number of Orchidaceous plants collected near Rangoon and up the Salween River. On arriving in England the box was unfortunately exposed to severe frost, and in consequence many of the tender species had suffered. Dr James also sent a list of sixty-seven species of Orchids which he had collected in Burmah, and cultivated at Rangoon.

The Rev. John James Muir presented fresh specimens of *Isoetes Hystrix* from Guernsey.

Dr W. Craig presented an early-fruiting specimen of *Botrychium Lunaria*, collected the previous day in Lanarkshire.

8th May 1873.—JAMES M'NAB, President, in the Chair.

The following Candidates were elected as resident Fellows :—

WILLIAM M'DOUGALL OGILVIE, Royal Bank, Lochlee.
R. RAMSAY WRIGHT, M.A., B.Sc., 10 Forres Street.
THOMAS DRUMMOND, 1 East Newington Place.

The following Communications were read :—

I. *Notes on the Fertilisation of the Cereals.* By ALEXANDER STEPHEN WILSON, Esq. Communicated by Mr SADLER.

Several observers have recently been directing their attention to the manner in which the ovules of the cereal grasses are fertilised. Dr Boswell Syme read a note at the meeting of the Royal Horticultural Society, March 5 (1873), on the intra-palear fertilisation of wheat. He found that the anthers are empty when they are extended, and that the stigmas are never extended beyond the pales at all. Delpino in Italy and Hildebrand in Germany have also been making observations on the same subject. Hildebrand maintains, in opposition to previous writers, that the wheats are impregnated while the flowers are open, and that thus cross-fertilisation is rendered possible; and that

in barley the majority of the flowers never open; so that self-fertilisation alone is possible. Delpino states, however, that there are in an ear of barley a very small number of flowers differently constructed from the rest, in which cross-fertilisation is possible. In the oat the process is stated to vary according to the weather. In fine warm weather the flowers open freely, and cross-fertilisation is favoured; in cold wet weather they remain closed, and self-fertilisation is inevitable. In rye, fertilisation from the pollen of other flowers is provided for. The agent in the dissemination of the pollen is scarcely ever insects, almost invariably the wind, to which end both stigma and pollen grains are specially adapted.

The writer has not seen the papers above referred to, and these remarks are taken from "Nature," Nos. 176 and 177.

The cereals to which the following observations refer embrace about 15 varieties of wheat, 2 varieties of rye, 5 varieties of barley, and about 20 varieties of oats.

In all of these, except one variety of barley, the flowers open during the act of fertilisation. This variety is the two-rowed barley, called Italian or golden barley (*Hordeum distichon*). It is allied to the sprat or battledore, the fluckwheat, and some others, the peculiarity of which is, a short ear with the grains closely packed together, or at half the distance the florets are apart in the common two-rowed and chevalier barleys. Probably in none of these close-flowerd two-rowed barleys do the flowers ever open.

The cereal flowers are open for only about twenty minutes or half an hour. Even in the calmest days the whole of the pollen is discharged in one or two minutes. It is generally during the act of opening that fertilisation seems to take place. It is very true, as Dr Syme says above, that when the anthers of wheat are extended they are empty; but they do not empty themselves within the closed pales, but in falling from one side to another of the flower-cup as it opens; for if an anther is seized the moment it begins to appear on the opening of the flower, it is found to contain all its pollen.

But why do the flowers open at all? What force causes them to open? The cereal flowers are not like some others, which open many times and at stated hours of the day;

they open only once, and at all hours, shady as well as sunny. The principal facts are best seen in rye. If a rye-flower is opened a moment before the natural time of flowering, the filaments of the anthers will be found to measure about one-sixteenth of an inch in length. In the course of five minutes or less, from the instant the pales begin to open, the filaments will, in many cases, have grown or extended to twelve-sixteenths, while the whole of the pollen will have fallen out. In the oat the filaments, originally one-twentieth of an inch, extend to about one-third of an inch in length. This rapid extension of the filaments is not a mere straightening out of a doubled-up thread, but an actual growth or erection, which remains unretracted. And in the wheats which have light anthers, the filaments are frequently so rigid as to support the anthers for a time in a vertical position without any support, turning them spontaneously into new positions. In a very short time the flower begins again to close, but much more slowly than it opened.

