Meteor-Showers.

	R.A.	Decl.	
The *Perseids*	44°	... 56° N. ...	Max. August 10. Swift; streaks.
Near 41 Arietis	44	... 25 N. ...	Swift; streaks.
	96	... 72 N. ...	Slow.
Near θ Cygni	293	... 52 N. ...	Rather slow.

ON PARTIAL IMPREGNATION.[1]

DURING our researches on the formation of polar-bodies (see NATURE, vol. xxxvi. p. 607) we made the following observations, which are of considerable interest in connection with the theory of sexual reproduction.

As we were able to show that parthenogenetic eggs form only *one* polar-body, while sexual eggs give rise to *two*, we looked out principally for those cases in which both kinds of eggs are present in the same species.

On examining the sexual eggs ("Dauereier") of certain species of *Moina*, we found, to our astonishment, that even those which possessed a firm vitelline membrane, and in which four segmental cells were already present, still contained a sperm-cell.

We first of all took this to be a supernumerary spermatozoon which had penetrated into the egg, but it was soon apparent that all eggs of a corresponding stage contained a similar sperm-cell, and that there was always *one* only. Further observations showed us *that we had had here to do with a case of partial impregnation. Only one of the first four segmental cells, and not the entire egg-cell, becomes united with the sperm cell.* This is the case, at least, in *Moina paradoxa*. In *Moina rectirostris*, impregnation must occur at a rather later stage, for in this species we have seen eggs in which the first four segmental cells were again ready for division, and still the sperm-cell had not fused with one of them.

In *Moina paradoxa* the process takes place as follows:—Immediately after the extrusion of the egg into the brood-chamber, it is a naked sausage-shaped mass. In this stage, a spermatozoon penetrates into it in the region of the vegetative pole, and then the vitelline membrane becomes formed, and prevents the entrance of a second. The germinal vesicle at the same time becomes transformed into the first polar-spindle, which lies at the surface; the first, and soon afterwards the second polar-body then becomes constricted off, and the nucleus of the ovum, surrounded by protoplasmic particles, migrates to the centre of the egg, which has by this time contracted to the usual form. Now follows the first division of the ovum, which, however, only consists in a separation of these first, or, as we will call them, *secondary* egg-cells in the centre of the egg;—the two first segmental cells come to lie, as usual, in its longitudinal axis—one, which is always recognizable by the proximity of the polar-bodies, nearing the animal pole, the other the vegetative pole. *The sperm-cell always lies in the neighbourhood of the latter*, without, however, yet becoming united with it.

Then follows a second division of the segmental cells, together with the separation of the daughter-cells in the transverse direction. There are now four star-shaped daughter-cells present, which lie at an almost equal distance apart, at a right angle with one another. The sperm-cell can be seen near one of the two lower (*hintern*) cells, and it now begins to show amœboid movements, and to approach the segmental cell, a short narrow bridge of protoplasm being formed, and the two cells beginning to unite with one another. *Fusion then follows, and in the next following stage, of eight segmental cells, no sperm-cell can any longer be seen in the egg.*

The uniting of the sperm-cell with the cell- and nuclear-constituents of the egg thus only takes place *after* the embryonic development has already advanced to the four-celled stage. It would naturally be of great interest to know what eventually becomes of those segments which are concerned in fertilization —that is, which parts of the embryo are formed from them. A very possible supposition is, that only those parts of the egg become fertilized out of which the germ-cells of the young animal will subsequently be formed. This conjecture is rendered by no means improbable by the fact that it is one of the two segmental cells lying at the vegetative pole of the ovum which becomes fertilized; for it is from these cells, according to Grobben's beautiful discovery with regard to the summer eggs of *Moina*, that the germ-cells arise. At a future time we hope to be able to speak more definitely on this point: at present it is only necessary to add that we are studying these processes in other *Daphnidæ*, and have already observed a similar series of stages in *Sida crystallina* to those above described. But in this case fertilization occurs earlier, in the two-celled stage of segmentation.

