

(*Chrysotis ochrocephala*) from Guiana, deposited; six Chinchillas (*Chinchilla lanigera*) from Chili, a Burrowing Owl (*Speotyto cunicularia*) from Buenos Ayres, two Hoopoes (*Upupa epops*), British, a Gould's Monitor (*Varanus gouldi*) from Australia, purchased; two Mule Deer (*Cariacus macrotis*), a Yellow-footed Rock Kangaroo (*Petrogale xanthopus*) born in the Gardens; two Blood-breasted Pigeons (*Phlogœnas cruentata*) bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

RELATIVE POSITIONS OF THE PRINCIPAL STARS IN THE PLEIADES.—We have received vol. i., part 1, of the Transactions of the Astronomical Observatory of Yale University, containing an important paper by Dr. W. L. Elkin, giving the results of his researches with the Yale heliometer on the relative positions of sixty-nine stars situated in the above-mentioned group. The work consists, in reality, of two independent triangulations: one resting on measurements of the distance of each star in the group from each of four stars situated near its outer limits, so that nearly the entire group is inclosed symmetrically by the quadrilateral formed by them; the other resting on measurements of distance and position-angle from Alcyone, the central star of the group. These two independent determinations are in very satisfactory agreement, and Dr. Elkin has thus furnished a most accurate catalogue, for the epoch 1885, of the relative positions in R.A. and declination of these sixty-nine stars. For comparison of his results with the Königsberg places for 1840, Dr. Elkin has adopted the corrections to the latter resulting from Prof. Auwers's researches, and brought up the newly reduced places to 1885, exhibiting the comparison in the form of apparent displacements in R.A. and in declination, the place of Alcyone being made identical in both series. For the six largest cases of relative displacement there is a remarkable community both of direction and amount of apparent motion, and it is remarkable that this general drift is very similar to the reversed absolute motion of Alcyone as given by Newcomb. For two of the stars, Bessel's Nos. 14 and 35, the coincidence is, in Dr. Elkin's opinion, sufficiently close to warrant the deduction that these two stars at least do not belong to, but form only optical members of, the group. It is possible, if not probable, that the other four should also be placed in the same category. The general character of the internal motions of the group appears, however, to be extremely minute, and Dr. Elkin thinks that the hopes of obtaining any clue to the internal mechanism of this cluster seem not likely to be realized in the immediate future. Dr. Elkin also compares his results with the micro-metrical measures of M. Wolf at Paris and of Prof. Pritchard at Oxford, and arrives at the conclusion that "the use of the filar micrometer for such large distances as those under consideration is likely to be accompanied with considerable casual error, and, unless great care is taken, with large systematic error. The conclusions of Messrs. Wolf and Pritchard as to the relative motions in the group have thus been unfortunately vitiated, and must be replaced by those formulated" in Dr. Elkin's most able paper.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1887 JULY 10-16.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 10

Sun rises, 3h. 57m.; souths, 12h. 5m. 1'7s.; sets, 20h. 13m.; decl. on meridian, 22° 16' N.; Sidereal Time at Sunset, 15h. 27m.

Moon (at Last Quarter on July 13) rises, 22h. 32m.*; souths, 3h. 51m.; sets, 9h. 19m.; decl. on meridian, 8° 32' S.

Planet.	Rises.		Souths.		Sets.		Decl. on meridian.
	h. m.	h. m.	h. m.	h. m.	h. m.		
Mercury	6 14	13 40	21 6	15 33	N.		
Venus	8 10	15 10	22 10	10 57	N.		
Mars	2 21	10 42	19 3	23 59	N.		
Jupiter	13 8	18 26	23 44	9 4	S.		
Saturn	4 34	12 35	20 36	21 16	N.		

* Indicates that the rising is that of the preceding evening.

July.	h.	
12	2	Mercury at greatest distance from the Sun.
13	20	Venus at greatest elongation from the Sun, 46° east.
14	14	Mercury stationary.

Variable Stars.

Star.	R.A.		Decl.		July	h. m.	
	h. m.	h. m.				h. m.	h. m.
U Cephei	0 52'3	81 16	N.	...	12, 22	52	m
o Ceti	2 13'6	3 29	S.	...	11,		m
Algol	3 0'8	40 31	N.	...	12, 21	12	m
S Leonis	11 5'0	6 4	N.	...	13,		M
W Virginis	13 20'2	2 48	S.	...	11, 3	o	M
δ Libræ	14 54'9	8 4	S.	...	15, 23	42	m
β Lyræ	18 45'9	33 14	N.	...	12, 22	o	M
R Lyræ	18 51'9	43 48	N.	...	16,		M
δ Cephei	22 25'0	57 50	N.	...	15, 1	o	M
R Pegasi	23 1'0	9 56	N.	...	13,		M

M signifies maximum; m minimum.

Meteor-Showers.

	R.A.	Decl.	
From Hercules	271	21	N. Very slow.
Ophiuchus	280	14	S. Very slow.
Near π Pegasi	329	36	N. Swift. Red streaks.
From Andromeda	352	38	N. Swift.

REPORT OF THE COMMITTEE OF INQUIRY INTO M. PASTEUR'S TREATMENT OF HYDROPHOBIA.

THE following is the text of this important Report to the President of the Local Government Board:—

SIR,—In accordance with the instructions contained in a letter dated April 12, 1886, from your predecessor, the Right Honourable Joseph Chamberlain, M.P., appointing us to be a Committee to inquire into M. Pasteur's treatment of hydrophobia, we beg leave to present to you the following Report.

