Texas, 1974, in an area 100 miles north of Houston we had a very severe outbreak of anthrax involving some hundreds of animals - not a human case occurred. The organism was found in surface water. This was confirmed by the Center for Disease Control (CDC) so is quite credible. In discussing this with experts in the field, we all agreed that anthrax had declined precipitously. Less animal vaccine is being sold today than at any time in this century since vaccines were first discovered. This is a cost benefit, that the average farmer may not have an outbreak in a county for 20-30 years such as the two cases I have cited. This is not only occurring in the United States but in Europe, all across Russia and in places like the Philippines, Australia and many parts of South America. Africa is a little more difficult to cite as there records are practically unknown.

Now as to human prevention, the United States had a large program of trying to develop new vaccines for industry and also for civilian hazards. An aggressin has been used. An aggressin is a

filtrate of bacterial growth. These were used in animals 50-60 years ago without much success. But with refinement now Wright and his colleagues working at Fort Detrick demonstrated that these were quite successful in protecting people at high risk. The question of human immunization has been a problem for many years. Researchers have developed an effective non-viable cell free protective antigen for the protection of workers in industries where they may be exposed to bacillus anthracis. This preparation is well tolerated and greatly reduces the incidence of anthrax in occupationally exposed workers handling coarse wool and goat hair. Goat hair is used largely for the batting of our suits, and this is probably the most dangerous of all the animal fiber industries because goat hair is most frequently contaminated. Immunization has been recommended for certain textile workers previously cited, veterinarians and their assistants, and laboratory workers who may be exposed. The vaccine is available from the Center for Disease Control (CDC), U.S. Public Health Service, Atlanta, Georgia. In the United Kingdom the same vaccine is available from the Ministry of Health. The Russians carry on a lot of research in this area; some very fascinating experiments have been published in their literature. They use aerosol vaccines. They had tried this out first on guinea pigs and then sheep and a year or two before I was there in 1963 they had just published their human experimental data where people just sit around in a room and aerosol is injected into the room - this attenuated nonvirulent organism that the Western World calls Sterne vaccine and the Russian World calls their ST 1 and 2 provides a good immunity. One of the problems in anthrax is measuring immunity. There are no antibody levels to measure, as with other diseases, so you have to do indirect evaluation. You could do this with the guinea pigs and sheep but you could not do it with humans. You don't challenge humans no matter how totalitarian your state may be. So by indirect experiments in sheep and guinea pigs they came to the conclusion that the vaccine was of great value. They told me that they were distributing about a million doses of human vaccine a year. On one hand I had been told by the veterinary authorities that anthrax was under control and there was no hazard either in industry or public health. One of my conclusions was that they had something going well that nobody challenged or criticized, so they just kept repeating it. Now that was 1963. Things may have changed considerably and they may not now be vaccinating so many people. The important thing is they could vaccinate a million people a year without any undue side effects.

As to antibiotic therapy, it has been well known that anthrax responds very well to practically all the antibiotics. Penicillin is the agent of choice both in man and in animals except for the

very acute type of anthrax. There you have a shock syndrome associated with the disease, an irreversible process. No matter how much antibiotic you give, intravenous or intramuscular, you do not reverse the course of that disease. In those cases both in man and in animals, on autopsy, mediastinal lymph nodes are badly inflamed indicating that the organism has broken through the lymphatic barrier and entered the general circulation. So you are dealing with a bacteremia at that point and usually death results from the organism entering the brain and causing bacterial meningitis. There is one complication that people should bear in mind that occurs in industry, an unusual side effect. Doctor Brockwin and his colleagues were called in after a human case of cutaneous anthrax was identified in one of the workers in a New Hampshire textile factory that was handling coarse wool and goat hair. Inquiry led to investigation of three deaths that had occurred earlier that month in the plant which had all been signed off as cerebral vascular accidents. Within a population in the 6th and 7th decade of life you can suppose that if a person is healthy one day, collapses that night, and is dead the next day, a cerebral vascular accident is a sensible diagnosis. But Brockman suggested that they re-examine these bodies. They exhumed two of them and were able to demonstrate the anthrax organism in the brain through the fluorescent antibody technique. Industrial physicians should bear in mind that when such sudden deaths occur in a cluster, they can be possibly anthrax.

