

missioned to report on the progress of chemical industry as manifested at the various International Exhibitions. But it was on the petroleum industry of Baku, on the Caspian, that this influence has been most widely felt. Fifteen years ago the production of petroleum in Russia was a monopoly, and was accompanied by all the evils which usually spring from monopolies: the trade was exceedingly limited, and apparently incapable of development. Thanks largely to his action, both on the platform and in the press, the opening up of the boundless supplies of the peninsula of Apsheron was thrown open to the world, with the result that petroleum threatens to effect an industrial revolution in Eastern Europe and in Asia. Indeed, it is not too much to say that the oil industry of Baku is rapidly becoming, directly and indirectly, one of the most powerful factors in the Central Asian problem. Mendeleeff's interest in the development of the Baku industry has led to his being sent to the Caucasus and to Pennsylvania, to report upon the best modes of working the wells, and of separating and utilizing the products. Last year, during the coal crisis in Southern Russia, he was commissioned to study the economic condition of the industry in the rich coal-basin of Donetz.

No man in Russia has exercised a greater or more lasting influence on the development of physical science than Mendeleeff. His mode of work and of thought is so absolutely his own, the manner of his teaching and lecturing is so entirely original, and the success of the great generalization with which his name and fame are bound up is so strikingly complete, that to the outer world of Europe and America he has become to Russia what Berzelius was to Sweden, or Liebig to Germany, or Dumas to France. Nowhere has Mendeleeff's pre-eminence been more quickly or more fully recognized than in this country. English men of science and of learning have delighted to do him honour. In 1882 the Royal Society gave him the Davy Medal; and now, the Chemical Society, which is proud to number him among its Honorary Fellows, has conferred upon him the highest distinction in its power, by the award of the Faraday Medal. To the great regret of the large gathering of British chemists which had assembled to welcome him and to listen to the memorable address on the subject which he of all others is best fitted to expound, Mendeleeff was unable to receive the gift in person; but the circumstances of his absence awakened a deep feeling of commiseration and sympathy, and served to intensify the sentiment of respect and admiration with which he is regarded by all English men of science.¹

T. E. THORPE.

THE PREVENTION OF HYDROPHOBIA.

AS was foretold three years ago, by those experienced in its behaviour, rabies is again making itself felt in this country by becoming epidemic. No disease probably has been more misunderstood in the past, none is more clearly known to-day. We are not therefore, as in

1885, caught napping. Since M. Pasteur showed us the whole story of rabies, we have acknowledged the brilliancy of his researches and the most gratifying discovery he made of the way in which the disease may be prevented from developing in any individual unfortunately bitten by a rabid dog. The manner too in which he gradually unfolded one secret of Nature after another, by his extraordinary insight into the phenomena of infectious disease, has been demonstrated with beautiful clearness in the recent Croonian Lecture delivered by Dr. Roux before the Royal Society.

The gradual evolution of the science of preventive inoculations by M. Pasteur has taught us how to obviate the appearance of rabies or hydrophobia when the virus has been introduced into the system; how, in fact, the virus may be hindered from exerting its frightful effects on the nervous centres of those unfortunately exposed to the danger. Consequently he enjoys the supreme pleasure of having saved hundreds, not only from a most painful and miserable death, but from what is actually far more painfully important—the most dreadful of apprehensions.

But this last point, the apprehension or dread of the disease, which is so appalling a feature of this malady, owing to the extraordinary length of its incubation period, has forced upon everyone save the anti-vivisectionists, the fact that it is far more necessary, in this of all troubles, to prevent the chances of the mischief occurring, than to try and shut the door after the evil has found admission. We have persistently urged that in islands like Great Britain the mere existence of rabies is a matter of the greatest reproach; that preventive legislation is to a very unusual degree able to cope with it and destroy it utterly. A brief repetition of the grounds of this belief will not be out of place. Of all acute specific diseases, rabies is evidently the one in which the virus survives removal from living tissues with the greatest difficulty. As retention of virulence and viability by the viruses of different acute specific diseases is a subject of the highest interest, as well to the practical hygienist as to the pathologist, we fortunately know enough from the work of recent years to speak with confidence on the point. Bacteriological experience has shown that the difficulty of artificially cultivating a zymotic virus in dead material, *e.g.* gelatine, increases, roughly speaking, in proportion to the length of the incubation period. In proof of our contention we may quote the extreme cases of tuberculosis and anthrax. In the former disease the virus is a slow-growing bacillus, growing in artificial cultures with the utmost difficulty, and destroying life only at the end of many weeks. In anthrax, on the contrary, we have a bacillus which develops with the utmost activity on artificial nutrient soils, and which kills in a few hours.