In order to answer the several questions involved in the inquiry, we found it necessary that some of the members of the Committee should, together with Mr. Victor Horsley, the Secretary, visit Paris, so as to obtain information from M. Pasteur himself, and observe his method of treatment, and investigate a considerable number of the cases of persons inoculated by him; and, further, that a careful series of experiments should be made by Mr. Horsley on the effects of such inoculation on the lower animals. The detailed facts of these observations and experiments are placed in the Appendix to this Report; a summary of them, and the conclusions which we believe may be drawn from them, are given in the next following pages.

The experiments by Mr. Horsley entirely confirm M. Pasteur's discovery of a method by which animals may be protected from the infection of rabies. The general facts proved by them may be thus stated:

If a dog, or rabbit, or other animal be bitten by a rabid dog and die of rabies, a substance can be obtained from its spinal cord which, being inoculated into a healthy dog or other animal, will produce rabies similar to that which would have followed directly from the bite of a rabid animal, or differing only in that the period of incubation between the inoculation and the appearance of the characteristic symptoms of rabies may be altered.

The rabies thus transmitted by inoculation may, by similar inoculations, be transmitted through a succession of rabbits with marked increase of intensity.

But the virus in the spinal cords of rabbits that have thus died of inoculated rabies may be gradually so weakened or attenuated, by drying the cords, in the manner devised by M. Pasteur and related in the Appendix that, after a certain number of days' drying, it may be injected into healthy rabbits or other animals without any danger of producing rabies.

And by using, on each successive day, the virus from a spinal cord dried during a period shorter than that used on the previous day, an animal may be made almost certainly secure against rabies, whether from the bite of a rabid dog or other animal, or from any method of subcutaneous inoculation.

The protection from rabies thus secured is proved by the fact that, if some animals thus protected and others not thus protected be bitten by the same rabid dog, none of the first set will die of

rabies, and, with rare exceptions, all of the second set will so die.

It may, hence, be deemed certain that M. Pasteur has discovered a method of protection from rabies comparable with that which vaccination affords against infection from small-pox. It would be difficult to over-estimate the importance of the discovery, whether for its practical utility or for its application in general pathology. It shows a new method of inoculation, or, as M. Pasteur sometimes calls it, of vaccination, the like of which it may become possible to employ for protection of both men and domestic animals against others of the most intense kinds of virus.

The duration of the immunity from rabies which is conferred by inoculation is not yet determined; but during the two years that have passed since it was first proved there have been no indications of its being limited.

The evidence that an animal may thus, by progressive inoculations, be protected from rabies suggested to M. Pasteur that if any animal or any person, though unprotected, were bitten by a rabid dog, the fatal influence of the virus might be prevented¹ by a timely series of similar progressive inoculations. He has accordingly, in the institution established by him in Paris, thus inoculated a very large number of persons believed to have been bitten by rabid animals; and we have endeavoured to ascertain with what amount of success he has done so.

The question might be answered with numerical accuracy if it were possible to ascertain the relative numbers of cases of hydrophobia occurring among persons of whom, after being similarly bitten by really rabid animals, some were and some were not inoculated. But an accurate numerical estimate of this kind is not possible. For

(1) It is often difficult, and sometimes impossible, to ascertain whether the animals by which people were bitten, and which were believed to be rabid, were really so. They may have escaped, or may have been killed at once, or may have been observed by none but persons quite incompetent to judge of their condition.

(2) The probability of hydrophobia occurring in persons bitten by dogs that were certainly rabid depends very much on the number and character of the bites; whether they are on the face or hands or other naked parts; or, if they have been inflicted on parts covered with clothes, their effects may depend on the texture of the clothes, and the extent to which they are torn; and, in all cases, the amount of bleeding from the wounds may affect the probability of absorption of virus.

(3) In all cases, the probability of infection from bites may be affected by speedy cauterizing or excision of the wounded parts, or by various washings or other methods of treatment.

(4) The bites of different species of animals, and even of different dogs, are, probably, for various reasons, unequally dangerous. Last year, at Deptford, five children were bitten by one dog and all died; in other cases, a dog is said to have bitten twenty persons, of whom only one died. And it is certain that the bites of rabid wolves, and probable that those of rabid cats, are far more dangerous than those of rabid dogs.

The amount of uncertainty due to these and other causes may be expressed by the fact that the percentage of deaths among persons who have been bitten by dogs believed to have been rabid, and who have not been inoculated or otherwise treated, has been, in some groups of cases, estimated at the rate of only 5 per cent., in others at 60 per cent., and in others at various intermediate rates. The mortality from the bites of rabid wolves, also, has been, in different instances, estimated at from 30 to 95 per cent.

To ascertain, as far as possible, the influence of these sources of fallacy in cases inoculated by M. Pasteur, the members of the Committee who went to Paris requested him to enable them to investigate, by personal inquiry, the cases of some of those who had been treated by him. He at once, and very courteously, assented, and the names of 90 persons were taken from his notebooks. No selection was made, except that the names were taken from his earliest cases, in which the periods since inoculation were longest, and from those of persons living within reach in Paris, Lyons, and St. Etienne.