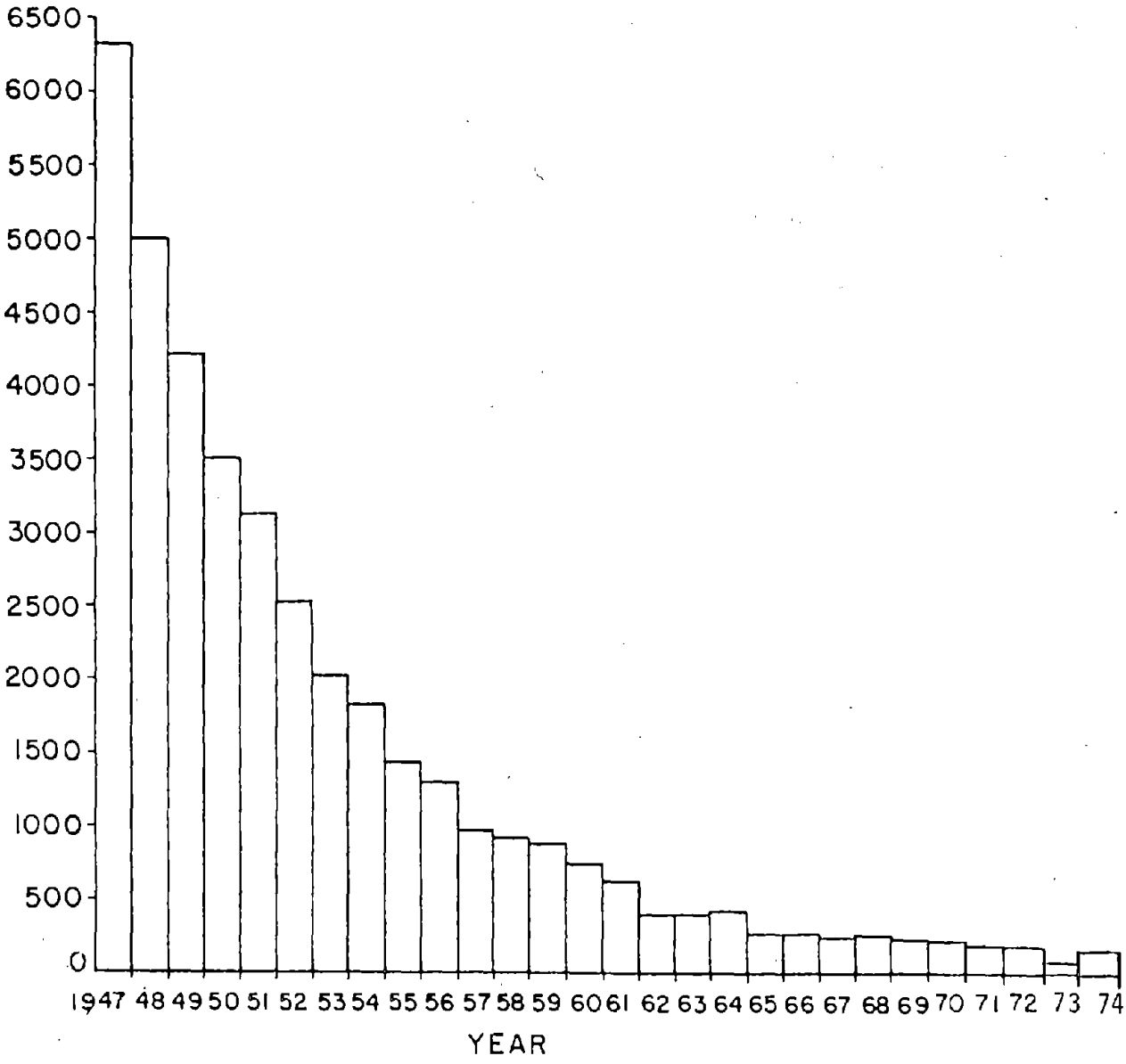
So much for anthrax except one other point that is almost academic. What has happened to soil contamination with anthrax? These organisms have lived for many decades in soil. The Japanese in the 1890's impregnated threads with bacillus anthracis in tubes. They open up a tube every ten years. The last one they opened in 1967 still had viable organisms. Now this whole picture has changed in the United States and in Western Europe. My colleagues both in the veterinary field and ecologists and environmentalists, speculate that there may be a number of different factors at hand. First, the Sterne vaccine, an avirulent stable mutant, may have replaced what we call the wild population and has seeded the soils throughout the world. This one does not produce disease. Second, the farmers' broad use of antibiotics, is often as widespread as his use of insecticides. If you inject a cow on the inside it must be good on the outside too! Third, there are changes in our agricultural practices. The Gulf Coast of Texas up to the mid 1950's was what you call an anthrax zone - district. Everybody had to vaccinate, otherwise you were going to lose some cows that year. This has changed completely. Where formerly east Texas was largely a pasture area, today it is one of the biggest rice producing areas

