

spraying, etc., have any definite chances of success in India. Paving crops like fruits and industrial crops like cotton, tobacco, etc., are the ideal ones for such trials. For the sucking insects, especially thrips and the mosquito bug of this tree which constitute the main pests spraying the shoots with a contact insecticide like tobacco decoction after pruning badly infested shoots will be found economic and beneficial. For the leaf eaters which are not so bad, handpicking in time might alone be found sufficient; if, however, the attack becomes wide spread spraying or dusting with stomach insecticides will control the pest. The control of the borer beetles is not, however, an easy job. Preventive measures have to be adopted in the shape of pruning and destroying early infested stems and branches, removing dead and dying branches and keeping the orchard clean. Direct methods in the way of removing or killing the grubs on the attacked trees by hooked wires, injection of petrol, etc., can also be adopted. Biological control may be very effective in some cases but the same will have to be always supplemented by the ordinary prophylactic and curative measures like spraying, dusting, etc. And as far as the pests of this tree are concerned no effective natural enemies have been discovered as yet.

SELECTED ARTICLES

Rabies and its Control in India.

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Rabies is one of the oldest known diseases. It is found in nearly all parts of the world and in all climates. It has not so far been introduced into Australia or New Zealand and has been stamped out of the British Isles by the destruction of all animals infected with the disease, or suspected to be so infected, by the muzzling order and by strict quarantine regulations concerning the import of dogs. Once the symptoms have developed, it ends fatally almost always. It is also a source of imminent danger to human life and domestic animals, causing considerable economic loss.

To apply suitable measures of control against this disease it is essential as in the case of many other diseases, to have a thorough public awakening.

Rabies is primarily a disease of wild and domesticated canines, e. g. dogs, jackals, foxes and wolves, but all the warm-blooded animals like cattle, horses, goats, sheep, cats, monkeys, rabbits, camels, elephants, fowls and human beings are susceptible. Infected canines particularly pariah dogs, so widely and extensively distributed in India, spread the disease among themselves and other susceptible animals and human beings. The mongoose and blood sucking (Vampire) bat have been reported to act as a natural reservoir of rabies virus in South Africa and South America respectively and to convey the infection to domesticated animals and human beings; but in India the virus is usually maintained by wild carnivores and stray dogs.

Cause. The causative agent of this disease is a virus which passes through bacterial filters and is not visible even with the aid of the microscope. Desiccation, heat, sunlight and antiseptics adversely affect the virus, but glycerine acts as a preservative, as is the case with most of the viruses. The virus is destroyed by exposure to a temperature of 60°C, for half an hour or by the ordinary disinfectants.

With the bite of an infected animal the virus which is present in the saliva, even 10 days before the onset of the symptoms, is injected into the victim. The quantity of the virus thus injected depends upon the depth and number of bites and presence or absence of clothes and hair covering the skin. Crushing of soft tissues caused by the bite of a rabid dog produces a favourable environment for the propagation of the virus and its penetration into the nerve trunks and transmission to the brain and spinal cord. Besides saliva, the urine of a rabid dog is also infective. Rarely may the disease be acquired by infective saliva or urine coming into contact with the eye. The virus of a natural case produces inconstant results and is called 'street virus' to distinguish it from its modified form known as 'fixed virus' which is obtained by serial passage through rabbits and produces constant results in them on inoculation. The latter is chiefly employed in the manufacture of vaccines.

Symptoms in dogs After the introduction of the virus into the tissues of the victims, some time must elapse before the symptoms of the disease appear. This period, known as 'the period of incubation', varies with the species, site and character of the bite, and the quantity and virulence of the injected virus. It usually ranges from 15 days to 6 months in dogs, 15 to 60 days in cats, 10 to 45 days in horse, 14 to 60 days in sheep and pigs and 14 to 64 days in human beings. Cases are on record of much longer periods extending even up to two years. It is shorter in young animals and also when infection has taken place near to the head.

As the virus affects principally the nervous system, the symptoms are associated with nervous derangement. In a typical case three characteristic stages of melancholy, excitement, and paralysis are observed. But in dogs one should not expect all the usual symptoms to be present in each case. In some cases, particularly of small pet dogs, the stage of excitement is usually so short as to pass unnoticed, and paralysis, especially of the jaw and hind limbs, sets in early (dumb rabies). In others, especially dogs of larger breeds, the stage of excitement is very pronounced and the ultimate paralytic symptoms are delayed (furious rabies). However, there is no fundamental difference between the two forms.

