

# On the prevention of foot and mouth disease

by

Dr. HENRIQUE MARQUES LISBOA e Dr. ARMANDO ALVES DA ROCHA.

In a paper on the prevention of foot and mouth disease published in KOLLE and WASSERMANN's treatise, M. CASPER states that immunity follows an attack of this disease, but mentions that opinions on the duration of immunity vary.

We have had the opportunity to make observations in many foci of apthous fever and have also been making an experimental study of this disease for over six years, so that we feel justified in giving our opinion on the subject.

The average duration of immunity after apthous fever is about one year and we believe that the divergence of opinions on this point is due to the varying intensity of infection and to the degree of individual resistance. If an animal has a slight attack of foot and mouth disease it may be liable to another benign attack at the end of some six months, though this is very exceptional. The shortest period of immunity we observed lasted only four months and occurred after a very slight infection, following experimental inoculation of the disease. These cases were found among a herd of Devonshire cattle imported by the State of Minas Geraes. Four months after benign experi-

mental inoculation with eight bladed scari-fiers, to test the vaccinating power of Cow-pox, a pig with foot and mouth disease was put in the pen where this herd was kept. Other pigs in the same pen were contaminated and boils appeared on the skin of three head of cattle, accompanied by a slight rise of temperature. After two days the fever and the boils disappeared leaving no traces. If the animals had not been under observation, it is probable that the outbreak would not even have been noticed.

The longest period of immunity which came under our notice lasted for two years and occurred after a virulent attack.

We have never met with complete immunity though we have heard of it; but we were not given sufficiently convincing proofs of the positive risk of infection to which the supposedly immune herd was exposed. The fact that the disease be found in neighbouring ranches is not enough as one may only be sure of contagion when there has been promiscuity of healthy and sick cattle. It is well known that calves born of cows which had the disease in an advanced state of pregnancy, without miscarrying, are very refractory and



this is very striking when compared with the sensibility of those born before an epidemic of foot and mouth disease. Considering the short time immunity lasts it is not to be expected that vaccination should confer resistance for more than a few months. This is however not so very important as an epidemic on a farm may last for only a month or even less and seldom lasts longer. Immunity for about a month or six weeks is quite sufficient as the epidemic may be crushed in that time. *Loeffler* also mentions this fact (Deut. Med. Woch. 30. Nov. 1905.)

One of us had been experimenting so as to find a practical way of inducing immunity since 1912 and succeeded in finding a process which we applied about two years ago with quite satisfactory results. Before describing the method itself, we would give a synopsis of the several phases in the shaping of it.

The very first obstacle we met with was the difficulty of transporting the virus, which was gathered about a mile and a half from our laboratory at the Experiment Station of Bello Horizonte. We inoculated the gums of several calves but only one of them had aphthae.

When the distance was longer we used pure glycerine, or 30 % and 50 % glycerine solution as preserving medium for the aphthae. Although we used ice and took other precautions, no results were obtained if the material took over twenty four hours to reach us.

Sucking-pigs were then used for the transportation of virus. We found that indigenous pigs were the worst possible carriers, but obtained good results with some half bred Yorkshires available near the Experiment Station. LOEFFLER also obtained good results with Yorkshires, though his may have been pure bred.

The best way to infect them is to make them swallow aphthae or other contaminated products, though it is advisable to inject or to scarify the skin if it is necessary to obtain pustules. Another good method

is to make the pigs suck cows that have contracted the disease or to give them contaminated milk.

It is exceedingly difficult to keep the virus in the laboratory unless sucking pigs are available. We could hardly get calves which were susceptible to the disease and indigenous pigs gave very uncertain results. On this account, we followed LOEFFLER's technique or got material from neighbouring farms.

Pericardial liquid aseptically taken may be kept for five days in 30 % glycerine and often even for eight or ten. LOEFFLER mentions having kept it for thirty, but the longest we could manage was fifteen.

By inoculating Yorkshire pigs and withdrawing their pericardial liquid, we immunised a native cow which yielded a quite active serum. Unfortunately we had to abandon this method on account of the exorbitant price of half-breed sucking pigs and the great mortality among them, especially as these experiments were only made so as to test our hypothesis. At the same time, other experiments were carried out on Mr. JOAQUIM NOGUEIRA's farm in Queluz, and gave very good results, thanks to the good-will of this landlord and the thoroughness of our assistant JOÃO CLAUDIO DE LIMA.

