SPLENIC FEVER IN THE ARGENTINE REPUBLIC[1]

THE author stated that he did not think any one who had worked much on the subject of splenic fever could doubt that the bacilli which caused that disease were capable of considerable variation in their effects on animals and man. Whether this disease, which is without doubt the one which has been most thoroughly investigated of all zymotic affections, gave any support to the views of Dr. Carpenter was another matter, but there could be no doubt that the *Bacillus anthracis* can be so modified by artificial means that the disease which it produces when introduced into animals, such as sheep and cattle, varies considerably as to duration, amount of fever produced, as well as to its mortality.

That, on the other hand, this bacillus has at least a very strong tendency to retain the characters which it at present presents in Europe is shown by the fact that in the Argentine Republic,—into which the affection was introduced at least thirty years ago, and where the conditions are very different from those which exist in Europe,—we find that the minute organism retains its characteristic form and the properties with which we are so well acquainted in Europe, and that the disease which it produces is practically identical with the European disease. That it should vary in some particulars is perhaps only to be expected, but Dr. Roy preferred leaving that point to be treated of elsewhere and occupying the time at his disposal with an account of the observations which he had made as to the means of protecting from the disease by means of inoculation.

Some six months ago he had been requested by a City company who possess a large tract of land in the Argentine Republic, to pay a visit to their property in order to investigate a disease which was causing much mortality amongst the cattle, sheep, and horses, and which was affecting the *employés* as well to a very serious extent. This disease, he found on arriving at the River Plate, was splenic fever, of which the absence of efficient veterinary surgeons and the general apathy of the owners of stock had prevented the recognition. Having spent some time in studying the characters of the disease, he proceeded to make observations on the best means of protecting the stock by means of inoculation, which work was much facilitated by the liberality of the company (the "Las Cabezas Estancia Company") who gave him "carte blanche" as to the number of animals which he might employ for his experiments. Having previously found, in a small series of observations made in this country in conjunction with Dr. E. Klein, that splenic fever virus from white mice was of the proper strength to protect sheep from the disease, he proceeded in the same lines, employing such animals as were available to produce the inoculating fluid. After a number of animals had been tried, he found that the blood of *Biscachas* (prairie dog) which had died of the disease gave satisfactory results when used to inoculate cattle and horses. It was, however, a little two powerful, as 1 or 2 per cent. of the cattle so inoculated died. The pecuniary loss entailed by this was, however, more than counterbalanced by the arrest of the mortality from the natural affection. With regard to sheep, greater difficulties were encountered, and no animals were found giving a virus sufficiently mitigated to cause only a slight form of the disease with subsequent protection. Unfortunately it was impossible to repeat on a large scale the successful experiments which Dr. Roy and Dr. Klein had made with virus from white mice, these animals not being obtainable. Virus from field-mice and rats did not prove satisfactory.

Under these circumstances the speaker then proceeded to investigate the results obtained by artificial mitigation of the bacilli in the laboratory. He first employed the method of Toussaint, which consists in warming the fluid containing the pathogenic organisms to a temperature of 55° C. for a period varying from a half hour to one hour and a half. It was found possible by this means to diminish the strength of the virus so that it took longer to kill, and by graduating the duration of the heating it is not difficult to obtain a virus which will only kill a small percentage of the animals inoculated. But unfortunately, in weakening the virulence of the organised poison, this process weakens also its power of protecting from a second attack, and it was easy to kill the animals so inoculated by subsequently introducing into their system strong virus which had not been subjected to heat. This method having failed, Dr. Roy proceeded to Buenos Ayres, where, in the laboratory of the "Collegia Nacional," which was kindly placed at his disposal, he manipulated the virus by the method of Pasteur, which consists in cultivating the virus in sterilised chicken broth at a temperature of 42°—43° C. At this temperature the bacilli grow much les readily than at one more nearly approaching blood heat. The bacilli so cultivated diminish in virulence day by day, and after being cultivated for six or eight days no longer caused the death of full-grown sheep, although they still killed lambs and prairie dogs.

Careful experiments with inoculating fluid prepared in this manner showed that with it a slight fever could be induced which suffices to protect, at least for some time, from a second attack of the disease. The same objection, however, which characterises the inoculating fluid prepared by Toussaint's method exists, though to a less extent, with regard to Pasteur's fluid; in the case of the latter as well as the first named, the protecting power is seriously diminished at the same time that the virulence of the bacilli (as indicated by the mortality) is lessened. With care it is possible, however, to prepare a liquid which, while its virulence has been brought sufficiently below the lethal limit to insure that none of the inoculated animals succumb to the inoculation, still retains enough protecting power to enable the sheep to resist the effects of strong virus employed some ten to fifteen days after the first inoculation. Dr. Roy was, therefore, able to confirm the assertions of M. Pasteur regarding the attributes of his inoculating fluid in so far that it is possible effectually to protect sheep from anthrax by its use. Still, it was impossible to overlook the fact that its employment necessitated very careful graduation of the strength of the mitigated virus to the resisting power of the animals inoculated. The speaker did not think that the method was one which was likely to be adopted universally, and he rather looked forward to the general acceptation of some inoculating fluid which had been mitigated by cultivation in the bodies of some animal distinct in species from that which it was desired to protect. In the case of cattle the virus taken from *Biscachas* seemed to protect in all cases, whether the illness produced by the inoculation was mild or severe. It was to be hoped that more extended inquiries would confirm the favourable results obtained by employing the virus from white mice to protect sheep. The speaker stated that he proposed communicating the results of his observations on this subject to the Royal Society at an early date.

