Incidentally, the object of these experiments is by no means restricted to the taking of photographs in the earth's atmosphere, although this application may have more uses than were at first suspected.

Regarding the ultimate developments of the method, I do not wish to leave the impression that these will be restricted to researches in or near the earth's atmosphere. On the contrary, every one of the matters so far proposed is, as I have already maintained, based upon sound physical principles, and can therefore be realized. Further, there are additional principles, the application of which is certain to lead to results of even greater interest and importance. All these results will be realized, however, not by argument and discussion, but by the application of real research methods to the problems that are waiting to be solved.

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SCIENTIFIC BOOKS

Studies on the Variation, Distribution, and Evolution of the Genus Partula. The Species Inhabiting Tahiti. By Henry Edward Crampton. 313 pp., 34 plates, 252 tables, 7 text figures. Publication No. 228 of the Carnegie Institution of Washington, January, 1917.

Interest having been diverted from pure science by the war, no adequate review has appeared of this monumental and fundamentally important work which represents the results of four journeys of exploration made by its author in Polynesia; in the course of which more than 75,000 adult snails were collected together with over 7,000 adolescent individuals; more than 200 of the valleys of the Society Islands having been visited for this purpose.

The present volume deals with snails from Tahiti alone, and the thorough, scholarly, and conservative treatment given the subject renders this work of paramount value to all future students of the variations of *Partula*.

Not alone were variations and distribution of the adult snails studied, but the young contained in the brood pouches of the adults were dissected out, thus throwing light upon the fecundity of each variety, and the ratio of elimination of the young before they can reach maturity.

Crampton shows that these snails are not found in the dry low-lands along the shore, nor do they occur in the cold regions of the high peaks of the interior, for a temperature of 55°–60° F., stops their activity. The snails are therefore restricted to the relatively moist deeply wooded troughs of the intermediate regions of the valleys where they are commonly found during the day-time on the undersides of the leaves of the banana, wild plantain, caladium, turmeric, wild ginger and dracæna.

The ridges between valleys are generally dry, and thus the snail population of each valley is more or less isolated. Crampton finds that these snails descend from the trees and bushes and feed during the night, or on moist days, upon decaying vegetation. The young and adolescent being more active in this feeding reaction than are the adults.

It has long been known from Garrett's studies that the Tahitian species of *Partula* like the *Achatinella* of Oahu varied from valley to valley, some forms ranging over a wide area while others are restricted to a single valley, or even to a limited region within a valley.

In general moreover the farther apart two valleys the wider the diversity between their snails, although this is not always the case. Crampton's work has the merit of giving precision to our hitherto more or less vague knowledge of the distribution of the 8 species of *Partula* found in Tahiti. He shows conclusively that great changes have occurred since Garrett studied the snails, in 1861–1884, and that in some cases the species have spread over wider areas, and in the interval have produced some new sub-species or varieties. Thus the fascinating picture of a race in active process of evolution is presented. The details of this process are rendered clear by the excellent photographs of relief maps, and

the numerous diagrams which accompany the text.

In a brief review such as the present it is not possible to do justice even to some of the more important details of Crampton's masterly work, but it is interesting to see that according to Garrett, *Partula clara* was rare and found only in a sector of valleys comprising about 1/4 the area of Tahiti, while Crampton found it to be very common and to range over 4/5 of the whole island, this dispersal having been accomplished by migration from the former restricted habitat of the species. There are now 7 subspecies, and mutation has occurred not only in some of the new valleys the snail has occupied since Garrett's time but also in the area in which it was found by Garrett.

Partula nodosa which in 1861 was confined to Punaruu valley has now migrated into 6 other valleys, and 3 new varieties have arisen in the area into which it has traveled, as Crampton illustrates in his text-figure 6 on page III.

Nearly one half of Crampton's volume is devoted to an analysis of the group species *Partula otaheitana* with its 8 subspecies and varieties of primary, secondary, and tertiary degree, thus constituting the most complex of the known species of *Partula*.

Crampton collected more than 20,000 adult and 6,000 adolescent snails of this form in practically every habitable area of Tahiti.

In Fautaua valley these snails form an extremely complex colony which stands in parental relation to the diverse colonies of other valleys; for in any one of the latter the shells exhibit one combination or another of the so-called unit characters displayed by the Fautaua group as a whole. In this snail Crampton finds some evidence that in the variety *rubescens* red and yellow colorations bear a Mendelian relation to one another, red being dominant. On the other hand in the variety affinis plain color seems to be dominant over the banded pattern in Mendelian inheritance.

Partula hyalina is peculiar in not being confined to Tahiti for it is found also in Mangaia, and Moki of the Cook Group and Rurutu and Tubuai of the Austral Islands, and in marked contrast to this wide dispersal *Partula, filosa,* is found only in Pirai, and *P. producta* in Faarahi valley and have not migrated from these valleys since Garrett's time.

Crampton concludes that in the production of new varieties the originative influence of environment seems to be little or nothing, and isolation is a mere condition and not a factor in the differentiation of new forms. This is in accord with the studies of Bartsch upon *Cerion,* for he found that no new varieties were produced in any of the numerous colonies of Bahama Cerions which he established upon the Florida Keys from Ragged Keys near Miami to Tortugas. When however, these Cerions of Bahaman ancestry crossed with the native Florida from the second generation of the hybrids gave rise to a large number of variations both in form and color.

This observation indicates that similar experiments should be conducted upon *Partula,* for it seems possible that new species may result from the breeding of mutations with the parent stock, or of species with species producing fertile hybrids unlike either of the parent stocks.

The editorial work upon Crampton's volume reflects the greatest credit upon Mr. William Barnum the well known editor of all publications of the Carnegie Institution of Washington. The 15 colored plates lithographed by Hoen are faithful reproductions of the colors and appearance of these snails, and the fact that the book is published upon the best of paper is fortunate for it will be even more interesting to students a hundred years hence than it is at present.

Crampton's work is of such wide interest and importance, and in the light of Bartsch's observations so suggestive of future experimental research that it is hoped these studies may be pursued continuously under the auspices of the Carnegie Institution until final conclusions have been reached through breeding experiments conducted in the field.

A. G. M.