of the world, between western Louisiana, and Gulf Coast of Texas, and Arkansas. That area produces as much rice as any other geographical area of similar size in the world. We export more rice out of Houston than any other port in the world. So these three factors may combine to explain a situation as it exists in a local area of the United States. On the other hand I can't explain why the Mississippi or the Missouri River Valleys, or the Central River Valley of California, all which were formerly called anthrax districts, do not see much disease any more.

Brucellosis Another success story is brucellosis. Figure 1 shows how we dropped from a high of some 6,500 human cases in 1947 to about 170 in 1974. That decline has continued almost as predicted and is a beautiful example of animal disease control and decline of human disease concurrently. I reported to the Third Inter-American Congress on Brucellosis in early 1950 that this was the most serious occupational disease we had among our rural people and in our animal handling industries. We had the support of two groups immediately: the livestock and dairy farmers of America, and the meat-handling unions that were concerned about disease among their employees. These two groups focussed on Congress, and appropriations were made. We have probably spent well over two billion dollars between 1952 and 1974 in reducing the incidence of this disease in our animal populations from a figure of say 18-20%, the accepted figure for dairy cows in 1950, to less than .2 of 1% today. Many states can be identified as brucella free areas. If the human disease had continued at the level of 1950, and applying Jesse Steinfeld's 1975 figures on the costs of a human case of disease of this type, that such a case costs $8,000, we find that these two things balance each other out. We would have been spending two billion dollars on the care and the convalescence of the estimated 250,000 people that would have had the disease over the 25 years instead of this small number now that is down to the hundreds. So from this point on, we're practically home free in cost benefits so far as brucellosis as an occupational disease is concerned. We're going to run at 100-125 cases a year. There is always some pig that turns up with brucellosis somewhere. We've got 100 million of them and we can't keep track of all of them. Out of the 174 human cases reported last year, 37 were in people who had been traveling abroad and eating dairy products outside of the United States. Most of those were in Mexico. The human cases reported in Mexico have remained at a level of about 40,000 cases for the past 25 years without much variation. The same thing is true for the whole of Latin America for which I commonly use a figure of possibly 100,000 annual cases of brucellosis. Western Europe has followed a program very similar to ours, of eliminating affected animals, and the cost benefits there are

FIGURE 1

HUMAN BRUCELLOSIS, UNITED STATES, 1947-1973



Preliminary data. (From National Communicable Disease Center Zoonoses Surveillance Report, Annual Brucellosis Summary, February, 1974.

quite similar to what I have just cited here, in controlling human disease. In addition, I should point out that animals that are free of brucellosis carry their young to term, increasing their value; their milk production is higher; and when they come to be utilized for meat, they are not condemned or restricted.

One point as to human vaccination. We spent a lot of time on human vaccination. I was in school when Huddleson attempted to vaccinate veterinarians against brucellosis in 1936-1937. Practically the whole senior class at Michigan State developed either disease or sensitivity to the organism. My colleagues tell me that they can't get near a cow that's got brucellosis without getting a reaction. We were working with dead vaccines. Throughout World War II all kinds of vaccines were tried, especially Strain 19, which is the modified strain used in calves, first identified in the late 1920's by the old Bureau of Animal Industry. But this gave some very severe reactions and we more or less dropped human brucella vaccination investigation by the mid 1950's. The Russians pursued it using this Strain 19 vaccine but they were using it with scarification technique for everybody in the animal handling industries; veterinarians, slaughter house workers and railroad men hauling animals should be vaccinated. Many Russian veterinarians told me about the severe reactions they suffered. I do not feel that human vaccination has much place today even in the countries like Mexico that have a very high incidence of disease.