The work was done in the following way: Aphthae taken from a bull that had had a virulent attack of foot and mouth disease were crushed in a mortar and diluted in physiological solution; after that they were filtered, first through large meshed tissue and afterwards through filtering paper. This took about an hour. The substance thus obtained was injected in the jugular vein of an ox that had hitherto proved refractory to aphthous fever. This was repeated four times, at intervals of seven days and was done at night so as to prevent the virus from being spoilt by heat.

Ten days after the last injection, we bled the ox at the jugular vein; the serum obtained was kept in 0,5 % carbolic solution. The epidemic died out on the



farm and as there was no communication between it and neighbouring farms it did not spread further.

The ox was then bought by the Experiment Station and its serum used on two lots of pigs bred near the slaughter-house. It proved to be preventive in doses of 40 cc. for adults and 20 cc. for suckling pigs. It was also used on two Large Black sows, in an advanced state of pregnancy, which suffered from the disease and had fever, varying from 41 to 42° C., with intense dyspnoea and were obliged to keep standing, with their heads low and their feet well apart. On the day following injection, the two sows showed no signs of the disease by which they might have been distinguished from the normal ones.

The serum had however no effect on pigs that already had aphthae and the disease ran its usual course.

A small quantity of the same serum was used with good results on some calves in Ubá, but as there were only a few of them we did not take them into account.

Other experiments in immunising animals were made near Juiz de Fora on a ranch belonging to Dr. HERMENGILDO VILLAÇA, to whom we are much indebted for his kindness. In this place the mortality among pure-bred Schwitz calves was terrible; five of them were dying when we arrived. We succeeded in immunising a cow from a neighbouring farm, on which the epidemic had spent itself. Ten days after the last injection, that is a month from starting of the work, the disease died out on the farm so that we had no further opportunities of testing the value of the serum obtained.

We then transferred the serum to JOÃO PINHEIRO, in the West of Minas Geraes and inoculated five calves which were taken from a farm where the infection was recent and severe. Another calf, taken from the same farm was used as witness; it fell ill after three days, had chills and a lot of aphthae in its mouth, whereas the calves that had been vaccinated did not contract the disease

during the epidemic, which lasted four weeks.

Dr. HONORIO HERMETO also applied the serum in the same place with the same results.

On dosing the serum in our laboratory we found that 120 cc. protected adults, while 80 cc. were enough for calves over six months of age.

The efficacy of serum obtained by the injection of emulsion of aphthae during one month at least being proven we were prepared to make large quantities of it on the farms where epidemics occurred.

Just about this time several farmers appealed to the Minister of Agriculture so as to have the necessary measures taken against the disease. The work was entrusted by the then Minister, PEREIRA LIMA, to Dr. ALCIDES MIRANDA, the Chief of the Board of Pastoral Industry, who was given a government subvention for the carrying out of the same.

Our assistant Dr. FRANKLIN DE ALMEIDA made several liters of serum in the state of Rio de Janeiro, while we began to take prophylactic measures in the state of Minas Geraes; the serum was made in Ubá and used in Viçosa, Teixeiras and Ponte Nova.

The technique used was as follows:

1. Vaccination of well-developed head of cattle by rubbing aphthae on lips and tongue and sub-cutaneous inoculation of 100 c. c. of serum, 12 hours latter.
2. Intravenous injection of the emulsion of 2,5 gr. of aphthae, 6 days after the first injection.
3. Intravenous injection of the emulsion of 10 gr. of aphthae, 12 days after the first injection.
4. Intravenous injection of the emulsion of 10 gr. of aphthae, 18 days after the first injection.
5. Intravenous injection of the emulsion of 20 gr. of aphthae, 24 days after the first.
6. Letting of 4 liters of blood from the jugular vein, 10 days after the last injection.
7. After each bleeding, inducement of hyperimmunity by injection of 10 gr of fresh



aphthae, crushed in boiling water and filtered, first through cloth and afterwards through filtering paper. The animals were always bled 10 days after inoculation.

