ON THE NATURE OF RABIES AND ANTIRABIC TREATMENT.

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I. INTRODUCTION.

THE present outbreak of rabies in England is sufficient justification for the publication of an article on the salient points connected with rabies and antirabic treatment.

In this article I purpose to deal with the subject mainly from a practical point of view, so that whatever information it contains may be available in giving practical advice and prophylactic treatment to those bitten or infected by rabid animals. With this object it is not necessary to enter into every detail connected with rabies; neither is it necessary to give a description of the symptoms of rabies in dogs or hydrophobia in man, as these subjects are fully dealt with in the textbooks.

The fact that the prevention of rabies and hydrophobia is, comparatively speaking, easy of accomplishment in island countries like the British Isles, and that cure or recovery when the disease has become developed has, as far as we know, never taken place, adds to the importance of a dissemination of knowledge on the subject. The truth of the saying that "prevention is better than cure" is nowhere better exemplified than in rabies.

"Rabies" is the term used when animals suffer from the disease, and "hydrophobia" when it has been communicated to man. At present there is a tendency to apply the term "rabies" to man and animals rather than to make a misleading distinction by using two names; besides, the term "hydrophobia" conveys a wrong impression of the disease in man; the dread of water is only in evidence when the patient attempts to swallow water or any other fluid, owing to the fact that such attempts bring on paroxysmal spasms of the muscles involved in swallowing; attempts to swallow solids act in the same way.

In Pasteur's prophylactic treatment of persons infected by rabid animals, we speak of it as "antirabic treatment." A dog or other animal we speak of as "rabid," and sometimes as "mad." The term "mad" applied to some animals, or to man, would probably convey a different meaning altogether. For example, "mad bull" or "madman" would not suggest the condition being due to rabies; whereas in the case of the dog, cat, jackal, or wolf it would suggest rabies.

The point is, that whether we speak of the disease as rabies in animals or hydrophobia in man, the cause is the same in both cases; and on this account it would perhaps be better to use the terms "rabies" and "rabid"—words more suggestive of the cause and condition in man and animals. The French use the term *la rage* for man and animals, and speak of "*rage du chien*," "*rage de l'homme*," etc.

II. THE NATURE AND LOCALIZATION OF RABIES VIRUS.

All warm-blooded animals are susceptible to rabies. When the disease is referred to in the British Isles, in 99 cases out of 100 it means an infection of dogs, but we have also to reckon with cats, horses, cattle, foxes, deer, pigs, and sheep.

In some parts of the continent of Europe (especially in Russia) wolves are an important factor in keeping up the disease, and in India and other Asiatic countries in addition to wolves we have jackals, monkeys, and other wild animals, as well as numerous ownerless dogs. For the practical purposes of this article it will suffice to confine our attention to what happens when dogs are infected with rabies, as they are the big outstanding source from which the disease is kept up in all countries, and practically the only source as far as the British Isles are concerned.

Rabies is a specific infectious disease; the cause of which has not yet been discovered. The saliva of man and animals suffering from rabies contains the infective agent; hence the danger of bites from rabid animals, or of their

saliva coming in contact (directly or indirectly) with wounds, scratches, or abrasions. Infection cannot take place through the unbroken skin, but it may take place through a mucous membrane, injured or uninjured.

In addition to being present in the saliva—which means that it is present in the salivary glands—infection is always present in the brain, medulla, spinal cord, cerebrospinal fluid, and large nerves of man and animals suffering from rabies. It has been found in the pancreas and mammary glands, and, I believe, also in the suprarenal capsules and spleen in some cases of rabies. It is a disputed point whether the virus has ever been found in the blood stream. I have inoculated many rabbits subdurally with blood taken from animals suffering from rabies, and also from cases of hydrophobia, and the results have invariably been negative. Pasteur's experiments with the blood also gave negative results. Recent experiments by Remlinger,¹ which confirm similar facts published by Konradi, seem to prove that placental transmission can occur.