There has been considerable advance in therapy of brucellosis in man. Combined streptomycin-tetracycline is the therapy of choice, but even that fails under certain conditions; people have relapses and the physician must determine how long he wants to maintain the course of antibiotic therapy. When some people have had the disease, be it mild or severe, they become sensitized and any time they come in contact with the organism thereafter they will have a sensitivity reaction which is hard to differentiate from disease per se. They'll have fever, chills, and flushing and so forth, but take them out of the environment where they're in contact with either live or dead protein and those signs and symptoms will disappear immediately.

Today the investigators have done a lot of work in setting up serotypes. In that last paper, 1968, I was talking about three main groups of organisms - the abortus which is the cow organism, the suis that belongs to the swine and the melitensis which is the goat. Since that time all of these have been broken down into sub-serotypes. Geographically we can pinpoint these different sero-types, but with the vast movement of people and animals this is not as clearcut as it formerly was. But a new organism has appeared in

this group that is going to cause a lot of concern in our urban areas. Originally we looked upon it as an occupational disease of kennel men. Brucella canis was first described in Atlanta, Georgia in 1960 and for the next ten years I thought we were dealing with occupational disease or kennel disease that was confined largely to experimental dogs and occasionally we would have a human case occur. For the first ten years, I took the position that this organism was not dangerous to man. We were working with it in the laboratory; nothing happened to anybody, and then two human cases occurred in Cornell University laboratory workers, and then cases just piled up after that. There is a paper in print by George Lovejoy, epidemiologist of the Memphis Health Department, in investigating 12 human cases of brucella canis in that town. He did a dog survey and found that 25% of the dogs in the lower economic areas of the town were infected. So here we have a new problem and we cannot say that this organism is related to any of the other three that I mentioned. It is related to brucella ovis, a sheep organism which does not cause disease in man, but where this one came from and how it evolved we can't say except that it turned up at the best possible place that it could, in Atlanta, Georgia where CDC is. It therefore got immediate attention and maybe there is a certain degree of serendipity to that.

Glanders Another bacterial disease is glanders. The reason I cite this one is that glanders is a disease that has practically disappeared in the world. It occurs in only a few places. We have not had a case in the United States in some 30 years. Haven Emerson one of the most outstanding public health men in the United States served on the Committee on Communicable Disease Control with me in the early 1950's just before he retired. He told me that at the turn of the century this was the most important occupational disease in big cities where there were many livery stables, and horses providing transportation. Today the horse is only a recreational animal practically anywhere in the world. We don't even use them in Texas any more to speak of. This disease disappeared through what we call just good selective testing by an agent called mallein. You put a few drops in the palpebral fold, it produces an inflammatory reaction; you get a little pus coming out and that was the death certificate for that animal. It worked so well that by the 1930's Canada and the United States, and Western Europe had eradicated this disease and many other parts of the world too. In Leningrad I was looking at a wall covered with photographs of bearded distinguished looking individuals. These 30 odd photographs were of veterinarians that had died of glanders between 1877 and 1914, the period when the school maintained some records. Subsequent to that in the 1920's Russia experienced some very severe outbreaks of glanders that you can say were practically human

to human infections. So this is a disease that is of only historical interest except for places like India or Mongolia. But people do take trips to these remote places. You can go to Mongolia. These things can return.

Leptospirosis The next one I want to say a word about is leptospirosis. It is interesting and bewildering that more human leptospirosis is not encountered. This is a very widespread disease in domestic animals, swine, cattle, occasionally sheep, horses, dogs, rodents, many wild animals. There are some 150 different sero-types. The most important being that from rats, the so-called ectohemorrhagia which causes Weil's disease which was described by Doctor Weil in 1888. For this disease we have vaccines for animals that are satisfactory. As to human vaccination, this has not been successful to any degree, and I do not know anybody that is experimenting with human leptospira vaccination today except possibly the Russians. As to the management of human cases, the penicillin-streptomycin combination has been accepted by many people as satisfactory. On the other hand, I have had experience with laboratory workers that have splashed organisms into the conjunctiva, or ingested them through capillary tubes. They were given antibiotics immediately and they still came down with the disease. Fortunately, we have few fatalities, but we still do have 3, 4, 5 a year and these occur in a broad spectrum of workers. The most common one, the most readily understood are plumbers and those that are working in stagnant water or water that may be contaminated with rodent urine or other animal urine.