¹ The terms referring to "preventive" treatment will be used for that designed to prevent the occurrence of the disease in one already infected; those referring to "protective" treatment for that designed to protect a man or an animal from the risk of becoming infected. And it may be well to state that, though the usual custom is followed of employing the name of "hydrophobia" for the disease in men, and of "rabies" for that in animals, they are really the same disease.

The notes made on the spot concerning all these cases are given in the Appendix, and they include, as far as was possible, the evidence whether the dogs deemed rabid were really so, the situation and kind of bites, the immediate treatment of them, the statements of medical practitioners and veterinary surgeons to whom any useful facts were known.¹

Among the 90 cases there were 24 in which the patients were bitten on naked parts by undoubtedly rabid dogs, and the wounds were not cauterized or treated in any way likely to have prevented the action of the virus; there were 31 in which there was no clear evidence that the dog was rabid; others in which the bite, though inflicted by undoubtedly rabid animals, having been through clothes, may thus have been rendered harmless. Among these, therefore, it is probable that, even if they had not been inoculated, few would have died. Still, the results observed in the total of the 90 cases may justly be compared with those observed in large numbers of cases similar to these as regards the uncertainties of infection, but not inoculated. The estimates published as to the mortalities in such unsorted cases are, as we have said, widely various. We believe that among the 90 persons, including the 24 bitten on naked parts, not less than eight would have died if they had not been inoculated. At the time of the inquiry, in April and May 1886, which was at least eighteen weeks since the treatment of the bites, not one had shown any signs of hydrophobia, nor has any one of them since died of that disease.

Thus, the personal investigation of M. Pasteur's cases by members of the Committee was, so far as it went, entirely satisfactory, and convinced them of the perfect accuracy of his records.

After the first few months in which M. Pasteur practised his treatment, he was occasionally obliged, in order to quiet fears, to inoculate persons who believed that they had been bitten by rabid animals, but could give no satisfactory evidence of it. It might, therefore, be deemed unjust to estimate the total value of his treatment in the whole of his cases as being more than is represented by the difference between the rate of mortality observed in them and the lowest rate observed in any large number of cases not inoculated. This lowest rate may be taken at 5 per cent. Between October 1885 and the end of December 1886, M. Pasteur inoculated 2682 persons, including 127 who went from this country. Of the whole number, at the rate of 5 per cent., at least 130 should have died. At the end of 1886, the number of deaths stated by M. Vulpian, speaking for M. Pasteur, was 31, including 7 bitten by wolves, in three of whom the symptoms of hydrophobia appeared while they were under treatment, and before the series of inoculations were complete. Since 1886 two more of those inoculated in that year have died of hydrophobia.

The number of deaths assigned by those who have sought to prove the inutility of M. Pasteur's treatment is, as nearly as we can ascertain, 40 out of the 2682; and in this number are included the seven deaths from bites by wolves, and probably not less than four in which it is doubtful whether the deaths were due to hydrophobia or to some other disease. Making fair allowance for uncertainties and for questions which cannot now be settled, we believe it sure that, excluding the deaths after bites by rabid wolves, the proportion of deaths in the 2634 persons bitten by other animals was between 1 and 1.2 per cent., a proportion far lower than the lowest estimated among those not submitted to M. Pasteur's treatment, and showing, even on this lowest estimate, the saving of not less than 100 lives.

The evidence of the utility of M. Pasteur's method, indicated by these numbers, is confirmed by the results obtained in certain groups of his cases.

Of 233 persons bitten by animals in which rabies was proved, either by inoculation from their spinal cords, or by the occurrence of rabies in other animals or in persons bitten by them, only 4 died. Without inoculation it would have been expected that at least 40 would have died.

Among 186 bitten on the head or face by animals in which rabies was proved by experimental inoculations, or was observed by veterinary surgeons, only 9 died, instead of at least 40.

And of 48 bitten by rabid wolves only 9 died; while, without the preventive treatment, the mortality, according to the most probable estimates yet made, would have been nearly 30.

¹ The Committee are much indebted to M. Arloing, Director of the Veterinary School at Lyons; M. Savary, Veterinary Surgeon at Brie-Comte-Robert; and M. Charlois, Veterinary Surgeon at St. Etienne, for assistance in their inquiries.

Between the end of last December and the end of March, M. Pasteur inoculated 509 persons bitten by animals proved to have been rabid, either by inoculation with their spinal cords, or by the deaths of some of those bitten by them, or as certified by veterinary surgeons. Only 2 have died, and one of these was bitten by a wolf a month before inoculation, and died after only three days' treatment. If we omit half of the cases as being too recent, the other 250 have had a mortality of less than 1 per cent., instead of 20 or 30 per cent.

It has been objected that the number treated by M. Pasteur, which, from October 1885 to the end of 1886, included 1929 French and Algerians, was much greater than could reasonably be supposed to have been bitten by rabid animals. But there had hitherto been no careful registration of such cases, and the numbers that have occurred in the present year are not less than in the same part of last year, when the alarm about hydrophobia was greatest.

From the evidence of all these facts, we think it certain that the inoculations practised by M. Pasteur on persons bitten by rabid animals have prevented the occurrence of hydrophobia in a large proportion of those who, if they had not been so inoculated, would have died of that disease. And we believe that the value of his discovery will be found much greater than can be estimated by its present utility, for it shows that it may become possible to avert by inoculation, even after infection, other diseases besides hydrophobia. Some have, indeed, thought it possible to avert small-pox by vaccinating those very recently exposed to its infection; but the evidence of this is, at the best, inconclusive; and M. Pasteur's may justly be deemed the first proved method of overtaking and suppressing by inoculation a process of specific infection. His researches have also added very largely to the knowledge of the pathology of hydrophobia, and have supplied what is of the highest practical value, namely, a sure means of determining whether an animal, which has died under suspicion of rabies, was really affected with that disease or not.