The saliva of a dog may be infective for as long as five days, and in a few cases it has been found to be infective for six to seven days before any outward symptoms of rabies developed. These are points which should be taken into consideration in giving or refusing antirabic treatment to persons bitten or licked on scratches or abrasions by dogs apparently healthy at the time, but which later developed symptoms of rabies.

Pasteur in one of his early communications laid stress on the early infection of the salivary glands in dogs about to become rabid; he thought the explanation might be that the virus reached these glands from the nerve centres by way of the nerves which supply them.

"Virus" is a convenient term to use in connexion with any disease-producing material about which we know little or nothing.

Rabies virus we know is present in the tissues and localities I have already mentioned when man or animals suffer from rabies; material from any of these sources when inoculated into animals is capable of conveying the disease. We also know that it is very sensitive to heat; a temperature of 50° C. is sufficient to destroy it in fifteen minutes; it remains active for months in neutral glycerin, and for a considerable time at freezing temperature. The chemical bactericidal agents generally in use act injuriously on rabies virus.

In some animals it is more virulent than in others; in rabbits, for instance, after a series of passages from animal to animal, it takes on its most virulent form, and then remains at a fixed virulence; in this condition it is known as "Pasteur's fixed virus," or "*virus fixe*"; on the other hand, its virulence is diminished when a series of passages are made through monkeys.

Advantage is taken of its fixed virulence in rabbits, in the preparation of rabies virus of a fixed strength, or, in other words, "rabies vaccine." It is a filter-passing virus as far as Berkefeld filters and filters of a medium porosity are concerned, but a very fine porcelain filter prevents its passage.

Up to the present all attempts to grow it on artificial media or to stain and demonstrate it under the microscope have not been accepted as successful; on this account, when preparing a vaccine for antirabic treatment, we are obliged to have recourse to the nerve centres of rabbits which have succumbed to rabies after inoculation with fixed virus, where it is found in sufficient quantity and free from contamination.

Whether the bodies found in the brain and medulla in cases of rabies, and generally known as "Negri bodies," are the cause of the disease, or only the result of cellular changes or alterations brought about by the rabies virus, has not yet been finally decided; the balance of opinion inclines to the view that they are cellular changes brought about by the virus. These bodies, which are described and figured in bacteriological textbooks, are found in the brain and medulla in a very high percentage of rabid dogs, possibly in 95 per cent. or more; they are also found in the human brain in cases of hydrophobia, but I am not aware that they have ever been found in the salivary glands or saliva of man or animals suffering from rabies. They are most easily found in the cells of the cornu ammonis of the hippocampus major, or in the Purkinje cells of the cerebellum, in sizes varying from 25 μ to minute dots which are just visible when stained and looked at under a

magnification of 1,000 diameters. Only the smallest of these bodies could be looked upon as "filter passers."

Their presence in marked numbers in the brain of a dog or other animal suspected of rabies is diagnostic of the disease; on the other hand, they may be absent in the very early stages of rabies, or possibly so small and few in numbers as not to be found without great difficulty. Bodies indistinguishable from Negri bodies have been found in the brain cells and fascia dentata in conditions other than rabies. Harvey and Acton,² experimenting on healthy guinea-pigs with Russell's viper venom, living *pyocyaneus* emulsion, and the brain matter of a healthy dog which had been preserved in glycerin for seventy-two hours, found bodies indistinguishable from Negri bodies in the brain cells and fascia dentata of a number of the animals experimented on. They quote Babes as having found bodies very analogous to Negri bodies in the spinal ganglion cells of three cases dying from arsenical poisoning; and Pace as having found Negri-like bodies in three persons who died of old age, cerebral embolism, and aortic disease respectively. These authors are of the opinion that

Negri bodies are not truly specific of rabies; at the same time, we must state that in none of the above experiments have the Negri bodies been either so numerous or so large as those seen in rabies. As far as these experiments go we should feel inclined to assert—specificity apart—there is undoubtedly a very high correlation between the presence of numerous Negri bodies and rabies. Thus their presence forms a valuable, if not absolute certain, test for rabies. If they are few in numbers or absent no definite conclusion can be drawn.

