

sises the importance of close co-operation between palæontologists and geologists in all matters relating to past geographies, and deprecates the over-readiness of the former class of workers to assume the existence of land-barriers. In illustration he refers to the continent of Gondwanaland, the existence of which "depends more definitely upon biological evidence and awaits full confirmation." Gondwanaland is, however, by no means the creation of palæontologists alone; its foundations are also geological. Succeeding chapters are devoted to the description of different provinces of North America in the latter part of the Palæozoic era, and the author summarises the results of an intensive study of Upper Pennsylvanian and Permo-Carboniferous rocks in certain areas. It is difficult for a reader not conversant with American stratigraphy to interpret the formations mentioned in terms of European classification, and one feels the lack of more helpful correlation-tables than those provided.

One of the most valuable features of the book is the emphasis laid on the necessity for regarding fossils as once living things, and for considering their distribution in the strata in relation to the problems presented to them by their environment. The chapter on the climatology of the later Palæozoic is a particularly useful mine of information. In the concluding chapter the author discusses the development and fate of vertebrate life in the Permo-Carboniferous period in relation to physical conditions. During Early Pennsylvanian time the conditions were singularly uniform over large areas, and the climate was equable and humid; a monotonous environment implies a limit to the number of genera and species in a flora or fauna; older and simpler types would persist because the variants, which were possibly being constantly produced, would not have a chance to develop. This idea is elaborated, though not so clearly as one could wish. It is suggested that the Upper Pennsylvanian fauna, though hampered in its further progress by the monotony of the environment, was accumulating force preparatory to a great radiation which would find expression when the limitations were removed. Prof. Case adds: "The fauna, long restrained from any expression of its evolutionary tendencies, full fed, and in the vigour of its youth, responded at once to the change, and new forms appeared so suddenly as to be unheralded in the preserved remains." This and similar passages illustrate the more imaginative side of the author's work.

The palæobotanical data are largely taken from the contributions of Mr. David White, whose researches are well known. The American Coal

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Measures have unfortunately yielded scarcely any petrified material comparable with that from England and a few other European countries, and although there is a wealth of plant impressions, anatomical criteria of climatic conditions are not available.

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### Wheat and Wheat-growing.

*Essays on Wheat.* By Prof. A. H. R. Buller. Pp. xv + 339. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1919.) Price 2.50 dollars.

PROF. BULLER'S "Essays on Wheat" are among the most interesting things we have seen for a long time. As professor of botany in the University of Manitoba, he has unrivalled opportunities of studying the ramifications of the wheat industry, for in no city in the world is wheat so important as in Winnipeg. He is singularly fortunate in his subject, and he tells his story remarkably well, giving the wealth of detail, the figures, and the references needed by the man of science, without sacrificing interest or literary form.

The first essay deals with the early history of wheat growing in Manitoba. It is a story in which Parkman would have revelled. The first attempt was made in 1812 by a little band of pioneers sent out from Scotland by Lord Selkirk to colonise the 116,000 sq. miles of territory granted to him by the Hudson Bay Co.; they settled at the junction of the Red and Assiniboine rivers where Winnipeg now stands. The first crop failed, as also did the second. The failure is scarcely surprising. "There was not a plow in the whole colony, the one harrow was incomplete and could not be used, and all the labour of breaking up and working over the tough sod had to be done with the hoe." The Indians were amazed, and nicknamed the colonists "jardiniers." Fortunately for the settlers, potatoes and turnips did well, or they must have had two very bitter winters. The third crop succeeded. But the troubles were by no means at an end. Birds were a great nuisance, especially the now extinct passenger pigeon. In the fourth year the adherents of the North-West Company and their half-breeds made serious trouble and caused no little bloodshed, and, to crown all, in the sixth year, just as the settlers were about to reap their second good harvest, there came a great plague of locusts which stripped the fields and gardens bare. It was more than even these brave men could stand; the old record says: "The unfortunate emigrants, looking up to heaven, wept." It speaks volumes for their good Scottish upbringing if they did no

more. Troubles continued; mice and floods did great damage, and not until 1830 did prosperity come; from that time on, however, the tale is one of steady and increasing progress.