LOEFFLER warns against the use of sputum and other contaminated products in hyper immunising. As it is very difficult to draw the liquid aseptically and filtering through porcelain reduces virulence, we were hardly ever able to work with virus from natural infection. In a long series of injections LOEFFLER used for the most part pericardial liquid and only seldom aseptically taken aphthae, a fact which lengthened the period for obtaining serum. When the aphthae themselves are used, as was the case with us, there is a great deal of spontaneous infection which also lasts longer than that obtained from intact boils. Besides this the abundance of material allowed us to strengthen the immunity in a relatively short time. It is needless to exaggerate the danger of contamination by this process as it is not of much account, since cattle become immunised against very virulent germs and much more so against the ones generally found in the mouth.

The value of the results obtained can be deduced from the statistics we give. As we were satisfied with these obtained in 1918, we continued our work in 1919, with the following results:

In 1916, at the request of Count MODESTO LEAL, we set to work on his farm in Morro Agudo, where there were cases of foot and mouth disease. Thirty nine head of cattle were inoculated by one of our assistants and left with the sick cattle; they did not contract the disease.

We then attended to the request of Colonel ANNIBAL LOPES in Ipiabas, where forty five head were inoculated and also left with the sick cattle without having aphthous fever.

At the same time another member of our party inoculated the cattle on a farm belonging to Captain LAUDELINO DA SILVA in Pinheiro. Unfortunately there was not enough serum to go round; of the eighty nine head vaccinated, nine had the disease some days after the injections were made.

In fact we attended to many requests and obtained satisfactory results. The following table shows the advantages of treatment with anti-aphthous serum. In 80 % of the cases indemnity was obtained. If we exclude the animals that fell sick 48 hours after vaccination, the general percentage rises almost to 100 %.

On a ranch in S. Vicente Ferrer, which belongs to Mr. C. E. DE AZEVEDO, two hundred and seventy head of cattle were vaccinated; according to the owner they all fell sick. The same thing happened in S. Manoel amongst two herds. The serum had been obtained by bleeding oxen that did not resist immunisation and died several days after being bled. This kind of accident often happens to novices and hasty workers who do not filter carefully enough. Under these conditions septic particles get caught in the capillaries of the lungs and form centers of suppuration. When this occurs, the cattle become thin and feverish, cough a good deal and generally die on the twelfth day after vaccination.



Names	Locality	Animals Treated	Fell Sick	Percentage of Immunity	OBSERVATIONS
1. Count Modesto Leal. . . . .	Morro Agudo	39	0	100/100	
2. Colonel Annibal Lopes. . . . .	Ipiabas	45	0	«	
3. Cap. Laudelino da Silva. . . . .	Pinheiro	89	8	91,1 0/0	
4. Rodolpho Hess. . . . .	Passa Quatro	6	1	83,6 0/0	The infection was provoked.
5. Lucas. . . . .	S. José do Picú	28	0	100/100	
6. Viuva Mendes. . . . .	Itanhandú	6	0	«	All the cattle were injected with serum and artificially infected.
7. Colonel Augusto Gomes. . . . .	Serra do Garrafão	44	3	93,6 0/0	
8. Rambalducci. . . . .	Muquy	45	0	100/100	
9. Antonio de Freitas Lima. . . . .	Muquy	14	0	«	
10. Colonel Francisco Fernando Flores. . . . .	Banco Verde	94	0	«	
11. Light and Power. Cy . . . . .	Lages	90	45	50,0 0/0	
12. Dr. Ottoni Raolino. . . . .	Ipiabas	140	0	100/100	
13. Anthero de Moura. . . . .	Lages	16	0	«	
14. Dr. Alberto Diniz Junqueira	Pinheiro	357	?	?	
15. Posto Zootechnico de Pinheiro. . . . .	Pinheiro	350	0	100/100	
16. Abilio Godoy. . . . .	Rezende	472	1	99,74 0/0	
17. Baptista. . . . .	Rezende	18	0	100/100	
18. Dr. Raul Ferreira Leite. . . . .	Realengo	89	0	«	Of the 89 head, 3 were taken to a centre of the disease, the property of Dr. Aristides Caire, and were found to be immune.
19. Josias Alves Nogueira. . . . .	Livramento	50	0	«	
20. Dr. Luiz Cardoso. . . . .	Districto Federal	50	2	96,0 0/0	The two animals that fell sick before they were injected were considered suspect.
21. José Eugenio de Azevedo Pinto. . . . .	S. Vicente Ferrer	270	?	?	We had so much to do, we had no time for observation ; we heard however that many head of cattle fell sick ; perhaps of the serum not had been well prepared.
22. Guiot Rodrigues. . . . .	Rezende	180	7	96,8 0/0	
23. Vieira Filho. . . . .	Pinheiro	81	1	98,8 0/0	The sick animal was injected as the owner wished it, though our assistant thought it suspect.
24. Horacio da Costa Ferreira.	Rezende	123	0	100/100	
25. Luiz Heurique Still. . . . .	«	51	0	«	
26. Ezequiel Caetano da Silva.	Cabiuas	88	3	96,6 0/0	
27. Leopodina Maria Drumond.	«	62	2	96,8 0/0	
28. Pedro Caetano da Silva. . . . .	«	26	0	100/100	
29. Orestes Caetano da Silva.	«	32	2	93,8 0/0	