The virus of the dog, jackal, or wolf is generally referred to as "street virus." This virus, when inoculated subdually on to a rabbit's or dog's brain, has an incubation period of about fourteen days; in some cases it may be a day or two more or less. When carried on from rabbit to rabbit (using the brain matter or medulla) the virus increases in virulence and the incubation period diminishes until it reaches a fixed period of from six and a half to seven days for these animals; this is known as "fixed virus" (Pasteur's *virus fixe*). The number of passages required to obtain this fixed virulence for the rabbit may vary from twenty or thirty to as many as fifty. "Fixed virus" treated in various ways is used for immunizing persons bitten by rabid animals, or, in other words, for antirabic treatment. It will only be possible to fill in the gaps in our knowledge about rabies virus when its isolation and growth in pure cultures outside the animal tissues has been accomplished.

III. RABIES IN DOGS.

Typical cases of rabies in dogs have been so often and fully described by veterinary authorities that there is no necessity for me to chronicle the many and varied symptoms in rabid dogs,* but it is important to remember that rabies in dogs is not always typical.

In all animals susceptible to rabies the disease manifests itself in one of two forms—namely, "furious," or delirious rabies, and "dumb," or paralytic rabies. In rabbits (with rare exceptions) it assumes the paralytic form, but in dogs and other animals the majority of cases are of the furious form. Paralysis, exhaustion, and asphyxia are the closing symptoms in all forms of rabies.

In dogs, when it assumes the paralytic form, the predominant symptoms are muscular weakness and depression, and the animal shows no tendency to bite. This form is sometimes mistaken for distemper; the lower jaw drops, saliva dribbles from the mouth, and the animal is unable to swallow—a symptom which sometimes gives rise to the suspicion of a bone in the dog's throat. I have known more than a dozen cases of infection of Europeans in India by scratching their hands on the teeth of dogs suffering from dumb rabies when searching for a bone in their throat. At other times the disease at the outset is masked and takes on the form of restlessness and a disinclination for food, and no tendency is shown to bite until a later period, and sometimes not at all. In some cases the animal may remain tame and unaggressive until the end, unless irritated or interfered with. These are the cases in which infection by licks on wounds or abrasions of the hands or face is likely to occur.

IV. MODE OF INFECTION.

The virus of rabies implanted in the wound by the bite of a rabid animal, or by the saliva coming in contact with wounds, scratches, or abrasions, reaches the nerve centres (brain and spinal cord) by growing along the nerves from the seat of infection. On reaching the nerve centres a period of fourteen days or thereabouts elapses before the first symptoms set in.

The period taken by the virus in reaching the nerve centres is variable, and depends on many factors, such as individual susceptibility, whether few or many or large nerves have been infected, amount of virus implanted in the wound; and this, again, would depend on the number, depth, and seat of the bites, whether through clothing, etc. When bites are on the head, face, or neck, the virus has only a short distance to grow along the nerves before reaching the brain; on other parts of the body the distance is greater according to the seat of the bites.

The object aimed at in antirabic treatment is to confer an active immunity against rabies before the virus of the animal which inflicted the bite reaches the nerve centres; when this has been accomplished the failures rarely exceed 0.5 or 0.8 per cent., and they may be even less than 0.5 per cent. On the other hand, should the virus have already reached the nerve centres by the time the patient has arrived for treatment, there will be no symptoms to show that this has taken place, but hydrophobia will set in fourteen days afterwards, irrespective of whether he receives treatment or not. Again, to take another example: should the virus reach the brain one day before treatment is completed, the patient will develop hydrophobia thirteen or fourteen days afterwards, and during this interval he will probably not have a single symptom to show that the object of treatment was defeated one day before completion.

In order to follow the meaning of the examples I have given it is necessary to remember:

1. That the incubation period of the virus of a rabid dog ("street virus") is fourteen days or thereabouts when inoculated on to the surface of a dog's or rabbit's brain.
2. That when rabies is inoculated on to the surface of an animal's brain, no subsequent antirabic treatment will prevent the onset of the disease, and presumably this fact would apply in the case of man.
3. That antirabic treatment extends over a period of from fourteen to twenty-one days, according as to whether light, medium, or intensive treatment is carried out.