The question has been raised whether M. Pasteur's treatment can be submitted to without danger to health or life; and, in answering it, it is necessary to refer to two different methods of inoculation which he has practised, and which are fully described in the Appendix.

In the first, which may be called the ordinary method, and which has been employed in the very large majority of cases, the preventive material obtained from the spinal cords of rabbits that have died of rabies derived, originally, from rabid dogs is injected under the skin, once a day for ten days, in gradually increasing strengths.

In the second or intensive method (*méthode intensive*) which M. Pasteur adopted for the treatment of cases deemed especially urgent, on account either of the number and position of the bites or of the long time since their infliction, the injections, gradually increasing in strength, were usually made three times on each of the first three days, then once daily for a week, and then in different degrees of frequency for some days more. The highest strength of the injections used in this method was greater than the highest used in the ordinary method, and was such as, if used at first and without the previous injections of less strength, would certainly produce rabies.

By the first or ordinary method, there is no evidence or probability that anyone has been in danger of dying, or has in any degree suffered in health even for any short time. But after the intensive method deaths have occurred under conditions which have suggested that they were due to the inoculations rather than to the infection from the rabid animal.

There is ample reason to believe that in many of the most urgent cases the intensive method was more efficacious than the ordinary method would have been. Thus, M. Pasteur mentions that, of 19 Russians bitten by rabid wolves, 3 treated by the ordinary method died, and the remaining 16, treated by the intensive method, survived; and he contrasts the cases of 6 children, severely bitten on the face, who died after the ordinary treatment, with those of 10 similarly bitten children who were treated by the intensive method, and of whom none died; and M. Vulpian reports that, of 186 persons badly bitten by animals that were most probably rabid, 50 treated by the intensive method survived, and of the remaining 136 treated by the ordinary method 9 died.

The rate of mortality after the intensive method was not greater than that after the ordinary method; for among 624 patients thus treated only 6 died, or, counting one doubtful case,

7. But that which excited suspicion was the manner of death in some of them; and this manner was observed in a man named Goffi, sent from England. On September 4 last, he was severely bitten at the Brown Institution by a rabid cat, to which, in spite of repeated warnings, he exposed his naked hand. Twelve wounds were inflicted. They were at once treated with pure carbolic acid, and, six hours later, he was put under the influence of chloroform at St. Thomas's Hospital, the wounded portions of skin were freely excised, and the wounds thus made were treated with carbolic acid. On the same evening he was sent to Paris, and on the following morning M. Pasteur commenced the intensive treatment, and it was continued during twenty-four days. During all this time the man was repeatedly intoxicated.¹ He once fell into the Seine; and while crossing the Channel on his return home he was severely chilled.

On October 10 he returned to his work, and appeared to be in his usual health; but he became unwell, with pain in the abdomen, like colic, and with pain in the back. On the 18th he had partial motor paralysis in the lower limbs, and on the 19th complete motor paralysis of these limbs and of the trunk, and partial motor paralysis of the upper limbs and face. He was taken to St. Thomas's Hospital, where he died on the 20th.

To the last he was free from all the usual symptoms of hydrophobia, and the progress of his disease and the manner of his death were so similar to those of what is described as acute ascending paralysis, or Landry's paralysis, that a verdict to this effect was given at a coroner's inquest. But the certainty that his death was due to the virus of rabies was proved by experiments by Mr. Horsley. A portion of his spinal cord was taken to provide material for inoculations, and rabbits and a dog inoculated with it died with characteristic signs of paralytic rabies, such as usually occurs in rabbits.

In most of the other cases of death after treatment by the intensive method, the symptoms have been nearly the same as those just related; but in none of them has the same test of death from hydrophobia been applied. The likeness of the symptoms to those of the form of rabies called dumb or paralytic, usually observed in rabbits, has suggested, as we have said, that the deaths were due not to the virus of the rabid dog or cat, but to that injected from the spinal cord of the rabbit. But this is far from certain. In the case of Goffi, especially, the incubation period was such as would have followed the bite of the cat, not the inoculation of highest intensity; and the incubation period in the rabbits and dog inoculated from his spinal cord were such as have been observed after similar inoculations with virus derived, not only from rabbits inoculated in series by M. Pasteur, but from a dog, a cat, and a wolf that died of ordinary rabies. It may well have been, therefore, that the intensive inoculations in him and in the other persons who died after them were not themselves destructive, but that they failed to prevent the rabies which was due to the bites. They may also have modified the form in which the rabies manifested itself; giving it the characters of the paralytic rabies usual in rabbits, instead of the convulsive or violent form usually, but not always,² observed in man after bites of cats or dogs.

The question is likely to remain undecided; for to avoid the possible, however improbable, risk of his intensive treatment, M. Pasteur has greatly modified it, and even in this modified form employs it in none but the most urgent cases.

The consideration of the whole subject has naturally raised the question whether rabies and hydrophobia can be prevented in this country.

If the protection by inoculation should prove permanent, the disease might be suppressed by thus inoculating all dogs; but it is not probable that such inoculation would be voluntarily adopted by all owners of dogs, or could be enforced on them.