In the preliminary stage usually there is some alteration in disposition or habits. There may be unusual display of affection or the animal may turn morose, hiding under furniture or in corners and not usually responding to the owner's call. The eyes have a vacant look and the pupils are dilated. There is mental delusion and the animal snaps at imaginary objects, becomes restless, with a tendency to start at the slightest sound. Salivation is increased and the appetite becomes morbid, refusing ordinary food, but eating straw, wood, carpets, leather, stones, etc. There is a characteristic change in bark and there may be a rise in temperature and sometimes constipation. This stage usually lasts about two days and the animals may then develop either of the two forms mentioned above.

In the 'furious' form the animal will try to bite anything within reach such as its chain, metal bars or the woodwork of the cage, thereby causing injuries to its mouth. If the animal is loose, it runs about aimlessly for miles, biting anybody coming in its way and may engage in fights with pariah dogs thereby spreading the infection. Salivation and mental delusion are increased. There is great desire for water and the animal is unable to bark well and the voice is somewhat between a howl and a bark. Later on in the aggressive stage, the animal may even become dumb and attack others in silence. Appetite is usually suppressed and the animal bites its own body. In about three to four days paralysis sets in, affecting the jaw and limbs. The dog loses the power, but not the desire to bite. One has not to wait long to see the end of the affected dog, which occurs in seven or eight days unless it dies earlier due to exhaustion.

In the 'dumb' form the preliminary stage of melancholy is comparatively short, and is soon followed by signs of paralysis, there being practically an omission of the 'furious' stage. The jaw muscles and the tongue are the first to become paralysed with the result that the lower jaw drops, the animal cannot feed and salivation increases. There is no desire to bite, paralysis gradually extends to the hind and then to the fore limbs. The dog becomes comatose and dies in two or three days.

Other domesticated animals. The symptoms described above are more or less common to other domesticated animals which usually get the infection through the bite of a rabid dog. Affected cattle show general uneasiness, disposition to do damage, straining, stamping, bellowing, frequent attempts at micturition, sexual excitement and dribbling of saliva. This results in exhaustion and great loss of condition followed by paralysis of the hind and fore limbs. In some cases the excitement stage is short and paralytic symptoms appear earlier. Death usually results within five days of the onset of the symptoms. Similar symptoms are observed in affected goats, sheep and swine. During excitement they become aggressive and attack practically any class of animals, even dogs. An affected horse becomes excited and aggressive, walks round and very often bites his own body, especially the site of infection. The writer has met with two such cases, wherein the history and symptoms given by attendants were such as to give all reasonable suspicion of colic. But on a careful examination, both the cases were found to be of rabies. So one should always be very careful in handling any suspicious cases like these. There is increased sexual excitement and frequent micturition. Thirst is marked although there may be some difficulty in swallowing. The excitement stage results in paralysis affecting the throat and hind limbs. In fowls, the bird shows signs of conspicuous fright and unrest. It runs in circles with ruffled feathers, frightened look and hoarse cries, attacks the healthy birds and even human beings with the beak. Ultimately paralysis sets in, followed by death.

Hydrophobia. In man three stages of the disease are recognized. The first stage is of general malaise which is characterised by pain at the site of infection even if the wound is healed up, stiffness of the limbs and joints, rise of temperature, headache, general uneasiness and disinclination to drink. The patient does not sleep well and experiences spasms in the throat when he tries to swallow. This gradually passes on to the second or hydrophobic stage during which the spasms increase and become extremely severe even at the sight, or suggestion of water. There is actually fear of water (hydro-phobia). There is increased salivation and nervous irritability, accompanied by screams, fits of madness and convulsions. Sometimes the patient becomes aggressive. This causes rapid emaciation and passes on to the third or paralytic stage during which general paralysis and respiratory distress due to paralysis of the diaphragm are observed. This stage is of short duration and is very soon followed by death. The writer saw a case of rabies in a child about 11 years of age in the winter of 1940. The child developed rabies, even after going through a course of anti-rabic treatment immediately after the bite and showed all the typical symptoms of the disease.

Diagnosis. The usual history of a bite from a dog and the presence of a bite wound in addition to the symptoms mentioned above, should enable one to identify a case of rabies. It is advisable not to destroy a suspected case of rabies, but to keep it under observation in a suitable isolated place and allow the disease to take its natural course. This assists in arriving at the correct diagnosis. A rabid animal almost invariably dies within 7 to 10 days from the onset of symptoms. To catch a rabid dog alive especially a furious case, with minimum risk is a difficult problem. For this the use of a suitable catcher is recommended.