As the time occupied by the virus in reaching the nerve centres is variable, depending on the factors I have already mentioned, the importance of early treatment is evident. By treatment I mean local treatment of the seat of infection and subsequent antirabic treatment.

V. TREATMENT OF BITES BY RABID ANIMALS.

When a person is bitten or infected by a rabid animal it is most important that the wounds or seat of infection should receive early attention, with the object of getting rid of as much of the virus as possible.

Proper attention to the wound means cauterization at the earliest possible moment. Undiluted carbolic acid is the most efficient and least painful application; it should be well swabbed into the wound, and washed out with water immediately afterwards so as to prevent destruction of tissues. Carbolic acid has the advantage of penetrating into the crevices of a wound, and is not prevented from doing so by fatty tissue. Crude phenol also answers very well, and so does undiluted izal, lysol, or somewhat similar preparations, and iodine. Caustic soda, caustic potash, or silver nitrate are fairly good when well rubbed into the recesses of the wound, but they cause considerable pain. Nitric acid and the red-hot iron are barbarous methods and should never be used.

Cauterization, when thoroughly carried out within half an hour of the infliction of the bite, will prevent hydrophobia in many cases, but not in all. It is reputed to do some good up to eight or ten hours, but it is probably not much good after three to four hours, and is certainly no good after twenty-four hours.

When the tissues around the wound are excised there is always the danger of the virus in the original wound infecting the larger wound made by the excision. When a

* A clear and graphic account of the subject is to be found in Mr. Frank Karslake's monograph on *Rabies and Hydrophobia: their Cause and Prevention*, published by W. and G. Foyle, 121 and 123, Charing Cross Road, London, W.C.2; 1919; price 1s.

person sucks the wound there is the possibility of the virus infecting the lips or gums. If there be nothing available at hand for cauterization, it is better to wash the wound with any antiseptic lotion, or even with hot or cold water, than to do nothing at all. When washing is done early and thoroughly a certain amount of the virus is washed out. It will be gathered from what I have said that cauterization or other forms of local treatment cannot be relied upon to prevent infection in all cases, but when carried out early and efficiently the virus in the wound may be diminished, the chances of infection diminished, the incubation period prolonged, and treatment made easier and more certain of success. This is the best that can be said for any form of local treatment.

VI. PRECAUTIONS WHEN A PERSON IS BITTEN BY AN APPARENTLY HEALTHY DOG IN A RABIES-INFECTED AREA OR COUNTRY.

In any rabies-infected area or country bites from apparently healthy dogs should receive the same local treatment as laid down for the bites from rabid dogs, for the following reasons:

The saliva of a dog about to become rabid is infective for a few days before it shows any apparent symptoms of the disease, and consequently during this period its bites or licks on scratches or abrasions are capable of transmitting rabies. In probably all cases the saliva is infective for two to three days, but it may be infective for five to six days, and in some cases even longer, but I am not aware that it has ever been proved to be infective for nine or ten days before the disease declared itself by the manifestation of outward and apparent symptoms, although longer periods (thirteen and fourteen days) have been mentioned.

The practical application of these facts, in addition to the local treatment recommended, suggests the following precautions:

1. The dog should not be destroyed, but should be kept under control and close observation for a period of ten days from the date of the bite, and in the event of any symptoms of ill health or departure from its normal habits, a report should be made to the police at once. If at the end of the ten days' observation period the dog is still healthy and free from any symptoms of rabies, the person bitten has nothing to fear as regards infection; even though the animal should develop rabies on the eleventh day or on any subsequent date, no antirabic treatment would be required.

2. If the dog showed signs of rabies within ten days from the date of inflicting the bite, the person bitten should receive antirabic treatment as soon as possible after the condition of the dog had declared itself.