Police regulations would suffice if they could be rigidly enforced. But to make them effective it would be necessary: (1) that they should order the destruction, under certain conditions, of all dogs having no owners and wandering in either town or country; (2) that the keeping of useless dogs should be discouraged by taxation or other means; (3) that the bringing of

¹ Other cases, as well as this, have led M. Pasteur to believe that the risk of death from hydrophobia is much increased by habits of drunkenness.

² Cases of paralytic hydrophobia have been observed, though rarely, in men bitten by rabid animals, and not treated by inoculation. It may, indeed, be suspected that at least some of the cases of "acute ascending paralysis" may have been cases of this form of hydrophobia, although, in the complete absence of the usual violent symptoms, no suspicion of the source of the disease was entertained.

dogs from countries in which rabies is prevalent should be forbidden or subject to quarantine; (4) that, in districts or countries in which rabies is prevalent, the use of muzzles should be compulsory, and dogs out of doors, if not muzzled or led, should be taken by the police as "suspected." An exception might be made for sheep-dogs and others while actually engaged in the purposes for which they are kept.

There are examples sufficient to prove that, by these or similar regulations, rabies, and consequently hydrophobia, would be in this country "stamped out," or reduced to an amount very far less than has hitherto been known.

If it be not thus reduced it may be deemed certain that a large number of persons will every year require treatment by the method of M. Pasteur. The average annual number of deaths from hydrophobia, during the ten years ending 1885, was, in all England, 43; in London alone, 8.5. If, as in the estimates used for judging the utility of that method of treatment, these numbers are taken as representing only 5 per cent. of the persons bitten, the preventive treatment will be required for 860 persons in all England; for 170 in London alone. For it will not be possible to say which among the whole number bitten are not in danger of hydrophobia, and the methods of prevention by cautery, excision, or other treatment, cannot be depended on.

We have the honour to be,

Sir,

Your obedient Servants,

(Signed) JAMES PAGET, Chairman,
T. LAUDER BRUNTON,
GEORGE FLEMING,
JOSEPH LISTER,
RICHARD QUAIN,
HENRY E. ROSCOE,
J. BURDON SANDERSON.

VICTOR HORSLEY, Secretary, June 1887.

The Report is followed by appendices, two of which we reprint:—

Abstract Report of Mr. Horsley's Experiments.

The first object of the experiments was to test M. Pasteur's method of transmitting rabies by inoculation, and to compare its effects with those of rabies due to the bites of dogs found rabid in the streets.¹

Through the kindness of M. Pasteur, two rabbits inoculated by him were placed at the disposal of the Committee on May 5, 1886, and were conveyed within 24 hours safely to the Brown Institution, where the experiments were carried out by Mr. Horsley.

In these two rabbits the first symptoms of rabies appeared on May 11 and 12, and the disease followed exactly the course described by M. Pasteur.

At first the animals appeared dull, but continued to take food readily until symptoms of paralysis appeared. The first of these symptoms was commencing paralysis of motion of the hind-legs, not accompanied by any loss of sensibility. The paralysis soon extended to the muscles of the fore-legs, and later to those of the head, and the animals died comatose.

After post-mortem examination, portions of the spinal cord of each of these rabbits were crushed, according to M. Pasteur's method, in sterilized broth, and the liquid so obtained was injected beneath the dura mater into four rabbits and the same number of dogs, all being first rendered insensible with chloroform or ether.²

Of the four rabbits so inoculated, the first two showed the first symptoms seven days after the inoculation; the third and fourth on the sixth day. The symptoms as well as the incubation period exhibited by these rabbits were exactly the same as were observed in those brought from M. Pasteur's laboratory. Careful notes and photographs were taken in the case of all the animals, in order that the constant and specific nature of the disease might be demonstrated by observations during life and after death. It was also observed that during the incubation period the temperature of the body remained normal, that is,

¹ This expression is adopted from that usual in France, "*rage des rues*."

² All the experiments performed in this inquiry were thus made painless.

about 39° 4 C. With the first definite symptom the temperature rose to about 40° 4 C., which is the temperature usually observed during the first day of the obvious illness. By the next day it began to fall, and on the third day after the appearance of the first symptom it averaged 37° 5 C. On the last day it was always below normal, and on one occasion fell before death to 24° C. The animals did not appear to suffer any pain whatever in the course of the disease. They were free from the spasms which, in the earlier stages of the malady in man, form so painful a feature of the disease, and indeed the disease in them resembled throughout that rapidly fatal, but painless, disease of man known as acute ascending paralysis.

The post-mortem appearances in the rabbits were remarkably uniform. As a rule nothing abnormal, save congestion, presented itself either in the brain, spinal cord, heart, blood-vessels, or serous membranes. The larynx, pharynx, and, more especially, the epiglottis, and the root of the tongue, were frequently intensely congested. The lungs showed almost invariably capillary congestion; and sometimes small patches resembling broncho-pneumonia were observed. The mucous membrane of the stomach was very markedly congested, and there were at its cardiac extremity numerous hæmorrhages.¹ The constancy of these appearances was most remarkable, and corresponded in every particular with those subsequently observed in rabbits which had died of rabies from the bite of rabid dogs.

