

blows. An opinion has been expressed before this commission that the rust on the wheat blade is simply an exudation from the plant itself, a spontaneous overflow of sap, and is not the result of parasitical attack. But this theory is altogether without support, either in the general conditions and circumstances of the rust as observed by the naked eye on a great variety of plants, or in the microscopic appearances of the diseased wheat plant. For although the most luxuriant growths of wheat have doubtless suffered most from the rust, thus lending an apparent support to the theory of sap "exudation," it is an undeniable fact, that a large number of cereal plants and grasses—the very reverse of luxuriant—have also suffered from rust, which must, therefore, be accounted for in some other way than by the outflow of superabundant juices. The spores of the rust are proved to be true seeds, possessing a uniform and definite character according to their variety, retaining their vitality as other seeds do, and capable of being developed at any time by the application of heat and moisture. Your commissioners have examined through the microscope various specimens of last year's rusted wheat, and find the rust spores identical in appearance with those noticed and delineated by Mr. Cooke, and other eminent mycologists, who have written on the subject. There is, therefore, no doubt whatever, that the rust in wheat, now so painfully known to South Australian farmers, is identical with the disease long recognized by the same name in Europe, briefly described by Dr. Mueller, in his report hereto annexed. It has also been shown in evidence, that the red rust has affected, in addition to wheat and other cereals, flax, lucerne, wild oats, wild barley grass, reeds and many other vegetable productions. It has been noticed that the red rust appeared in some localities before the humid weather of September and October, and also (in the south-east) after the dry, hot weather had set in. On this point it may be remarked that there are two distinct varieties of red rust, designated in Mr. Mueller's paper, *Puccinia graminis* and *Puccinia straminea*—one of which has the power of producing its spores in almost any season. Mr. Ey, in his evidence, also refers to the two kinds of rust, and avows his conviction that both have been active agents in the destruction of last season's crop. The rust that appeared earlier is popularly known as the "long corn" rust, and is believed to have borne a full share with the *Tara rubigo* (or true rust) in the desolation of our late harvest. In the course of this investigation some points of importance have been established, materially affecting and modifying opinions hitherto entertained. In 1865, it was reported by the Agricultural and Horticultural Society, who took evidence on the subject of rust, that crops grown upon land long cultivated were much more liable to the disease than those grown upon new land, and that crops grown upon well cultivated and manured land were much less liable. These opinions, though disavowed by some cultivators, prevailed very generally down to the time when your commissioners entered upon their investigation; but the experience of last season excited grave doubts on the subject; and the result of the evidence now adduced entirely sets aside this portion of the report of the Agricultural Society. It is found, as the almost uniform result of last year's operations, that rust has prevailed upon all kinds of land—upon lands long cropped,

upon fallow lands, upon grazed lands, upon virgin soil, upon manured lands, upon the plains, and upon the hills. But more than this, it has been proved that in nearly every instance the richest lands have suffered the most from red rust; and that, in a large number of cases, the best crops have been reaped from the poorest natural soils, and from those most exhausted by frequent cropping. It is an almost universal fact that wherever the wheat grew most luxuriantly in September and October, there the failure has been most complete; whilst those crops that in the early part of the season were the least promising, as a rule, turned out by far the best sample and the heaviest yield. This very remarkable circumstance, attested by hundreds of witnesses, is thus accounted for: Luxuriance in vegetation, like excessive fat in animals, is not identical with vigor. Plants forced into abnormal luxuriance are more susceptible of climatic changes than those which are tough and hardy. The more juicy and succulent the plant, the more predisposed is it to the inroads of the rust. The pores of the leaf being unusually open, the minute spores of parasitical fungi can more readily enter. Then again, the more dense and heavy the crop, the less possible is it for the wind to circulate, and the saturated leaves to dry. On the other hand, in a thin, light crop, the leaf pores being less open to the entrance of the rust seed, the disease is not so freely propagated, whilst the whole crop is far better situated to enjoy the drying influences of the wind, which retard the development of the parasite. The poor crop has thus a twofold advantage over the thick and luxuriant crop in a season favorable for the development of rust. Hence, so far as red rust is concerned, rich soils, and what is termed "high farming," instead of shutting out the disease or mitigating its severity, operate in the contrary direction, always supposing that the climatic conditions favorable to the development of rust are present.