3. A person severely bitten on the head, face, or neck would not be justified in waiting ten days to know whether the animal was infective or not. A delay of ten days, or even four to five days, in a case of that kind might be disastrous, as it might then be too late for successful treatment; the safest course to adopt in such cases would be to commence antirabic treatment at once, and as soon as it became evident that the dog was not infective leave it off. In a rabies-infected district a person bitten by a stray dog which subsequently disappeared and was not again seen or heard of should receive antirabic treatment as a precautionary measure.

4. It is evident that in a rabies-infected area it would be a mistake to destroy a healthy looking dog immediately after it had bitten any one, because then all information regarding his condition would be lost unless the carcass or a portion of the brain was sent to a laboratory for experimental tests, which would mean a delay of from four to five days, up to a period of three weeks, or possibly longer, according as to whether Negri bodies were looked for and found, or the inoculation of an animal carried out.

VII. INCUBATION PERIOD OF RABIES.

Rabies virus only gives rise to rabies when it multiplies in the nerve centres. The variable factor in the incubation period is the time taken by the virus in reaching the nerve centres by the nerve paths from the seat of infection; once it reaches the nerve centres the period is limited to fourteen days or thereabouts.

It will be seen that the earliest period at which a man or animal bitten by a rabid animal could show any symptoms of hydrophobia or rabies would be fourteen

days after being bitten; and it could only be fourteen days provided the rabid animal implanted the virus on to the surface of the brain, which is scarcely conceivable. The disease manifests itself offtest in the course of the second or third month after infection, less frequently after the third month, and rarely after the sixth month. The nearer to the brain the wounds are situated, the shorter the incubation period; hence the serious importance attached to bites on the head, face, or neck, especially when they are multiple, severe, and lacerated. Multiple and deep bites through the exposed skin on other parts of the body where nerves are numerous may have an incubation period not much longer than a similar class of wounds on the head, face, or neck.

When the bites are slight, and only a small amount of virus implanted in the wounds, the incubation period may be prolonged up to five, six, or even nine months, and possibly longer. Individual susceptibility and the early and vigorous treatment of the wounds are also factors in the incubation period. These facts also apply to dogs and other animals when bitten by rabid animals.

It is quite possible that the bite from a dog which was apparently healthy, and which remained healthy, might be blamed for giving rise to hydrophobia in the person bitten. This might happen in the following way: A person with slight scratches or abrasions, when handling a dog with paralytic rabies mistaken for distemper, might easily get infected with the saliva and think nothing more about it, as the dog was thought to have had distemper. Or he might be licked on the hands by an apparently healthy dog whose saliva was infective before showing symptoms of rabies, and not hear anything more about the animal. In the event of his contracting hydrophobia from either source the incubation period would (in all probability) be prolonged. In the meantime he gets bitten by a dog which is apparently healthy and which remains healthy; a few weeks afterwards he contracts hydrophobia. The verdict of most people in a case of that kind would be, "A case of hydrophobia from the bite of a healthy dog." Or suppose the hands got infected in the way I have described, and the subsequent bite from a healthy dog not to have happened, the verdict might be, "A case of hydrophobia without any record of infection." Most cases of alleged very prolonged incubation periods in hydrophobia can be explained by subsequent infections which have not been noticed.

VIII. CHANCES OF INFECTION WHEN BITTEN BY RABID ANIMALS.

It is very difficult to get reliable statistical evidence, partly because some of the animals which inflicted the bites may not have been rabid; in other cases the observations of persons bitten may not have been carried out for a long enough period. The percentages given vary from 16 per cent. to over 60 per cent. I take it that the truth lies somewhere between these two extremes.

When the bites are inflicted through the exposed skin, and are severe and multiple, especially on the head and face or neck, the percentage of infections will be very high, possibly 60 per cent. or more. Bites on the same localities, but single and slight, will give rise to a much lower percentage of infections, and bites through the clothing (unless very severe and the animal has held on and bitten savagely) will give a lower percentage still, and may not be over 16 per cent.