Duration of incubation period, however, is not necessarily an index to the viability of a bacillus. But while it was clear from what has just been said that we were *a priori* fully justified in prophesying that the rabic virus would probably not develop in the absence of a living pabulum, *i.e.* living tissue, we have actual evidence to show that fortunately this most terrible virus in all probability is not possessed of powers of active resistance to those injurious influences which act upon it

¹ I have to express my grateful acknowledgments to Prof. Menshutkin and M. Gorboff, of St. Petersburg, and to Dr. B. Brauner, of the University of Prague, for much of the information on which this article is based.—T. E. T.

when exposed to the air, &c. This evidence is simply the fact that no case bears investigation in which the poison was asserted to have been found infecting the ground, woodwork, &c., of places habited by rabid animals—that, in short, the rabic virus cannot survive the drying, changes of temperature, &c., it necessarily undergoes when scattered over the ground, as we often see happen by the slobbering of a rabid animal.

This is the first and a most important point, upon which our opinion was based. We pass now to the second, which is to a certain extent the corollary of the first. It is, that the disease is communicated only by one animal biting another. There is really no evidence to show that accidental inoculation with the blood, &c., has ever occurred, and we are now in possession of direct experimental evidence to show that the poison cannot be absorbed, by being combined with food, through the mucous membrane of the alimentary canal. The only practicable mode of transmission of the disease, therefore, is by one animal biting and lacerating another's tissues, or by licking a wound and so introducing the virus.

This point, coupled with the first, establishes irrefragably the proposition that, for the permanent extinction of rabies from a country into which its reintroduction can reasonably be prevented, it is only necessary to prevent rabid animals from biting healthy ones. In other words, it is only necessary to apply the muzzle. Usually the public does not listen to scientific men, unless the matter happens to be one where their own experience, favourable or unfavourable, serves to help them to a conclusion. On the present question the experience of London in 1885 and 1886 is sufficient; and from the recent memorial of the County Council addressed to the Privy Council, the knowledge gained by the last epidemic has been speedily utilized. But with particular wisdom the County Council have asked for the general adoption of the muzzle all over the country, so that we may have not merely a temporary extinction of the disease in one locality, but a riddance of it from the whole country. It might well be asked, Why have not the Privy Council, who hold in their hands the machinery of prophylactic legislation, brought this consummation to a perfect conclusion without waiting to be urged by the public outcry which it was well known would certainly be raised sooner or later, according as rabies rapidly or slowly increased? The answer is simple, being nothing more than the well-known cowardice of authorities to interfere with what they believe to be a popular interest, sentiment, or feeling, on any point, however contrary to reason or fact that sentiment may be. The Select Committee of the House of Lords, whose Report we reviewed two years ago, did yeoman service to the cause by collecting an immense amount of valuable evidence; but unfortunately, misled by the interests falsely stated to be interfered with, reported adversely to a general adoption of muzzling regulations all over the country, and advised leaving the whole matter in the hands of the local authorities.

Even those members of the Upper House who were most interested in the subject, both from philanthropic and agricultural reasons, hesitated to support any measure which might involve some trouble in application. We allude of course to the muzzling of sporting

dogs more especially, and to the exemption of sheep and other dogs actually engaged in work. All these points were considered fully two years ago by the Society for the Prevention of Hydrophobia, a Society composed of dog owners and scientific men, and were treated by them in the provisional draft of a Bill which provided for each of the cases referred to. Fortunately this Bill will be introduced into the Lower House by Sir Henry Roscoe, so that the question will now be brought to a very definite head.

Nothing, however, in the way of philanthropic reform is said ever to succeed unless it is violently opposed. Violent opposition to the present proposals has assuredly not been wanting, nor will apparently be wanting. At the time of the last epidemic, and ever since, the anti-vivisectionists, turning from vilifying M. Pasteur's charitable efforts, maligned the police, and, to parody the celebrated dictum of Spinoza, first asserted that there was no such thing as rabies; secondly, that it was contrary to religion (of humanity); and thirdly (this only recently), that the disease was well known, but did not require preventing.

The diatribes of these people may be amusingly ridiculous, but naturally they are also mischievous. It is scarcely conceivable, in this present century of intelligence, that none of their subscribers should have seen that they are really opposing the only known means of counteracting rabies, and that their money is consequently being spent to perpetuate this terrible infliction among us. However, the infallible test of time is fortunately dispersing the mists of falsehood which have been so carefully spread around the subject.

M. Pasteur's splendid achievements have, as all scientific truth must, contributed greatly to the success of the movement for obliterating the curse from this country. For, attracted by the value of the work of the Pasteur Institute, and its single-mindedness, the Prince of Wales and the Lord Mayor of London have recently visited it, have seen the immense importance of the researches carried on in the laboratory there, and they are in consequence greatly desirous of providing similar blessings for this country. The Lord Mayor, in order to give effect to the opinions he has so strongly formed, has summoned a meeting at the Mansion House for July 1, at 3 p.m., and the Prince of Wales will write a letter in support of the same. At the last meeting of the Royal Society for the present session, held on Thursday, the 20th instant, the Society adopted a letter which had been drawn up by the President and Council, expressing sympathy with the Lord Mayor's attempt to obtain some public recognition in this country of the services rendered by M. Pasteur to science and humanity, and appointing the officers with Sir James Paget, Sir Joseph Lister, Sir Henry Roscoe, and Prof. Lankester, as their representatives at the meeting called by the Lord Mayor.