Freiburg i/B., December 12, 1887.

P.S.—In the continuation of the above observations another case has presented itself, in which impregnation does not take place until eight segmental cells have been formed. This happens in *Daphnia pulex*. Further details concerning partial impregnation, as well as theoretical support of the facts treated of above, we reserve for a future occasion.

May 21, 1888.

[1] Translated from a paper by A. Weismann and C. Ischikawa (*Berichte der Naturforschenden Gesellschaft zu Freiburg i/B.*, Bd. iv., Heft 1, p. 51)—W. N. P.

Addendum to the above Note on Partial Impregnation,[1] by Weismann and Ischikawa.

SINCE giving a short abstract of the observations which led us to the conclusion of the existence of partial impregnation, we have continued our researches, and have come to the conclusion that, in spite of the entire accuracy of our facts, we were mistaken as to the explanation of the phenomena described. The fusion with one of the eight first segmental cells does indeed take place regularly, but the uniting cell is not the sperm-cell. The first segmentation nucleus is here, as in all sexual eggs, formed by the fusion of the nucleus of the ovum with the sperm-nucleus, and the fusion of the two cells observed by us at a later stage *is something additional to the ordinary impregnation*. That this is the case is quite certain: we found the sperm-nucleus and its subsequent fusion with the egg-cell to occur in *the same* ova in which we could prove the presence of that cell which we at first took to be the sperm-cell.

We can hardly be blamed for this error if it be borne in mind that we found this cell, *without exception*, in every egg which had just passed into the brood-chamber; that the vitelline membrane was formed directly afterwards; and that, on the other hand, a fusion of this cell with one of the first eight segmental cells lying at the vegetative pole of the egg could be seen in *all* ova which we possessed of this stage, viz. in five species—two species of *Moina*, two of *Daphnia*, and one of *Polyphemus*. The fact that the form and size of the supposed sperm-cell differ from those of the sperm-cells in the testis of the corresponding species was indeed an objection to our explanation: it has, in fact, almost the same size and shape in all species. But the sperm-cells become altered as soon as they pass into the egg, and it was shown some time ago by Fol and Hertwig, and more recently by Boveri, that the sperm-nucleus grows considerably when within the ovum. Moreover, in one of the species examined (*Polyphemus*), as well as in *Bythotrephes*, the sperm-cell is extraordinarily large, and in both these species we followed the entrance of the enormous amœboid sperm-cell into the ovum by means of sections, step by step, and were able to convince ourselves of its essential correspondence with the supposed sperm-cell in the eggs of other species. What else could this cell within the ovum be, if it were not the sperm-cell? It was never wanting, and on the other hand there was *always one only*, so that any idea of its being a parasitic organism was out of the question. Moreover, the two polar cells were always present, so that it could not be mistaken for one of these. And up to the present time no one had ever seen any other cell but the sperm-cell within the ovum.

We should hardly, indeed, have discovered our error so soon, if we had not remembered that one of us had found some years ago that unimpregnated sexual eggs of Daphnidæ soon become disintegrated,[2] and had we not asked ourselves how the embryonic development advanced in such unimpregnated eggs before disintegration begins. For, as we believed that the sperm-cell was only ready for conjugation in impregnated eggs after they had segmented into eight parts, it was to be expected that segmentation would take place up to this stage in unimpregnated ova, and that then only would the disintegration begin. Had we found

[1] Translated from the proof of a paper to appear in the *Berichte der Naturforsch. Gesellschaft zu Freiburg i/B.*, Bd. iv. Heft 2, 1888.—W. N. P.

[2] See Weismann, "Beiträge zur Naturgeschichte der Daphnoiden," iv.; "Ueber den Einfluss der Begattung auf die Erzeugung von Wintereiern, *Zeitsch f. Wiss. Zool.*, Bd. xxviii. p. 198 *et seq.*

it otherwise, and did the first stages of division not occur in unfertilized eggs, we should have supposed that the sperm-cell present in the ovum, although in a resting-stage, had some invisible influence over it.