Local treatment has also to be taken into consideration, and so has the biting animal. Wolves and jackals have longer teeth than dogs; they bite more savagely, and by a series of successive snaps, and often spring at the face and neck; besides, the fact that a stray jackal or wolf approaches a human being is almost conclusive proof that the animal is rabid. The percentage of infections following the bites of these animals is very high.

The percentage of infections in a cold or temperate climate is lower than in tropical climates. When the body is only partially covered with a thin cotton garment leaving the legs and arms exposed, there is very little protection against the bites of rabid animals, especially wolves or jackals. I have known of an instance in which a rabid dog bit 15 Indians in a village in the Punjab; 8 came for treatment to the Pasteur Institute, Kasauli, and 7 remained in their village; within three months 5 out of the 7 who remained behind died from hydrophobia; the 8 treated cases remained well. In another instance a doz

bit three Indians in Calcutta; one came to Kasauli for treatment and the other two remained in Calcutta; the treated patient remained well, but the other two died from hydrophobia within two months.

I give these two instances as illustrative of the want of protection afforded by scanty clothing in tropical climates. On adding both sets of figures we get 18 persons bitten by rabid dogs—9 received antirabic treatment and remained well, and of the remaining 9 who were not treated, 7 died from hydrophobia within three months. It would be a mistake to reason from these few cases that 7 out of 9 persons bitten by rabid dogs in Europe, and not treated, would contract hydrophobia; probably not more than 2 would.

It would serve no useful purpose to quote an array of statistics which vary from 16 per cent. to over 60 per cent., but it may be of interest to refer to three sets of figures compiled by the French before Pasteur's antirabic treatment came into operation.

Renault³ gives the percentage of deaths as being one-third of the total number bitten. Bouley³ and the Comité d'Hygiène collected 383 cases between 1862 and 1872 with 180 deaths = 47 per cent.

Comité d'Hygiène,³ Years 1862-72.

	No.	Deaths.	Percentage.
Bites on the face	50	44	88.0
Bites on the hands	113	76	67.25
Bites on the trunk	22	7	31.81
Bites on the arms	40	12	30.0
Bites on the legs	33	7	21.21
Multiple bites (face, hands, etc.) ...	8	6	
Total	266	152	

It is not stated whether the bites on the trunk, arms, and legs were through the clothing, or whether the wounds received local treatment, or whether they were light or severe. Presumably the bites on the trunk, arms, and legs were through clothing, and it will be noticed that the percentage of deaths in these cases is much lower than in the hands and face cases.

Suzor says that while these figures are not an exact expression of facts, they are of great use in indicating in what direction the truth lies.

IX. RABIES IN MAN (HYDROPHOBIA).

When rabies has developed in man it is generally referred to as hydrophobia. A clear description of a very typical case is given in the *BRITISH MEDICAL JOURNAL* of June 28th, 1919, pp. 795-796, by Sir P. J. Freyer, K.C.B., Colonel I.M.S.(R.). I have seen many cases in India to which this description would apply in every detail, except in regard to the incubation period. An incubation period of eighteen months is exceptional, but there is no denying the fact that it is possible.

There are, however, some cases which might be referred to as atypical, and which conform more or less to the paralytic form of rabies in animals. Gradually increasing paralysis takes the place of the paroxysms seen in typical cases, and sooner or later the muscles of respiration and the heart are involved. Death in these cases comes on more gradually than in those in which there is excitement and paroxysms, and the duration of the illness may be a day or two longer.

In India I have seen several cases amongst Indians in which the symptoms were so masked that a casual observer might well mistake them for an ordinary attack of malaria. The patients covered themselves up in bed, refused food and drink, and implored to be left alone; exposure by removal of the blankets brought on slight paroxysms, which soon disappeared when the blankets were replaced; the expression on the face differed from what we find in malaria, and they were unable to swallow any fluids. I have only known the disease to assume this form in Indians who were weak, anaemic, and debilitated.

There are a few early symptoms which I have never known to be absent—namely, an increase of temperature,

a feeling of unrest, and an appearance of excitement about the eyes and face, and, most diagnostic of all, inability to swallow fluids. At this stage patients may ask why they are unable to swallow, stating at the same time that they are feeling quite well.