[1] Abstract of a paper read at the British Association by Dr. C. S. Roy.

SUGGESTIONS FOR FACILITATING THE USE OF A DELICATE BALANCE

IN some experiments with which I have lately been occupied, a coil of insulated wire, traversed by an electric current, was suspended in the balance, and it was a matter of necessity to be able quickly to check the oscillations of the beam, so as to bring the coil into a standard position corresponding to the zero of the pointer. A very simple addition to the apparatus allowed this to be done. The current from a Leclanché cell is led into an auxiliary coil of wire coaxial with the other, and is controlled by a key. When the contact is made, a vertical force acts upon the suspended coil, but ceases as soon as the contact is broken. After a little practice, the beam may be brought to rest at zero at the first or second application of the retarding force.

This control over the oscillations has been found so convenient that I have applied a similar contrivance in the case of ordinary weighings, and my object in the present note is to induce chemists and others experienced in such operations to give it a trial. Two magnets of steel wire, three or four inches long, are attached vertically to the scale pans, and underneath one of them is fixed a coil of insulated wire of perhaps fifty or one hundred turns, and of four or five inches in diameter. The best place for the coil is immediately underneath the bottom of the balance case. It is then pretty near the lower pole of the magnet, and is yet out of the way. The circuit is completed through a Leclanché cell and a common spring contact key, placed in any convenient position. The only precaution required is not to bring other magnets into the neighbourhood of the balance, or, at any rate, not to move them during a set of weighings.

The other point as to which I wish to make a suggestion relates to the time of vibration of the beam. I think that with the view of obtaining a high degree of sensitiveness the vibrations are often made too slow. Now the limit of accuracy depends more upon the smallness of the force which can be relied upon

[1] Paper read at the British Association by Lord Rayleigh, F.R.S.

to displace the beam in a definite manner, than upon the magnitude of the displacement so produced. As in other instruments whose operation depends upon similar principles, *e.g.* galvanometers, it is useless to endeavour to increase the sensitiveness by too near an approach to instability, because the effect of casual disturbances is augmented in the same proportion as that of the forces to be estimated. If the time of vibration be halved, the displacement due to a small excess of weight is indeed reduced in the ratio of four to one, but it is not necessarily rendered any more uncertain. The mere diminution in the amount of displacement may be compensated by lengthening the pointer, or by optical magnification of its motions. By the method of mirror reading such magnification may be pushed to almost any extent, but I am dealing at present only with arrangements adapted for ordinary use.

In the balance (by Oertling) that I am now using, the scale divisions are finer than usual, and the motion of the pointer is magnified four or five times without the slightest inconvenience by a lens fixed in the proper position. The pointer being in the same plane as the scale divisions, there is no sensible parallax. In this way the advantage of quick vibrations is combined with easy visibility of the motion due to the smallest weights appreciable by the balance.

To illuminate the scale, the image of a small and distant gas flame is thrown upon it by means of a large plate-glass lens. This artificial illumination is found to be very convenient, as the instrument stands at some distance from a window, but it is not at all called for in consequence of the use of the magnifying lens.

ON THE DEVELOPMENT OF PERIPATUS[1]

AMONG the acquisitions I made during my journey to the West India Island of Trinidad, a rich collection of Peripatus stands in the first rank. This has put me in a position to correct many mistakes, and to contribute a good deal to the knowledge of the histological anatomy of this interesting animal form, as well as especially to follow the process of development from beginning to end. Postponing for the present the anatomy of the adult animal, inasmuch as we have on this subject a good many studies, some of which are very good (for instance, that of Gaffron in *Zool. Beiträge*, edited by Dr. A. Schneider), I shall confine myself to a preliminary notice of the earliest stages of the development of Peripatus, although my investigations have not as yet been brought to a conclusion, nor have I been able to devote any attention to the development of the organs. I do this chiefly because the treatise published by Moseley and Sedgwick from the posthumous notes of Balfour contains some representations of embryos and cross-sections of the same, upon whose accuracy in details I, with my rich and well preserved collection of specimens, and observations on fresh objects, must cast some doubt, and the interpretation of which does not bear investigation. And yet these already serve as evidence for some theoretical explanations of embryonic processes in other groups of animals, which it would be well to avoid in such a case.