It was possible, however, to arrive at a decision on this point; for, although most Daphnidæ do not lay their eggs if copulation does not take place at the time the eggs ripen, in one species (*Moina paradoxa*), the extrusion of the ova occurs independently of copulation. We therefore isolated females of this species which contained ripe eggs in the ovary, and examined them when they had passed the eggs into the brood-chamber. How great was our astonishment to find that these ova, killed shortly afterwards, were already beginning to disintegrate, and a cell corresponding to that which we had taken for the sperm-cell was present in *each* of them! At first we considered the possibility of copulation having taken place before the females were isolated, and of the retention of the sperm-cell, which had become inactive, in the brood chamber. But sections which we made through nearly ripe ovarian eggs showed us that the supposed sperm-cell was already present in them. It was thus proved that this cell which unites with one of the eight first segmental cells (we will for the present call it the "conjugating-cell," *Copulationszelle*) cannot be an ordinary sperm-cell; and, moreover, that, besides it, an active sperm-cell from the male, which had previously escaped our notice, passes into the egg in consequence of copulation. In fact, this true spermatic element was found after renewed examination of old and new series of sections as an exceedingly small nucleus in the yolk-mass. It is difficult to recognize, but nevertheless may plainly be traced passing into the yolk, and finally uniting in the ordinary manner with the nucleus of the ovum.

Thus the impregnation of these ova is not exceptional, inasmuch as a normal fusion of the male and female nuclei takes place. But besides this normal conjugation of sperm-nucleus and egg nucleus, another fusion of cell bodies and cell-nuclei occurs between the enigmatical "conjugating-cell," present already in ovarian eggs, and one of the eight first segmental cells lying at the vegetative pole of the ovum.

It will be impossible to conjecture as to the meaning of this process until we know definitely how the "conjugating-cell" arises: at present we are not able to state anything about it with certainty.

We intend to continue our observations, and hope before very long to have more to say on this subject.

Freiburg i/B., July 12, 1888.

HOW TO INCREASE THE PRODUCE OF THE SOIL.[1]

IN this pamphlet Prof. Wagner distinctly asserts the power of leguminous cultivated plants, such as peas, beans, vetches, lupines, and clovers, to use the free nitrogen of the air for purposes of nutrition. As this conclusion is distinctly at issue with the opinions of the Rothamsted school, it revives a question of deep interest, the answer to which has varied with our knowledge from time to time. In the earlier days of agricultural chemistry the "mineral theory" of plant nutrition was in the ascendant. According to this theory the mineral, earthy, or ash constituents were taken from the soil, while the gaseous, combustible or organic portions of the plant were derived from the air. As knowledge progressed, this somewhat bold and sweeping generalization required to be modified, and the most usually received view (in this country, at least) for some time past has been that of the absorption of mineral matter and nitrates from the soil, and of carbonaceous matter from the air, and to a limited extent from the soil in the form of carbonic acid gas in solution. It has been urged that proof is entirely wanting of the alleged power of plants to take free or combined nitrogen from the atmosphere, while the intense effect of nitric nitrogen upon growing crops, when added to the soil, has amply proved that the soil is a source of nitrogen, and, according to received views, the chief or only source of nitrogen to growing crops. The results obtained by Sir John Lawes, Dr. Gilbert, and Mr. Warrington at Rothamsted, upon the cultivation of red and Bokhara clover, have been considered as proving that the source of nitrogen in these plants was not the atmosphere, but the soil and the subsoil, the plants having been found to send down their roots some fifty-four inches in depth into sections of the soil which, although out of reach of most cultivated plants, were able to yield sufficient nitrogen for the uses of these nitrogen-loving plants. Collectors of nitrogen these plants are allowed to be by all, but at Rothamsted the collection is considered to be carried on in the deeper layers of the soil, and not to extend above ground. Prof. Paul Wagner declares that cultivated plants may be properly divided into nitrogen *collectors* and nitrogen *consumers*, or as we might put it, into nitrogen savers and nitrogen wasters. In the first class are arranged the various members of the Leguminosæ already named. At a certain stage of their development these plants acquire the power of taking all their nitrogen from the air. They thus become a means of securing fertilizing matter from a free source, and are therefore profitable. In the second class are placed the cereals, grains, turnips, flax, &c., all of which are able to take next to nothing from the store of nitrogen in the air, but which waste the nitrogen of the soil, and must take from it, in the form of nitrates, all the nitrogen they contain. In the pamphlet under notice no proof is adduced for these views, but reference is made to the detailed investigations carried out by the author, Hellriegle, and E. von Wolff. These views must be considered as reactionary and startling, and as diametrically opposed to the current of opinion in this country for some years past.