The *modus operandi* of the disease is twofold. The rust spores, obtaining entrance through the open stomata, or breathing pores of the plant, are very quickly developed, and, pushing forward rootlets (*mycelia*), gradually work their way along the sap vessels of the leaf—in all probability injuring, by their multiplication and progress, its internal mechanical structure. But the chief damage—or, at all events, that which can with most certainty be traced—is caused by the absorption of the wheat sap by the parasite that has entered its channels. The juices that should have gone to nourish the wheat-ear are intercepted in their progress by the rust fungus, which starves the grain by living on its proper nourishment. This is not only deduced from microscopic observations, but is clearly demonstrated by chemical analysis. Healthy grains of wheat contain certain definite proportions of phosphoric acid, potash and soda, and magnesia. It has been demonstrated that rusted wheat is very deficient in that ash, having sometimes less than one-third its proper quantity. On the other hand, the rust spores, gathered from the rusty wheat, yield, on analysis, an extraordinary quantity of ash; and this ash is found to contain a large amount of the constituents present in the ash of healthy wheat, but wanting in the ash of rusty wheat. Doubtless further experiments

on the point are eminently desirable; but, as far as chemical analysis has extended, it seems fairly proved that the wheat perishes through the absorption of its proper nutriment by the rust fungus, and that the constituent elements wanting in the shrivelled grain are to be found in the parasite which has fed upon and destroyed it.

III. SEED WHEAT.—Your commissioners having come to the conclusion that the red rust is not originated in the soil, next directed attention to the several varieties of seed-wheat, with a view to determine whether any descriptions were of more hardy character than others, and better calculated to repel the attacks of the disease. On this subject the evidence of the numerous witnesses is remarkably coincident. With but very few exceptions it has been found in all parts of the colony that the Tuscan and purple straw varieties suffered least, whilst the more prolific varieties, such as the Goldsmith, suffered most. The Tuscan, however, being a poor yielding grain, is not likely to be generally selected for seed; and the purple straw therefore, is the wheat now generally recommended as combining a fair yield and a certain degree of resistance to the red rust. It, of course, remains for the farmer to determine whether (to insure the weightiest crop) he will sow prolific but tender varieties; or whether he will purchase a certain degree of immunity against the rust by being content with a variety of seed not quite so famed for heavy bearing. It is noticeable that the Victorian Commission of 1865 emphatically recommended care in the selection of seed wheat, reporting favorably of the red straw and Tuscan, and deprecating the golden drop, white prolific, white velvet and Winslow. Attention has been specially directed during this investigation to the question of the fitness or unfitness of shrivelled grain, and grain from rusted crops, for seed. There being in many districts of the colony, but little good seed this year, your commissioners deemed the point now under consideration to be one of the utmost importance, and they have much satisfaction in stating that numerous witnesses declare, as the result of their own personal experience, that shrivelled and rusty seed will produce healthy and abundant crops. This fact has, indeed, been known both to scientific observers and practical farmers for many years, and is specially remarked upon by the Victoria Committee. In that colony scientific research and practical testimony were both brought to bear on the subject; and, although Dr. Mueller and his colleagues appear somewhat hesitant to account for the fact, yet they are most confident in reporting that not only will shrivelled and rusty seed produce good plants, but in many instances have yielded healthier and heavier crops than those raised from first class seed. Nevertheless, as strong objections had been urged against the use of last season's rusted wheat as seed, the commission felt it desirable to bestow special care upon this branch of their inquiry. They therefore collected all the reliable information in their power, and also requested Dr. Schomburgk, of the Botanic Gardens, to experiment upon various samples, including some of the worst procurable. The result of experiments thus made fully supports the evidence of agricultural witnesses. The very finest grain germinated as readily as it appeared slightly weaker than the other, it grew freely, and in a few days was as vigo-

* September and October are spring months in Australia, answering to our April and May.—Sec.