In the carcase of a rabid dog one may find signs of salivation, soiled tongue injuries to the mouth and even broken teeth, resulting from biting at and ingestion of foreign bodies. These may be found in the stomach which may show haemorrhages. The feet may show signs of the animal having travelled long distances. However, to arrive at a definite diagnosis it is essential to send the brain of a suspected animal for microscopic and biological examination to the Pasteur Institute, Kasauli or some other laboratory doing similar work. Only a veterinary surgeon should undertake the removal, preservation and despatch of the brain of a suspected case. In microscopic examination a positive diagnosis is based on the presence of peculiar structures known as 'negri bodies' which are found in certain parts of the rabid brain. Although a positive diagnosis by this method is reliable, a negative diagnosis is not necessarily correct and in such cases, one should rely entirely on the clinical diagnosis given by the veterinary surgeon. The result of the biological examination depends upon the ability of the suspected brain material to infect rabbits, which develop the paralytic or 'dumb' form of rabies without showing any furious symptoms and die within 27 and 10 days from the date of inoculation in the case of 'street virus' and 'fixed virus' respectively. To wait for 27 days for the results of a biological test for recommending anti-rabic treatment of human beings or pet animals exposed to bites from or contact with an animal suspected to be rabid is extremely risky. On the slightest suspicion of rabies it is advisable to recommend their vaccination without waiting for the results of the laboratory tests.

Similarity to other diseases. Although the disease may be confused with nervous diseases like epilepsy and hysteria in dogs, encephalomyelitis in horse and cattle, the history and the symptoms described above enable one to differentiate these conditions without much difficulty. In epilepsy and hysteria the attacks are repeated and not continuous and the animal does not die eight or ten days from the onset of the symptoms. Mechanical injury to the jaw may cause dropping of the jaw similar to that seen in rabies, when the jaw is paralysed. Foaming at the mouth and frenzy caused by a foreign body in the roof of the mouth should always be handled with due precaution, as the existence of a foreign body in the mouth does not exclude the possibility of rabies, but on the contrary it increases the suspicion. There are certain other conditions like the nervous form of canine distemper, intestinal worms, foreign bodies in the rectum, which may produce certain nervous symptoms resembling those of rabies, but an experienced veterinary surgeon would find no difficulty in differentiating these conditions from rabies.

Prevention and control:— Rabies is primarily a disease of dogs, which spread the infection to other domesticated animals and human beings by means of their bites, and again it is the dog that while fighting or hunting wild animals like wolves, jackals and foxes brings the infection, although these wild animals may sometimes directly bite human beings and domesticated animals in the jungle. Therefore the control of the disease lies principally in controlling it amongst dogs. Complete eradication of the disease from India, where it is widespread, is perhaps impossible on account of geographical difficulties and the presence of wild carnivores and innumerable stray dogs which would keep the virus alive.

An attempt should be made to minimize the chances of the spread of the disease by the destruction of ownerless dogs, licensing of other dogs at least in municipal areas and restriction of the liberty of dogs, unless muzzled, to premises of the owners. To judge what can be achieved by the muzzling order one has only to glance at the statistics of Great Britain. Muzzling was begun in 1890, and the cases of rabies went down from 129 to 38 in 1892. When in response to public feelings the orders were relaxed, the result was that cases rose from 93 in 1893 to 672 in 1895. In 1895 the muzzling order had to be re-enforced with the

consequence that incidence of the disease went down, until between 1903 and 1907 no case of the disease was reported. It was about 1933, when the writer was working in Simla, that a great number of cases of rabies occurred there among dogs. The writer recommended the enforcement of the muzzling order and the results were most satisfactory. Free prophylactic vaccination of dogs with a suitable vaccine once a year preferably at the time of issuing licenses should also be introduced. With these measures the disease can be effectively controlled and its incidence immensely diminished in this country. Expenditure on prophylactic vaccination of dogs would be amply compensated by reduction in the cost of anti-rabic treatment of human beings. Unwanted pups should also be destroyed and the destruction of wild carnivores, such as jackals, wolves and foxes should be encouraged as far as possible. Bitches in season should not be let loose, so that dogs do not assemble and engage in fights facilitating the spread of infection. All dogs in contact with or bitten by a rabid dog and those newly imported into a locality should be muzzled and kept under proper control for a period of six months even if anti-rabic treatment is given.