Of the four dogs inoculated, the first showed on the eighth day after inoculation an alteration in the voice and commencing excitement; on the following day the excitement became excessive, and the bark was quite characteristic; on the eleventh day the dog was aggressive, notwithstanding slight paralysis of the legs; on the twelfth day the paralysis had increased, and on the next day there was complete paralysis and coma, and death occurred on the fifth day after the onset of the symptoms.

The second dog showed the first symptom on the ninth day after inoculation, when it was very dull and partially paralyzed; its bark was characteristic. Next day the paralysis was almost complete, and on the twelfth day the animal died. This was therefore a case of the rapid paralytic form; whilst in the first dog the disease was of the ordinary furious form of rabies terminating in paralysis.

The third dog showed the first symptom on the ninth day after inoculation, and from that time became gradually paralyzed, and died on the sixteenth day.

The fourth dog showed the first symptom in from eight to nine days after inoculation, and during the first day was extremely aggressive; on the two following days the characteristic bark was observed; and on the twelfth day there was paralysis of the hind-legs; it died on the thirteenth day. Thus the furious form and the paralytic or dumb form of rabies were represented in equal numbers, whereas, in the usual mode of infection by biting, the former is more prevalent.

The post-mortem appearances were as follows:—The brain and central nervous system were in some of the dogs the seat of considerable congestion; in others these organs appeared normal. The serous membranes were perfectly normal; the larynx especially, and sometimes the pharynx, were congested; the lungs always congested, especially in the lower lobes; the heart normal; the blood usually fluid, occasionally with post-mortem clots; the stomach was always found to contain foreign bodies, such as straw; and its mucous membrane was congested, frequently showing numerous hæmorrhages; the small intestine was always empty, and the large glandular organs showed venous congestion.

For the purpose of exact comparison of the disease just described with that produced when rabies is communicated to the rabbit in the ordinary way, some rabbits previously narcotized with ether were caused to be bitten by rabid dogs of the streets, or were inoculated by trephining with material obtained from the spinal cord of dogs or other animals which had died of rabies, and in one instance from that of a man who had died with hydrophobia.

Four series of experiments of observations in which rabbits were bitten by rabid dogs from the streets were made. In one of them the dog by which the rabbit was bitten exhibited the dumb form, in others the furious form, of the disease. In each series excepting the first a large proportion of the rabbits died; the symptoms presenting themselves in these cases were identical with those observed in the rabbits inoculated from M. Pasteur's virus, but the duration of the symptoms was usually longer. As

¹ In some, signs of post-mortem digestion were found.

has been stated, rabbits inoculated by M. Pasteur's virus rarely show symptoms during more than three days before death, whereas the rabbits bitten by rabid dogs from the streets often live for a week after the appearance of the first symptoms.

The post-mortem appearances in the rabbits dying after having been bitten by rabid dogs of the streets were the same as those already described in rabbits inoculated with the virus from M. Pasteur's rabbits.

In the case of rabbits inoculated by trephining with the virus from animals dying of rabies of the streets, the incubation period was from 14 to 21 days. In all cases the symptoms were similar to those produced by M. Pasteur's virus, and those of rabbits bitten by rabid dogs from the streets; but in the prolongation of the disease approached more closely in character to the latter.

The results of these experiments confirm several of the chief observations made by M. Pasteur; especially—

(1) That the virus of rabies may certainly be obtained from the spinal cords of rabbits and other animals that have died of that disease.

(2) That, thus obtained, the virus may be transmitted by inoculation through a succession of animals, without any essential alteration in the nature, though there may be some modifications of the form, of the disease produced by it.

(3) That, in transmission through rabbits, the disease is rendered more intense; both the period of incubation, and the duration of life after the appearance of symptoms of infection, being shortened.

(4) That, in different cases, the disease may be manifested either in the form called dumb or paralytic rabies which is usual in rabbits; or in the furious form usual in dogs; or in forms intermediate between, or combining, both of these, but that in all it is true rabies.

(5) That the period of incubation and the intensity of the symptoms may vary according to the method in which the virus is introduced, the age and strength of the animal, and some other circumstances; but, however variable in its intensity, the essential characters of the disease are still maintained.

The certainty that the virus of rabies can thus be transmitted without essential change made it desirable, in the next place, to ascertain whether, as M. Pasteur states, it can be so attenuated that it may be inoculated without risk to life, and whether animals thus inoculated are thus made safe from rabies. The methods for this protective inoculation which M. Pasteur has employed are described.

To test them, six dogs were "protected" by injecting subcutaneously the emulsions of spinal cords of rabbits which had died of rabies; beginning with that of a cord which had been dried for 14 days, and, on each following day, using that of a cord which had been dried for one day less, till at last that from a fresh cord was used.

None of these dogs suffered from the injections; and when they were completed, the six dogs thus "protected," and two others unprotected, and some rabbits unprotected, were made insensible with ether, and were then bitten by rabid dogs, or by a rabid cat, on an exposed part.

A "protected" dog, No. 1, was bitten on July 8, 1886, by a dog which was paralytically rabid. It remains perfectly well.

An "unprotected" dog, No. 1, was bitten a few minutes afterwards by the same rabid dog, and died paralytically rabid.

A "protected" dog, No. 2, was bitten on November 6, 1886, by a dog which was furiously rabid; it remains well. At the same time, four "unprotected" rabbits were bitten by the same rabid dog, and of these two died of rabies in the usual form (*i.e.* 50 per cent. of animals bitten).

