ments produced. The relation between agouti and black is precisely the same as that between short hair and long hair due likewise to differences in follicle activity, as I have elsewhere shown, but inherited quite independently of hair pigmentation. Short hair is the result of a determinate growth cycle; the hair grows so long and then stops growing; long or angora hair is the result of indeterminate activity on the part of the hair follicle; the hair keeps growing so long as its follicle is alive.

We are now able to give a rational explanation of the *origin* of the various color varieties of rodents. The wild cavy transmits *in all its gametes* the three factors *A*, *B* and *R*. By accident (mutation) a gamete has been formed which lacked *A*. When two such gametes came together the result is a black individual, *and this individual will breed true*. Here is the explanation of our occasional black squirrels, porcupines and the like. If by a further mutation *B* is lost, leaving *R* alone, a red race is produced which will breed true and *will not give reversion on crossing with blacks*. Such are ordinary red guinea-pigs.

But if mutation is directly from the wild or agouti condition, *ABR*, by loss of *B*, leaving *AR*, then there is produced a red not different from ordinary reds in appearance, but which will give reversion in crosses with black.

The albino mutation, which is frequently found in wild as well as in tame rodents, is not due, as might be supposed, to simultaneous loss of the three factors *A*, *B* and *R*, for albinos can be shown to possess, some one, some two and some all three of these factors. They have, according to Cuènot, lost a certain other factor necessary for the production of pigment of any kind, an activating or ferment-like factor.

It has been observed that one mutation is often followed by another. De Vries in his *Mutationstheorie* speaks repeatedly of *periods of mutation*. We can begin to see the significance of this; given one mutation, we can produce others.

Suppose, for example, that we possess agouti and ordinary red varieties only and desire black, we are not compelled to await a mutation to produce it; we can cross red with agouti and obtain black in the second generation. This is not hypothesis merely; its correctness has already been in part demonstrated. Thus, in one experiment, there was employed an agouti of the formula $AB \cdot AR$, which gave only reds and agoutis in crosses with red, but the agoutis so produced when mated in the same way as the parent gave blacks as well as reds and agoutis, for they were of the formula $AB \cdot R$. From such animals homozygous blacks ($B \cdot B$) are readily obtained.

To produce a red variety from agoutis and blacks alone would not be so easy; it would be necessary either to await a mutation or to work by the slow process of selection from continuous variations in the intensity of blacks under cross-breeding with agoutis. In mice and rabbits as well as in guinea-pigs red (or yellow) varieties are well known, but in rats yellow has never been obtained separate from black, though black and agouti varieties are common, both wild and in captivity.

We now know what the 'fixation' of a heterozygous character implies. When *A* and *B* are crossed, we obtain *C*. *C* is due either simply to co-existence of *A* with *B*, or to the co-existence with them of a third factor introduced with one or the other. In either case fixation will consist in getting *into the gamete* all the factors which produce *C*. In the first case, the zygote is $A \cdot B$, and the resultant is equivalent to *C*. Fixation will consist in getting a zygote of the formula $AB \cdot AB$; every gamete produced will then bear the equivalent of *C*, viz., *AB*. In the second case, the zygote is either $AC \cdot B$ or $A \cdot CB$; fixation will consist in obtaining a zygote, $ACB \cdot ACB$; every gamete formed will then contain the three factors, *A*, *C* and *B*.

W. E. CASTLE
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December 26, 1906

BOTANICAL NOTES

THE RUSTS OF AUSTRALIA

UNDER this title D. McAlpine, the government pathologist of Victoria, Australia, prepared a book of 350 pages, which has been

issued by the Department of Agriculture of that province. In it the author "aims at recording all rusts, as far as known in Australia at present," so as "to prepare the way for a consideration of the best methods of preventing their appearance, or limiting their spread in the numerous commercial crops subject to their ravages." Part I., consisting of 75 pages, is devoted to the general characters and mode of life of the rusts (*Uredineae*). This portion would be a very helpful text-book for college students anywhere, since the matter is presented in a clear and comprehensive manner. It appears that in Australia *Puccinia graminis* does not infect the barberry, even where the attempt is made to bring about such infection by artificial means. This is much like the condition which prevails on our own great plains, where wheat rust is sometimes very abundant, although there may be no barberry plants in the neighborhood, or if these are present they may have no aecidiospores upon their leaves. Part II., which includes 260 pages, is devoted to classification and technical descriptions. The arrangement here is principally by hosts, the rusts of the *Gramineae* being taken up first, and then those of *Cyperaceae, Juncaceae, Liliaceae, Haemodoraceae, Amaryllidaceae,* etc. Fifty-five plates (eleven of them beautifully and accurately colored) help to render the descriptions more easily understood. A glossary of technical terms, a bibliography, an alphabetical host index, a fungus index (alphabetical by genera) and a general index complete this very satisfactory volume.

POPULAR CANADIAN BOTANY

This appears to be the day of popular botany of a type somewhat different from that which used to be prepared for the perusal of the non-scientific reader. All the books on the ecological phase of botany owe much of their readableness to the fact that they are popular in a certain sense. They tell a good deal about plants and vegetation in language that may be understood by people who are not experts in systematic botany. The scientific lists of plants which used to be published were very illuminating to those botanists who knew plants by their latest Latin names, but they conveyed only the haziest ideas to other people, even though they were botanists, in some other field. So when we found books in which there were consecutive pages of 'reading matter' telling something about the kinds of vegetation in a field, a county or a state, no wonder that a good many of us rejoiced that at last we had the means of finding out about the plants of a region without the labor of building up a picture of its vegetation from the bare lists. All this time also there were popular books which aimed to please the non-scientific reader by presenting the beauties, the oddities, the curiosities in nature. Such books usually dwelt upon the wonders which the reader might see if only he was willing to open his eyes in the right way—the way of the author, of course. That such books are not yet extinct is shown by the republication, after revision, of Mrs. Traill's 'Studies of Plant Life in Canada' (W. Briggs, Toronto), a book of somewhat more than two hundred pages of descriptive text, accompanied by twenty plates, a part of them done in colors. The text is likely to appeal to many young people who have not yet waked to an appreciation of the scientific aspects of botany, and it will appeal, also, to many older persons who look at all vegetation as something to be admired and enjoyed without too much hard study. It has been recommended by several of the Canadian botanists as a book for use in nature study work in the public schools, and no doubt it might be helpful in such case if used as a reading text for the purpose of suggesting the notice of the many pretty and attractive plants to be found everywhere. Since poetry and Scripture are freely quoted the moral effect of the book is likely to be elevating, at least the author has distinctly intended it to be so.

THE PHILIPPINE JOURNAL OF SCIENCE

The announcement is made that beginning with the second year of its publication *The Philippine Journal of Science* will be issued in three divisions or series, viz., (*a*) general science, (*b*) medical science, (*c*) botany. This

will enable botanists to subscribe for the botanical parts alone, a considerable convenience, since the subscription price is only two dollars (U. S. currency) for the botanical series, instead of five dollars, as heretofore for the whole journal. As this publication is of constantly increasing importance to American botanists, it is hoped that it will be generously supported. Subscriptions are to be sent to the Director of Printing, Manila, P. I.

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