Destruction desirable. It is highly desirable to destroy all animals bitten by rabid dogs and to discourage curative vaccination, particularly when the animal is badly bitten, especially round the head as such dogs may develop rabies even if vaccinated and may thus be in an infective state before the completion of the process of immunization and therefore a source of danger to the owner, his family and attendants. Sometimes infection with a more highly virulent strain of virus cannot be suppressed by vaccination. The treatment thus creates a false sense of security. If in the case of valuable pet animals, it is desired by the owner to have anti-rabic vaccination carried out in spite of the above mentioned risk and expense, it is necessary that the bite should be thoroughly disinfected and cauterized. The vaccination (curative) may be carried out at the nearest veterinary hospital with a vaccine issued by the Pasteur Institute or any Government veterinary Institution in India. The usual time available for treatment after infection varies from 17 days for individuals bitten on the head to a period of two or three months for bites on the lower extremities. During this incubation period of 'street virus' active immunization with 'fixed virus' incorporated in the vaccine should be carried out with a view to aborting the infection. It is curative in the sense that it extinguishes the infection. The sooner this protective vaccination is undertaken after exposure to infection the greater will be the chances of success.

It should be made legally binding on the owner or person in charge of the animal infected with rabies or suspected to be so infected to report the matter to the local veterinary or public health officers. It is necessary that the carcasses of all such animals should be properly disposed of either by cremation or deep burial with a layer of lime and the premises, fitting, utensils, etc., should be thoroughly disinfected.

Preventive vaccine. The prophylactic or preventive vaccine referred to above is of the greatest importance in the control of this disease in the country like India, where it is widespread. The experience gained in this method of control by other countries where similar conditions exist is worth mentioning here. In Japan out of approximately 260,000 dogs vaccinated by the method of Umeno and Doi, only 169 contracted the disease during the year following vaccination, while 5,881 cases occurred among the unvaccinated dogs. It has further been shown that a significant decrease has occurred in the number of persons bitten and in the number of deaths from rabies after systematic vaccination by this method. Similar claims with regard to the reduction of the incidence of this disease by use of this vaccine have also been made by workers in the U. S. A.

In selecting a suitable vaccine one should see that it is :

- (1) Efficacious (early conferment of durable immunity after vaccination).
- (2) Safe (properly attenuated, producing no injurious effects such as the development of the disease or post vaccinal paralysis, etc.).
- (3) Easy to manufacture
- (4) Easy to use (one-dose vaccine preferable to others).
- (5) Of fairly long keeping quality (to enable transshipment in a potent state, from the place of manufacture to far off places).

Umeno and Doi's single dose vaccine (glycerinated carbolized) referred to above fulfils these conditions, but its manufacture and quality have yet to be tried in India using the local strain or strains of the virus and with such modifications as may be necessary to suit local conditions. In the absence of this vaccine the following vaccines which are available in the market and have been extensively used by the author with satisfactory results are recommended:—

- (1) Anti-rabic vaccine prepared at the Central Research Institute, Kasauli.

The oldest method is that of Pasteur which consists of a number of injections, usually seven with a 6 per cent brain emulsion prepared from sheep's brain with $\frac{1}{2}$ per cent carbolic. The writer has used this method both as curative and prophylactic for years with encouraging results. Post vaccinal paralysis has been reported in certain cases by others, but I have never come across one in my many years' experience. The immunity lasts for six months.

- (2) Mulfor's rabies vaccine prepared in America.

It is chloroform killed rabies vaccine containing 33 $\frac{1}{2}$ per cent of rabid brain and cord tissue. This is a single dose treatment and the immunity is claimed to last for a year. The writer has carried this out on a large scale for years with very good results.

- (3) Anti-rabic vaccine prepared at the Punjab Veterinary College, Lahore.

It is a simple and suitable vaccine prepared from an emulsion of a rabbit's brain and consisting of a 2 per cent brain emulsion in normal saline with carbolic acid.—*Indian Farming*, Vol. 3, No. 4, April 1942.

Agricultural Engineering in India.

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Who is an agricultural engineer? By American practice the term is applied only to those who have pursued a definite course of training in engineering and its application to agriculture. In England, apparently so far as I can judge by literature coming to me, an agricultural engineer is one who is engaged in the marketing of agricultural implements or in their manufacture and the term does not depend on what training the individual may have had, if any at all, other than experience. So far as I can determine, in India the term is applied to any engineer without regard to the branch of engineering in which he may have been trained who is assigned to a post carrying the title of 'Agricultural Engineer' usually in Government service.

Early experiments. The early agricultural departmental organization made no provision for agricultural engineering. The men appointed were administrators from the civil service, biologists and plant breeders, or agriculturists. Many of them were exceedingly capable men and laid very fine foundations for the splendid work which has been done since. None of them was an engineer and indeed the idea of the Agricultural Engineer, had not yet emerged in the west.