I collected in Trinidad over a hundred specimens of *Peripatus Edwardsii*, and a small number of a new species which is distinguished by its size from all those hitherto known, and which may briefly be thus characterised: The females, which are considerably larger than the males, attain a length of 15 cm. and a diameter of 8 mm.; the males grow to a size of about 10 cm. Their colour is a plain reddish brown above, darkening a little towards the middle line of the back, and growing pale a little towards the sides. The head, or, more correctly, the forehead, as well as the antennæ, is black, and marked off on the dorsal side by a light yellow necklace, which is often slightly interrupted in the middle, from the rest of the body. The under side is of a dark flesh colour. This species is especially characterised by possessing forty-one to forty-two pairs of feet, which is the highest recorded number, and a number which differs greatly from that of all other species. I call this new species *Peripatus torquatus*.

The ovaries are two small, elongated bodies, which are generally united along their whole length, and so appear as a narrow, spindle-shaped body, which is connected by one or often by two delicate muscular threads to the body wall. The ovaries are prolonged into the two horns of the uterus, which, each forming a bow with several curves, unite immediately before reaching the genital pore to form a very short vagina. At the point where the ovaries pass over into the uterus is situated a small, nipple-shaped gland and a spherical receptaculum seminis, the orifice of which every egg has to pass before it can enter the uterus. Now as a large number of embryos, from the "just furrowed" egg to the matured young, are always found in the uterus, it is very probable that each female Peripatus is only fertilised once.

The eggs of Peripatus contain no yolk, and seeing that in spite of this an animal of half the length that it attains when adult develops itself in the uterus out of a small egg whose diameter is about 0·04 mm., there must be some quite peculiar means for its nutrition, and this is the case to the most astonishing extent and in the most surprising manner.

As soon as the fertilised egg enters the thin portion of the uterus, a small enlargement takes place in its lumen, which is very narrow and is surrounded with very deep cylinder epithelia. Simultaneously with this the epithelium cells mass themselves a little together; the furrowed egg settles upon the epithelium, and immediately the lumen widens a good deal by the epithelial cells of the uterus becoming very depressed at that spot; so flattened do they become that they form a very thin pavement-epithelium, whereas before and behind the "breeding-nidus" (*Bruthöle*) an embankment is formed by the thickening of the connective tissue of the uterine walls, so as nearly to fill up the uterine canal.

In this stage we find a hemispherical mass of homologous cells attached by a broad basis to the extraordinarily thin lining of the uterine cavity, a lining which has been formed out of the two cells that originally surrounded the egg. Presently a small depression develops in this hemispherical mass, and now the embryo forms something like the half of a hollow sphere, still consisting of but a few cells. Through the multiplication of these the hemisphere and the cavity in it become a little larger, and now a difference is perceptible between the cells of the embryo which are situated immediately upon the uterine epithelium and the rest. The former, which I shall for brevity's sake here call basal cells, have a long, narrow, and very compact nucleus, whereas the others have a large, circular, granular nucleus. The basal cells multiply, and in doing so close the opening of the hemisphere, and form a layer which, lying between the embryo and the uterine epithelium, fastens the former to the latter. In the meantime the cells of the hemispherical mass have also multiplied to such a degree that the side looking towards the lumen of the uterus appears thickened by the cells mutually displacing each other.

In this stage the whole condition of the embryo resembles that of a flattened hollow sphere whose free wall has been thickened; the longer diameter is 0·09 mm., and the lesser 0·07 mm. The basal cells of the embryo now spread themselves out a little, a few isolated ones come out from under the embryo, and thus enlarge the basis of attachment—they form an *embryonic placenta*. From them is also developed a very delicate membrane, which becomes closely applied to the uterine epithelium, and envelops the embryo—it may be shortly designated as *amnion*.

In the meanwhile changes are also going on in the uterus; the epithelium of the "breeding-nidus" has become a little thicker, the nuclei have increased in number, and a number of small dark brown pigment granules have developed and collected in the protoplasm of the flat cells, which for a long time mark off sharply the uterine epithelium from the embryonic portions.

The basal cells now multiply to a remarkable extent, partly so as to increase the size of the placenta, and partly in a direction perpendicular to it, forming a solid stalk upon which the embryo is pushed out free into the lumen of the "breeding-nidus." The whole now forms a pyriform mass; the little head of the pear, the actual embryo, is, however, now no longer hollow; cells have been thrust in from the side furthest away from the stalk, which have filled up the whole "furrow cavity"; a sharp limit, however, is visible between them and the ectoderm at every point except the place where they have been invaginated; this point, which is comparable to the blastopore of other embryos, persists for a long time as the spot where material for the inner germinal layers is being continually provided by invagination, and is still demonstrable in embryos in which the form of Peripatus has long since been recognisable.

As soon as the "furrow cavity" has been filled up in the manner that has been described, a new cavity develops by fission in the central mass of cells. This is the definite visceral cavity. It develops by the embryo becoming composed of two layers (ectoderm and entoderm) in the half that is nearest to the

[1] Translated from a notice, by Dr. J. von Kennel of Würzburg, in the *Zoologischer Anzeiger* for October 8, 1883.