The same results followed with the "protected" dog, No. 3, and the "unprotected" rabbits, bitten at the same time. The dog still lives, the rabbits died of rabies.

The "protected" dogs, Nos. 4 and 5, were bitten on January 20, 1887, by a furiously rabid dog; and on the same day the "unprotected" dog, No. 2, and three "unprotected" rabbits were bitten by the same dog. The "protected" dogs remain well; the "unprotected" dog and two rabbits died with rabies (*i.e.* 75 per cent. of the animals bitten.)

The "protected" dog, No. 6, was bitten on three different occasions by a furiously rabid cat on September 7, 1886; by a furiously rabid dog on October 7, 1886; and by another furiously rabid dog on November 6, 1886. It died ten weeks after being bitten for the third time, but not of rabies. It had been suffering with diffuse eczema during the whole of the time

that it was under observation, and it died of this. At the post-mortem examination, no indication of rabies was found; and two rabbits, inoculated by trephining with the crushed spinal cord, showed no sign of rabies, either during life or, when they were killed several months afterwards, in any appearance after death. It was thus made certain that the dog was not rabid.

Thus, all the experiments performed by Mr. Horsley have confirmed those of M. Pasteur, and the experiments last described have shown that animals may be protected from rabies by inoculations with material derived from spinal cords prepared after M. Pasteur's method. The protection may be deemed somewhat similar to that given by the inoculation for anthrax, or by vaccination for small-pox, though the theory of the method of inoculation devised by M. Pasteur is very different from that upon which vaccination for small-pox and inoculation for anthrax is based. The further step, the prevention of rabies or hydrophobia in animals or in persons into whom the virus has already been introduced by bites or otherwise, is considered in the body of the Report.

In the course of his experiments, Mr. Horsley observed many interesting facts concerning the modification of the action of the virus according to the method of its inoculation, and the condition of the animal inoculated; but he found nothing to justify a belief that any animal not inoculated is insusceptible of rabies, or that the disease ever arises spontaneously.¹

Coincidentally with these experiments, some were made by Mr. Dowdeswell for the purpose of ascertaining whether any drugs can protect an animal from rabies. Their result is recorded in a paper read before the Royal Society, and may be summed up in the statement that rabies can neither be prevented nor influenced in its course, unless it be for the worse, by any of the drugs that were employed, including allyl alcohol, atropine, benzoate of soda, chloral, cocaine, curare, iodine (dissolved in iodide of potassium), mercuric perchloride, quinine, salol, strychnine, urethane.

*M. Pasteur's Methods of Preventive Inoculation.*²

M. Pasteur believes that the virus of rabies is a living micro-organism, and that, like some others, it produces in the tissues it invades an excretory substance by which, when present in sufficient quantity, its own development and increase are checked, as are those of the yeast ferment by the alcohol produced in the vinous fermentation. In accordance with this theory, he thinks that the spinal cords of animals that have died of rabies contain both the virus and this excretory substance which, practically, may be deemed its antidote. He believes therefore that by injections of an emulsion from such spinal cords into the systems of animals bitten or inoculated with the virus of rabies, the antidote may be able, during the period of incubation, to arrest and prevent the fatal influence of the virus. But, in order to avoid the possibility of injecting a still potent virus, M. Pasteur holds that the virus in the spinal cord must be weakened by drying the cord in a pure and dry atmosphere at a temperature of 20° C.; in which drying the efficiency of the antidote may be reduced to a much less extent than the potency of the virus. By such drying this potency may be so reduced that an emulsion of the dried spinal cord may be injected without any risk of producing rabies: and this risk is in no measure increased by the daily injections of emulsions from cords dried during a gradually less number of days, and which, though more virulent than those first used, still contain a larger proportion of the antidote than of the virus.

In accordance with this theory, the method of the preventive injections first used by M. Pasteur was adjusted in the following manner:—

Days of Inoculation.	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.
Days during which the spinal cord had been dried	14	13	12	11	10	9	8	7	6	5

In consequence of some deaths among those who had been thus treated, M. Pasteur deemed it necessary, in cases of very severe bites and of persons bitten long before the treatment

¹ The minutest facts connected with all these experiments will soon be communicated to one of the scientific Societies.

² As derived from the observations made by the Committee, and from a full description supplied by Prof. Dr. Grancher, April 11, 1887.

could be commenced, to increase the intensity of the treatment by more speedily increasing the strength of the injections, by more frequent repetitions of them, and by using on certain days spinal cords dried during only three, two, and one days. Thus in September and October 1886 he adopted the following formula :—

Days of Inoculation.	1st.	2nd.	3rd.	4th.	5th.	
Days' drying of the cords	14, 13, 12	11, 10, 9	8, 7	6, 5	4, 3	
Days of Inoculation.	6th.	7th.	8th.	9th.	10th.	11th.
Days' drying of the cords	2	1	6, 5	4, 3	2	1

In very severe and perilous cases this course was repeated even three or four times. It was distinguished as the *methode intensive*, and among such severe cases it was followed by a marked diminution of mortality. But when it appeared possible that it might be dangerous, M. Pasteur changed it for that which he now uses, and which may be thus represented :—

Days of Inoculation.	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	
Days' drying of the cords	14, 13	12, 11	11, 10	10, 10	9, 9	9	8	
Days of Inoculation.	8th.	9th.	10th.	11th.	12th.	13th.	14th.	15th.
Days' drying of the cords	8	8	7	7	7	6	6	5

The material for injection is prepared by crushing portions of the dried spinal cord, and diffusing them in sterilized broth free from all risk of putrefaction, decomposition, or any change due to the presence of other micro-organisms; and the injection is made with syringes through fine tubular needles into the subcutaneous tissue.