Space does not allow of quotations from Prof. Buller's description of modern wheat growing in western Canada, but this is less necessary since it is more generally known than the earlier history. While it has less human interest, the tale is still a fascinating record of what can be achieved by intelligent organisation.

Another essay is devoted to the Red Fife and Marquis wheats. Red Fife was introduced into Canada some sixty years ago, and by reason of its sterling merit and great suitability to Canadian conditions it spread far and wide, doing much to make Canada's reputation as a wheat-producing country. The farmer is rarely a writer, and David Fife, who raised the first crop about the year 1842, has himself left no record of how he did it. But, though written contemporary records are lacking, oral traditions are abundant; some of them are reproduced by Prof. Buller, and they can almost be graded in point of time by their respective wealth of picturesque detail. The earliest written record is in the *Canadian Agriculturist* for March, 1861. It is there related that David Fife, of Otonabee, Ontario, in 1842 procured from a friend in Glasgow a quantity of wheat drawn from a cargo coming direct from Danzig. The wheat arrived in spring and some of it was sown forthwith; it failed to ripen, excepting only three heads, which apparently sprang from a single grain. These were preserved and the grain sown the next year; the progeny did very well, escaping rust, while all round the local wheat was badly infested. Again the grain was harvested separately, and gradually a large stock was worked up and distributed among other farmers.

The Continental origin of Red Fife was definitely established by Dr. Charles Saunders in 1904, when he proved its complete identity with a Galician spring wheat.

Dr. William Saunders, the revered first organiser of the experimental stations in Canada, whose courtly bearing and distinguished kindness will always be remembered by those who knew him, began soon after 1886 to make crosses between Red Fife and other varieties with a view to improvement. One of the crosses actually made by his son Arthur in 1892 was between Red Fife as male and an early ripening Indian wheat, Hard Red Calcutta, as female. Unfortunately, the Indian wheat is a mixture, and the precise variety used cannot now be determined. When Dr. Saunders's second son Charles became Dominion

Cerealist, he made a careful examination of the progeny of this cross, and selected from the mass of material one strain of outstanding excellence, which he called "Marquis," and which, from a single head in 1903, has spread over Canada and the United States, until in 1918 it was sown on 20,000,000 acres of land and yielded some 300,000,000 bushels of grain. So wonderful a rate of growth can scarcely have occurred before in the whole history of the world.

It is not often that a reviewer wishes a book had been longer, but that is decidedly one's feeling in closing this volume. One can only hope that Prof. Buller will find time to give us more of these delightful essays. E. J. RUSSELL.

### The Fertilisation of the Ovum.

*Problems of Fertilization.* By Prof. Frank Rattray Lillie. (The University of Chicago Science Series.) Pp. xii + 278. (Chicago, Ill.: The University of Chicago Press; London: The Cambridge University Press, 1919.) Price 1.75 dollars net.

THE problem of fertilisation, of what really happens when the spermatozoon meets the ovum, and of how the latter is incited to begin the long series of rhythmical cleavages that finally result in a new organism, is one of the most interesting and at the same time one of the most complex in biological science. From the time of Aristotle, who held that "the female always supplies the matter, the male the power of creation," the problem has engaged the attention of biological philosophers, and no doubt it will continue to do so for generations to come, for the more it is investigated the more intricate it becomes, and each new theory, evolved under the influence of new experimental methods, is discarded in turn as our knowledge of facts increases. Not the least interesting part of Prof. Lillie's book is the historical survey with which it opens. The discovery of the spermatozoon by Leeuwenhoek and Hamm in 1677 was epoch-making for biological science, and, of course, was rendered possible only by the advent of the compound microscope. Like all other great discoveries, it was immediately followed by sensational nonsense, and we find "a certain Dr. Dalen Patius" claiming that the human body is actually visible in perfect miniature within the spermatozoon! This grotesque view, however, was but an extreme form of that held by the spermatist school in general, which maintained that the ovum plays no other part in the production of the young animal than that of furnishing the germ contained in the spermatozoon with nourishment.