Now, what is the source of the force which opens the flower? It is a very considerable force. In the natural position the spikelet of darnel lies closely against a hollow in the rachis; but the opening of the lowermost inner flower will for a time push the whole spikelet out of its natural place; and in the fly oat (*Avena sterilis*) and Canadian oat (*Avena sativa*), which have very stiff pales, the force which separates them would be quite measurable. What, then, is the initiative act in opening the flower? Does the maturity of the pollen stimulate the sudden extension of the filaments? If in a field of flowering rye an ear which has not yet blossomed be gently drawn through the hand, in a minute perhaps three or four of its flowers will begin to open, and the anthers to show themselves. The stroke of the morning sun, an abrupt eddy of wind, the collision of one ear against another, is enough to bring the force into play by which the ripe flower is opened and the filaments extended. But what the nature of this force is, and what the sequence of the phenomena, the writer will not yet venture to conjecture.

So long as the anthers are kept by the half-opened pales in a more or less vertical position in upright ears, little pollen

is discharged. The discharge seems to follow from purely mechanical causes. There does not seem to be any inherent projectile force in the anther. If an ear of rye ready to blossom is placed under a glass shade, and the flowering watched, it will be seen that no dehiscence takes place until the anther is at least in a horizontal position, or falls into that or a lower inclination with a jerk. The rapid extension of the filament throws the discharging pores of the anther into various positions, until at last the anther is pushed out of the flower-cup altogether, and hangs with the openings lowermost. But even in this position, the adhesion of the pollen grains to the inner sides of the lobes prevents complete discharge where there is no mechanical disturbance.

It is probable that fertilisation usually results from the few pollen grains which fall out on the inside of the pales, as the anthers are being tumbled out of the flower-cup. These, however, may not come into contact with the stigma until after the flower has again closed. This result is more probable in wheat, barley, and oats than in rye. The anthers of rye are very much larger than those of the other cereals, and contain a far larger number of pollen grains—about 20,000 each. But notwithstanding this large provision, there are always in rye ears far more barren ovaries than in wheat, barley, and oats; which seems to result from the fact that the filaments of rye extend to a much greater length than those of the other three grasses, and so carry the pollen further beyond the reach of the feathers of the stigma. Besides, the discharging pores of the anthers in rye are generally outside before any discharge takes place, so that fertilisation must be either cross, or due to little eddies of air carrying back a few grains to the enclosed stigma. In most cases the anthers, of rye especially, are speedily pushed into what appears the worst possible position for ensuring self-fecundation, as if there was a danger of over-fecundation to be avoided. And yet this conjecture is scarcely warranted in view of the Italian barley, the pollen of which is discharged inside the unopened pales—whether wholly or but partly is yet questionable.

The assertion made above, that the majority of the

flowers in barley never open, is certainly not consistent with the phenomena as exhibited in Scotland. The Italian variety alone fertilises in an unopened flower. Now, the cause of this does not seem to be the closeness and pressure of one floret upon another; because in the six-rowed barley (*Hordeum hexastichon*) the florets, while equally close, open in the same way as in the long-eared two-rowed varieties. The secret remains to be discovered. It is also a question in what way the pollen gets itself discharged within the close flowers. But however it is done, whether by a proper ejecting force in the anther, or by the filament pushing the lower end of the anther uppermost, and so letting the pollen run out mechanically from the waving of the ear, fecundation is more successfully accomplished in the close flower than in the open; for while in the barleys which open their flowers barren florets are frequent, defects of this kind in the Italian variety are very rare.

Neither is it the case in this country that oat flowers do not open in wet weather. They do not open so freely in gloomy wet weather as in warm sunny weather; but a floret may remain shut during a day or a week of damp weather without discharging its pollen, and open for fecundation afterwards. The upper flowers of the oat panicle are often in blossom before the lower are out of the sheath. One floret arrives at puberty, so to speak, before another on the same ear, and even in the same spikelet.

With the exception of the barley referred to, the circumstances attending the flowering of wheat, rye, barley, and oats are closely similar. In a field of any of these grasses, especially rye, on a good flowering day, clouds of pollen may be seen passing over the slightly waving spikes. That grains from one flower may alight on the stigmas of other flowers, is certainly possible and probable; but that cross-fertilisation takes place in this way, or takes place at all, is perhaps not yet rigorously proved. Unquestionably insects are no part of the agency of fertilising the cereals, neither is it perhaps correct to say that the wind is an agency in the same sense as it is in dicœcious plants. The essential agency is probably the sudden extension of the filaments causing a few grains of pollen to be emptied out of the anthers before they are entirely ejected from the flower-cup.