For transmissions of rabies through rabbits, in order to obtain the spinal cords required for its prevention in other animals, injections of virus of highest intensity are made through minute holes in the skull into the space under the dura mater or fibrous covering of the brain.

The materials for the protective inoculations are prepared in the same manner as those for the preventive, from spinal cords dried from ten days to one day.

UNIVERSITY COLLEGES AND THE STATE.

ON Thursday last, June 30, a deputation consisting of members of Parliament and others had an interview with the Chancellor of the Exchequer, who was accompanied by Mr. Jackson, M.P., to urge that Government assistance should be extended to local university colleges situated in various parts of the country. Among those present were Sir John Lubbock, M.P., Mr. Mundella, M.P., Mr. J. Chamberlain, M.P., Sir Lyon Playfair, M.P., Mr. Bryce, M.P., Mr. Arnold Morley, M.P., Mr. Jesse Collings, M.P., Mr. R. Chamberlain, M.P., Sir U. Kay-Shuttleworth, M.P., Mr. Theodore Fry, M.P., Mr. Burt, M.P., Sir Henry Roscoe, M.P., Sir A. K. Rollit, M.P., Prof. Stuart, M.P., Sir Bernhard Samuelson, M.P., Mr. Howard Vincent, M.P., Sir W. H. Houldsworth, M.P., Dr. Percival, and Sir Philip Magnus.

Sir John Lubbock, as the representative of the University of London, introduced the deputation. Their request was that a Parliamentary grant should be made to English colleges, as was already made to those in Ireland, Scotland, and Wales. The colleges on behalf of which they appeared were doing excellent work, but were greatly hampered for want of funds. The claims of these colleges were not based alone on their services to learning and study; they were calculated to contribute largely to

the material prosperity of the country. We now imported £150,000,000 worth of food annually, and our population increased at the rate of about 350,000 a year. How were so many to be fed, and how could a revival and return of trade be promoted? Our rivalry with foreign nations was now not on the battlefield but in the manufactory and the workshop; and it was none the less severe because it was a competition rather than a contest. The need of the assistance for which they asked was very pressing. Without going into details as to particular colleges, he observed that the more recent institutions were generally spending more than their income, and even the oldest and the richest were sadly crippled for want of funds. It was found practically impossible to increase the subscriptions, and local authorities, as a rule, had no power to supplement their funds. As to raising the fees so as to make the colleges self-supporting, that might be possible but would be very undesirable. He only wished the fees could be abolished altogether, for those receiving education at the colleges benefited not only themselves but the whole nation. As to the expenditure on education, it was in the opinion of some people very large, but it was small in comparison with other items. Our ignorance cost us very much more than our education. Moreover, the principle for which they contended had been conceded in regard to Scotland, Ireland, and Wales. The grants to Irish colleges amounted to £25,000, to Scotland £16,000, and to Wales £12,000. The University of Glasgow had a special grant of £150,000 for building. None of the English colleges had such aid. Their request simply was that in this matter of education England should be treated in the same way as Ireland, Scotland, and Wales.

Mr. J. Chamberlain said that he attended as the representative of Mason College, Birmingham. Their case was the same in principle as that of all the other colleges. They urged that State-aided education had been accepted in principle in England and in all other countries, but in England alone we had not followed out the principle to its logical conclusion. We had stopped at the lower grade, and in this respect had made a great mistake. If it was of national importance that every one should have placed within his reach the instruments of education, it was of equal importance that they should be stimulated and encouraged to make use of these facilities. An attempt had been made in some halting fashion to redress the inequality in which this country was placed. The Charity Commissioners had recently been diverting funds which were, to some extent at all events, intended for the benefit of the poorer classes of the population to the purposes of higher secondary education. That practice was open to very serious objection, because it was robbing Peter to pay Paul; and also because under that system nothing whatever was done for the colleges represented by the deputation, which were carrying on and extending the education given in the primary and secondary schools. The enormous development of primary and secondary education had created a demand for higher education. Proof of that was to be found in the fact that, although the institutions now represented were nearly all of them the creation of the present generation, they had had, in spite of deficiency of means, the most remarkable success; and the daily increasing number of their students showed that they were established to meet a real want. The pressure of commercial competition came almost exclusively from those nations in which technical instruction and higher education had been developed and stimulated by the action of the State. The demand now made upon the Government was really a very moderate one, and the sum asked for was never likely to assume any very large amount. He believed the grants for primary education amounted to something between £2,000,000 and £3,000,000 a year, and that the additional grant now asked for would only amount to something like £50,000.

Mr. Goschen.—Will the deputation be able to supply me with a scheme for the distribution of the £50,000 or with the principle?

Mr. Chamberlain replied that, in his opinion, the grants should be made conditional upon further local aid. In that way the Treasury would be able to distinguish the colleges which were entitled to share in the grant.

Mr. Goschen.—Conditional upon further local aid?

Mr. Chamberlain.—Proportioned, in the first place, to the number of students, and, in the second place, conditional upon the amount of local aid.

Mr. Mundella.—Not in all cases further local aid.

Mr. Chamberlain agreed with Mr. Mundella that in some