Pain in the region of the bite, or in the limb on which it is situated, may or may not be present, but is probably more often present. I have known it to be complained of in cases severely bitten and who successfully underwent a course of antirabic treatment and remained well.

It has not been established that recovery ever takes place in rabies of man or animals. Cases of alleged cure or recovery in man are accounted for by a simulation of hydrophobia known as "spurious hydrophobia," "lyssa-phobia," "pseudo-hydrophobia," "hysterical hydrophobia," and possibly other names. I have only seen one case of this kind.[†]

When I was Director of the Pasteur Institute of India, Kasauli, a Eurasian medical student was bitten by a rabid dog on May 15th. The bites were deep, at the base of the left thumb. He came under antirabic treatment three days after he was bitten. On May 22nd, seven days after the bite, he suddenly complained of pain in the throat and chest, difficulty in swallowing and speaking, became delirious and suddenly ran out of the room, saw a dog on the road and immediately ran back in a state of panic. Two hours later his whole aspect was one of extreme terror—eyes widely open; the pupils were dilated and the breathing rapid and laborious; temperature 101.8°, and pulse 120; answered questions with difficulty; complained of great pain in the throat, and after speaking a word or two would roll back on the bed, grasping at his throat with the appearance of suffering the acutest agony from pharyngeal spasms. He constantly asked for water, and when it was brought to him attempts to drink brought on violent pharyngeal spasms, and he dashed the cup away and rolled back on the bed clutching at his throat and groaning. Altogether he was in a condition which might have been mistaken for true hydrophobia.

It was noticed that the examination of his throat with the aid of a tongue depressor could be made with ease and failed to bring on any pharyngeal spasms, an almost impossible and cruel proceeding in a case of true hydrophobia. It was also noticed that the pharyngeal spasms did not spread into one of tetanoid spasms of the respiratory muscles such as we see in the height of the symptoms in hydrophobia.

There was also the fact that the attack had developed with unheard of rapidity, and without any premonitory symptoms, so that in two hours from the commencement he was in the condition somewhat resembling that of a true hydrophobia case on the second or third day of his illness. The most important source of information, and one which threw a flood of light on the diagnosis, was derived from the fact that he had been bitten only seven days previously, and hydrophobia contracted from a bite at that time was out of the question. Then came the difficulty of excluding an anterior infection. There was no history of such an infection, but there was a bare possibility of it from the fact that the patient had within the last year seen and helped to attend three cases of hydrophobia in the hospital where he was a student. Taking all the facts and symptoms into consideration, we diagnosed the case as one of "spurious hydrophobia," and subsequent events proved that this was correct. The patient was given bromide and chloral, kept in bed for a day, when his symptoms gradually disappeared, and the day after his antirabic treatment was continued and completed in due course, and without any untoward incident.

Some two or three weeks after he returned to his home I had a telegram from his medical attendant informing me that "Mr. — has contracted hydrophobia; can anything be done?" I replied by telegram, explaining what had happened in Kasauli, and a few days afterwards I had a letter from the medical attendant, explaining that he had made a mistake in diagnosing the case, and that his patient was now quite well and at his work.

I give this case as an example of what might be mistaken for hydrophobia and recovery.

In most cases of hydrophobia, towards the end of the disease, getting rid of theropy saliva from the mouth and throat is a troublesome symptom, and attendants on patients should be warned about its infectivity. It gets on to the patient's hands, and when in a paroxysm he may scratch his attendants, or cough or expectorate on to their faces. These are possible methods of infection which would suggest themselves to any medical man attending a case.

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- ¹ Contribution à l'étude de l'hérédité de la rage; *Annales de l'Institut Pasteur*, vol. xxxiii, p. 375; 1919. ² *Parasitology*, 1911, vol. iv, pp. 255-272. ³ Dr. Renaud Suzor: *Hydrophobia and Pasteur's System*; 1887; London, Chatto and Windus.

(To be continued.)

[†] Described in the *Lancet*, July 18th, 1903, by Captain W. S. Harrison, who was then my assistant.