Salmonellosis Salmonellosis is the next one. This one I call the most important of the animal diseases in the United States. This is not only a matter of occupational exposure but is also important as a disease of ingestion. I think the largest occupational disease outbreak that ever occurred was in the Philadelphia General Hospital in 1967 where CDC had some 2,300 positive cultures sent in from the hospital during a period of roughly March 1966 to January 1967 and this was not only a matter of ingestion. The disease was introduced by what are called second grade eggs referred to in the industry as checked. Salmonella Derby was the agent. The first cases were seen in people that were on soft diets, either egg nogs or soft boiled eggs. Then it spread to the nurses that were taking care of the patients. Then the environment became contaminated. Subsequently more patients, more hospital workers, until we had something close to 100 people working in the hospital that were ill. You can imagine the legal aspects of the thing were just overwhelming. There were three or four nurses that died of fulminating salmonella disease. The industry where we see this most frequently is in the rendering industry where dead animals are

handled. I also have a citation here on a study from France in which some 100 people working in the plant were examined over a period of some months and the infection rate in this group was about 50% but without any evidence of disease. They were shedding salmonella, the same kind they were getting out of the swine going through the plant. When you encounter situations like this, all you can do is think in terms of what the dosage is and that the host is dealing with a parasite in an effective way. Now as to therapy for salmonella. The experience at CDC with hospital outbreaks has been to the effect that frequently you prolong the course of the disease when you use antibiotics. You eliminate the gram positive organisms, an ideal situation for the gram negatives to continue to multiply and so the CDC recommendation in the Handbook on the Control of Communicable Diseases recommends supportive therapy except for typhoid fever where chloramphenicol is the drug of choice. As to vaccination, there is no satisfactory vaccination for salmonella disease in man. Typhoid vaccine under certain conditions is acceptable but I don't think everybody should be immunized against typhoid fever. We're much better off saying that we create an environment that is free of salmonella. But to do that is very difficult because all the species I have cited for leptospirosis likewise are infected with salmonella. In fact I can start with the smallest amphibia and end up with man, and say that every thing that is in between zoologically be they cold blooded or warm blooded can be carriers of salmonella.

Tetanus A word about tetanus. Tetanus is a disease that all physicians as well as veterinarians have recognized for long periods of time, and we all know the early antitoxin immunization procedures that were developed by Behring and his colleagues in the 19th century. But the point that I want to make here is that it was such an important disease in World War I that the French Army at the end of the war assigned one of their distinguished scientists Dr. Gaston Ramon to develop a better tetanus vaccine. Out of his investigations came the tetanus toxoid which, as you know, is the agent of choice today. It worked so well on horses they tried it on humans and you know the success of World War II. I include this disease not to point out that animals are the reservoir except that the intestines of all animals including man harbor the clostridium tetani. The control procedure is immunization and this is one of the most effective immunizations that we have for both man and animals. Among animals we only immunize valuable horses. I have been in Samoa, where tetanus is so widely disseminated that they also immunize domestic animals including dogs, but that's the only place I've ever encountered this procedure. The number of human cases in the United States is now less than 200 annually, and this will continue downward. I've always been

an advocate of having everybody who gets a license to operate an automobile show evidence that he or she has had tetanus toxoid. I've never gotten very far with this argument. They say, well you get that accomplished, and they'll insist on something else. Kids going to school have to have a long series of immunizations including tetanus, but every once in a while there is a person that comes up to adolescent age and wants to drive a car and just doesn't have evidence of tetanus immunization. I hope that may disappear in the next ten years.

Tularemia The next disease is tularemia. Wild animal reservoirs include many species. This one occurs all across the Northern Hemisphere but strangely enough, south of roughly 35 degrees latitude, which is more or less the North Carolina-Georgia state line extended across the continent, there is little tularemia. Most of the tularemia is in the temperate zones around the world, also in northern Europe, Russia, across Japan. South of the equator tularemia is practically unknown. Today we have very effective means of controlling tularemia through a live vaccine that was developed by the Russians. We have brought this vaccine back to this country. It's available through CDC for the populations that are at risk, meaning it is an experimental vaccine. The therapy of tularemia is a combination of streptomycin and any other antibiotic that you may want to use. There is a tremendous literature on tularemia in Russia for those of you who want to read more extensively on it. Today I look upon it as both a recreational and occupational disease.