It is not to be wondered at that Prof. Wagner should give considerable prominence to a feature in agricultural practice which has almost entirely disappeared—green crop manuring. If clovers, lupines, and vetches, extract their nitrogen from the supernatant aërial ocean, and are able to supply upwards of 180 pounds of atmospheric nitrogen per acre per annum continuously for a period of three years, no easier system could be devised for obtaining the necessary nitrogen for fertilizing purposes. All that is required is to secure the full development of the nitrogen collector by supplying it with sufficient water, sufficient phosphoric acid, potash and lime, so that it may exert its powers upon the constantly passing stream of air—it then provides nitrogen for itself. What is this but a re-statement of the old mineral theory applied especially to the Leguminosæ?

Prof. Wagner's views upon the absorption of atmospheric nitrogen and his consequent recommendation of green crop manuring, are the two principal features of this little work. In some places the German fault of verbiage is only too evident—whole paragraphs being devoted to what is perfectly self evident. Still, various practical suggestions of great value are made. The remarks upon the proper method of applying nitrate of soda are particularly worthy of attention. The effect of this active manure in developing stem and leaf rather than flower and fruit is acknowledged, but only as a consequence of the period of the plant's growth when it is applied.

Nitrate of soda enables the plant to seize upon the stores of phosphoric acid, potash and lime in the soil, and the effect is rapid growth. This effect is however short lived, as the nitrate is freely movable in the soil, and readily finds its way to lower sections when it is no longer available. The case is therefore as follows:—Nitrate of soda applied in February, March, or April, is employed in the development of leaf and stem, and by the time the period has arrived for grain formation it is spent. If the same dressing had been applied later in the history of the crop, and at the time when the embryo grain was being formed, the same stimulus would have been given towards grain formation, which under ordinary circumstances takes the form of leaf and stem development. The practical recommendation based upon the consideration is to apply one-sixth part of the application in autumn, two-sixths in March, and the remaining three-sixths in May. The plant is to be fed during its whole life, and not only at the period when it is forming leaves and stem, but especially at the important period when it is forming fruit. The remarks upon the ripening effects of superphosphate upon root crops are also well worthy of attention. Excessive quantities of superphosphate hasten too rapidly the processes of maturation, and tell against prolongation of growth into the late autumn, and this, it is submitted, accounts for the occasionally smaller results obtained by the use of phosphates in large quantities as compared with those produced by more moderate dressings.

Prof. Wagner comes to the conclusion, which we quite agree in, that nitrogen, phosphoric acid, and potash are the principal elements of fertility that require to be added to soils. The remaining essential substances, although equally important to the well-being of the plant, are usually present in ample quanti-

[1] "The Increase in the Produce of the Soil through the Rational Use of Nitrogenous Manure." By Prof. Paul Wagner, of Darmstadt. Translated by George G. Henderson. (London: Whittaker and Co., 1888.)