Names	Locality	Animals Treated	Fell Sick	Percentage of Immunity	OBSERVATIONS
30. Diogo Pires de Amorim. . .	Coutinho	110	0	100/100	
31. Emiliano Bello de Amorim.	«	41	0	«	
32. Josias Alves Nogueira. . .	Livramento	98	0	«	
33. Cap. Francisco Pimentel.	«	47	0	«	
34. Dr. Jayme Cotrim. . . . .	Campo Bello	327	0	«	
35. Dr. Aristides Caire. . . . .	Deodoro	22	22	0 0/0	
36. Eurico Terra. . . . .	Itaocara	113	3	97,3 0/0	
37. Colonel Camillo Soares. . .	Coelho Bastos (Município de S. Manoel)	60	0	100/100	
38. Colonel Macario Garcia.	Itaperuna	—	—	—	
39. Juho de Aquino. . . . .	«	14	0	100/100	
40. Cap. João Leandro. . . . .	S. Manoel	10	0	«	All the cattle, except 10 calves which we vac- cinated had the disease.
41. Colonel Horacio Lemos. . .	Bemfica	147	0	«	
42. Colonel Horacio Gomes. . .	«	17	0	«	
43. Senator Francisco Salles. . .	Capim Branco	109	0	«	
44. « « «	Peripery	32	0	«	
45. Dr. Adolpho Soares. . . . .	Ponte Nova	—	—	—	We found all the cattle in convalescent state.
46. Geraldo Ubaldo da Silva.	« «	6	0	100/100	
47. Pellegrino Vianna. . . . .	Alfenas	52	0	«	
48. Joaquim Jacintho. . . . .	«	35	0	«	
49. José Pinto Penna Carvalhal.	Itanhandú	39	0	«	
50. Daniel Rocha. . . . .	Tombos de Ca- rangola	60	0	«	
51. Snr. Prates. . . . .	Passagem de Marianna	15	0	«	
52. Francisco Jorge Diniz. . . .	Brumadinho	126	0	«	
53. Octavio Contigio Machado.	Livinopolis	9	0	«	
54. Colonel Firmino Mariano.	« (Cacho- eira factory)	148	0	«	Of these 146 pigs, 1 bull, 1 cow and 146 pigs were already ill.
55. Antonio Amaral. . . . .	Capella Nova	14	0	«	
56. Joaquim Jacintho. . . . .	Alfenas	12	0	«	
57. Major Feliciano Pinto Brandão. . . . .	Bemfica	86	0	«	These oxen were used for traction.
58. Dr. Adolpho Soares. . . . .	Ponte Nova	28	0	«	
59. Francisco Jorge Diniz. . . .	Brumadinho	24	0	«	
60. Board of Pastory Indus- tra. . . . .	Rio de Janeiro	23	0	«	
61. Dr. H. Villaça. . . . .	Juiz de Fóra	108	0	«	
62. Dr. José Rezende. . . . .	Ubá	103	0	«	