Tuberculosis (Bovine) I do not believe there has been a proven case of bovine tuberculosis as an occupational disease in the United States in a decade or more. The incidence in our animal population is practically nil except once in a while we get a big outbreak as we did in Georgia last February, and that's what you call a clerical error. The herd hadn't been tested in some ten or twelve years, but those things will occur. Outside the United States I wrote a text book in 1969-1970 in which I pointed out that the economic losses for tuberculosis in South America, Africa and Asia exceeded all the foreign aid that the under developed countries received. This is on the basis that an animal with tuberculosis will give 30% less milk and this is on a linear equation that is compounded each year, and at the end of five years the carcass is not even worth salvage for meat. The elimination of bovine tuberculosis is by test and slaughter. We never use BCG. BCG was demonstrated to be of no value early; the new drugs, isoniazid derivatives are satisfactory if you've got very expensive animals and you can keep after it and maintain your dosage, but no area that I know of except South Africa is using any of the anti-tuberculous

drugs except in zoos. Zoos will use them for very expensive animals or valuable specimens and they will also use them in colonies of chimps, orangutangs or gorillas which are expensive experimental animals.

PARASITIC DISEASES

Moving on to parasitic diseases. There are few among these of any major importance to talk about in the temperate zones. These diseases are mainly in the tropics except for hydatid disease. Hydatid disease is transmitted by the dog tape worm, and forms large cysts in the human lung and liver and sometimes heart and brain. This is practically a rare disease in the United States except for some cases recorded in Arizona, Utah and California. In school, I was taught that this disease was not present in the United States and only a few cases have been revealed in the last decade. But in countries surrounding the Mediterranean or across southern Asia, this disease is a major problem. I was in Cyprus this past summer. Thirty years ago hydatid disease was the most important reason for surgery on the island. Today with the elimination of the dog population, reducing it from 46,000 to 6,000, they have practically brought the disease under control. It will still be 30-40 years before people that were exposed in the last decade are no longer a part of the present scene. An interesting argument came up in Cyprus about why is it necessary to kill these dogs? There was a parliamentary investigation, and the chief veterinarian of the country took his evidence to the parliamentary group and then he went on talking. He said: "I dare say that one out of ten or you legislators have the disease and you don't know it." When you've got a disease like that you can make your point stick! He was able to obtain very effective dog control.

RICKETTSIAL DISEASES

One that I should mention here is Rocky Mountain Spotted Fever, truly an occupational disease of rural people and now of vacationers too. We have good vaccines for this but in many areas of the country people have forgotten to vaccinate and in 1973-1974 we had more deaths from Rock Mountain Spotted Fever than we had in the previous decade. To a certain degree complacency is the problem. Diagnosis is missed; vaccination isn't practiced. We had a death in Texas in April and investigation showed that the old farmer felt that: "A little fever isn't going to bother me," and when the rash came: "Some insect had been after me," and finally he was sick enough that he presented himself. But he was in extremis at that point and there wasn't much you could do about it.

Q. fever is another one of interest in the United States. Certainly it was occupational at the beginning. But today I think this disease is so widespread that we have successfully self-immunized our entire population, animals and human. All the sheep, all the goats and all the cattle have it, and at the time of parturition the fetal tissues are just teeming with the organism. Morbidity and Mortality reports from CDC reveal a scattering of cases, but as all good epidemiologists know, luck follows them around so they do find cases to report. When I went to Cyprus this summer, they told me about a beautiful outbreak of Q. fever among British soldiers fresh out of England, all out of Manchester, London and other urban areas. They probably never milked a cow in their lives. They had 100 cases of pneumonia among these troops and these fitted exactly parallel with the animal parturition period of November to March. On the other hand, in the native population or refugee population, which is very large, there wasn't a single case. As a vaccination against Q. fever, nothing of any importance can be recommended except possibly for laboratory workers. Even there I think they might just as well take the risk of having a mild case of acute fever as to risk the acute reactions I have seen from the vaccine. Controlling Q. fever is just impossible. To vaccinate the animals that have it is of little value. It doesn't interfere with lactation or parturition; they usually retain their fetuses to term.

VIRAL DISEASES

As to viral diseases, the arthropod-borne ones are present all the time. They are occupational for people working outdoors, as well as avocational. Children also are susceptible. We are all constantly being exposed, especially in a year like this with a lot of St. Louis equine encephalitis around. We are all asking ourselves "where has St. Louis been the past ten years?" We are certainly not seeing any more mosquitoes this year than usual. Certainly we have no explanation of why we should have an epidemic year of this disease.