The whole business of the meeting will be devoted to, first, the providing of a sum of money to be paid to the funds of the Pasteur Institute as a slight acknowledgment of the great benefits which the Institute has gratuitously extended to over 200 of our fellow-countrymen threatened with rabies; secondly, the formation of a fund to cover the expenses of poor people tra-

velling to Paris for inoculation and unable to support themselves; and thirdly, a strong resolution calling upon the Privy Council to instantly inaugurate such muzzling and other restrictive measures as shall definitely and finally exterminate rabies. The anti-vivisection agitators, whose object it is, apparently, to keep alive rabies in this country, have opposed the meeting, which we hope will be crowded by genuine lovers of men and animals. The form their opposition has taken is amusing to the last degree, since it consists of a petition, advertised in the daily papers, made of four or five headings, each of which may be called in question. In the very first paragraph it is stated that the Manager of the Dogs' Home in Battersea has passed a large number of dogs through his hands, and that he never saw a case of rabies among them. If this means that there has never been a case of rabies at the Dogs' Home, we believe evidence can be produced to the contrary.

The innate falsity of this agitation is always making itself felt, and it is nothing more than Nemesis that the statements made by agitators in the hope of deceiving the public should be detected and exposed again and again. Such a statement as that asserted to have been made by the Manager, even if he did make it, has no value in view of the incontrovertible facts of the police records of the existence—nay, more, of the increase—of rabies in London. The Mansion House meeting will do much to blow away this miserable opposition, which attacks biological science alone, knowing full well that no false sentiment can be hashed up against physical science and its benefits to mankind. The object of the meeting is to honestly acknowledge our great indebtedness to M. Pasteur, to provide for our poorer fellow-countrymen gaining the benefits of the Pasteur Institute, and, finally, to stamp out rabies.

No scientific man who really has the interests—in fact, the honour—of his country at heart will refuse his support on this important occasion; and we may well hope that many will be found able to attend the meeting personally, to render the occasion worthy of the great chemist whose work has so essentially led to the successful performance of the hygienic measures now about to be executed.

STELLAR EVOLUTION.

Stellar Evolution and its Relation to Geological Time.

By James Croll, LL.D., F.R.S. (London: Edward Stanford, 1889.)

DR. CROLL'S book, though chiefly dealing with the question of stellar evolution from the astronomer's point of view, calls in the evidence afforded by geology in favour of the theory which is set forth in its pages. The particulars of the theory are clearly stated, and the new facts which have been gathered since the theory was first published are fully considered.

Dr. Croll accepts the nebular hypothesis of Kant and Laplace, and deals mainly with the question of the pre-

nebular condition. According to his theory, large cool dark bodies, moving with enormous velocities, were either created or were eternal; and these colliding with each other here and there, the evolution of the celestial bodies was accomplished. With regard to the origin of these bodies endowed with motion, Dr. Croll states:—"We are perfectly at liberty to begin by assuming the existence of stellar masses in motion; for we are not called upon to explain how the masses obtained their motion, any more than we have to explain how they came into existence. If the masses were created, they may as likely have been created in motion as at rest; and if they were eternal, they may as likely have been eternally in motion as eternally at rest" (p. 3). It is argued that the heat energy which would have been derived from gravitation alone could not possibly have been equal to that which the solar system originally possessed. But there is absolutely no limit to the amount of available energy from Dr. Croll's point of view. The most important argument against the gravitational theory is undoubtedly the geological and biological one. The whole question of geological time rests on an estimation of the time during which the sun has been radiating its heat, and on this point Dr. Croll remarks: "If gravitation be the only source from which the sun has derived its heat, then life on the globe cannot possibly date farther back than 20,000,000 years, for under no possible form could gravitation have afforded, at the present rate of radiation, sufficient heat for a longer period" (p. 35). The adoption of Langley's value (1.7 times that of Pouillet) for the rate of solar radiation reduces Helmholtz's estimate of 20,000,000 years to 12,000,000 years, and even this would not be available for plant and animal life, as millions of years must have undoubtedly elapsed before the earth was prepared for them. Prof. Tait ("Recent Advances in Physical Science," p. 175) has shown that, from the physical point of view, "10,000,000 years is about the utmost that can be allowed for all the changes that have taken place on the earth's surface since vegetable life of the lowest known form was capable of existing there." Sir William Thomson states his conclusions on this point thus: "In the circumstances, and taking fully into account all possibilities of greater density in the sun's interior, and of greater or less activity of radiation in past ages, it would, I think, be exceedingly rash to assume as probable anything more than 20,000,000 years of the sun's light in the past history of the earth, or to reckon on more than five or six million years of sunlight for time to come" ("Popular Lectures and Addresses," p. 390).

It is not necessary here to enter into details of the various methods by which geologists and biologists have attempted to estimate the length of time which must have elapsed since the earth first received the heat of the sun. On this point Dr. Croll says: "The grounds upon which the geologists and biologists found the conclusion that it is now more than twenty or thirty millions of years since life began on the earth are far more certain and reliable than the grounds upon which the physicist concludes that the period must be less" (p. 68). Here again, it may be well to quote Sir William Thomson, who says:—"What then are we to think of such