A word about small pox. As you know, the announcement that small pox has been eradicated from the world will come sometime this year; I think they're shooting for a December 1975 date. Concurrently with the disappearance of small pox, I should make one statement. I was involved in responsibility to review the literature of the world to determine if there was any animal reservoir of small pox. There is no animal reservoir. There are animals that are susceptible to small pox, mainly sub human primates and cats. We can take the vaccinia and grow it on cats and you also can grow it in some

other experimental animals, rabbits, guinea pigs, but none of these constitute a reservoir. On the other hand, with the disappearance of small pox, cow pox has disappeared, the type Jenner described, vaccinia. I have not seen a proven case of cow pox in the last decade but we do have a disease that is very similar called pseudo cow pox which has a very hard cornified lesion that is sometimes painful and sometimes not. And there is another disease that simulates that called orks or contagious eczema or "sore mouth" in which sheep get big sores in their mouths. People frequently vaccinate lambs against this disease and in handling the vaccine they infect themselves. Monkey pox is an occupational disease among people handling monkeys, of little consequence.

The most dangerous laboratory disease that we've ever encountered is the great African green monkey disease or Marburg agent disease which occurred in 1967 in Germany. I've written it up in some detail. There were seven deaths among physicians, veterinarians and people working in the laboratory. It caused a very severe hemorrhagic death with shock syndrome. That was the only time the disease ever appeared in laboratories. During the next seven, eight years, so far as we knew, it disappeared. Then in January 1975 two cases appeared in South Africa in young Australian people who were hiking around the continent. The young man died within days and the diagnosis was made by electronic microscopy of the tissues. They could do that within hours after they got the specimen at CDC - certainly one of the more dramatic illustrations of the use of the electronic microscope. As to control, we have no idea what its reservoir is. We get the disease by coming in contact with the organism and we would say it is one of the most dangerous diseases we know.

Vesicular diseases we have in many varieties in animals, but rarely in man. The most important for the world economy is foot and mouth disease. Fortunately, man is highly resistant to this. Only occasionally do we have laboratory cases where people develop lesions on their hands and other parts of the body. I know of no fatal case of human foot and mouth. There was a famous case in England in 1966 when an automobile mechanic developed the disease and the government put him in quarantine in the best hotel in London so he wouldn't come in contact with any animals.

Chlamydia Infections These are psittacosis and ornithosis. For years they were associated with the bird breeding industry. Today they are particularly important in the turkey industry. They are with us and will be with us. We have no way of controlling them

in birds. We can treat humans and birds effectively with tetracycline but they are all sporadic. Two years ago a friend of mine was giving a paper on "what happened to turkey ornithosis?" and that summer we had the first big outbreak in Texas in some 15 years.

Influenza Just one point on influenza. Now the consensus is that we constantly have re-combinations going around of organisms in man and animals and these are the ones that generate the new types that cause pandemics. Statements are being made that sometime in the 1980's we're going to see the next pandemic. This is of particular interest to me. I became ill with a highly pathogenic strain of the avian influenza virus that was demonstrated to be fowl plague. The organism was confirmed by Plum Island and reported back to CDC as the first human case that ever survived. Along with the letter confirming the identification of the organism was a subsequent paragraph to the effect that we should destroy all virus material we had, and tissues containing it, so I lived only by the grace of the United States Department of Agriculture.

Rabies I do not consider an occupational disease. Many people ask why; I say this is not a matter of vocation, but rather a matter of the accident of living. There are several fungal diseases like coccidiomycosis arising from the stirring up of dust in agricultural operations. Sporotrichosis occurs in those working with sphagnum moss in the florist industry. Ringworm can be acquired from working around infected animals. Griseofulvin is the agent of choice of treatment both for man and animals in these.

In closing I would say that we should not close our minds to the importance of these diseases that we've brought under control. Nature does have a way of saying:"Look, I want to survive as much as you do." Even infectious microbes seem to survive our best efforts to control them, at times.

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Marilyn K. Hutchison, M.D. NIOSH Project Officer

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AMA

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David J. Sencer, M.D.
John F. Finklea, M.D.
Marilyn K. Hutchison, M.D.
Leo Sanders
Marilyn Hodge

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