by the systematist, or has rarely been considered at all, for he has no means of testing it, and to him the two sets of adaptive characters must be equally specific, whatever their origin. Nor is it easy to see how a universal measure of discrimination can ever be supplied, for even if a few general laws were derived, as doubtless they will be, from experimental observation of the kind suggested by Dr. Jordan, it is not likely that they would be serviceable in special cases much, if at all, beyond the limits of what we now call local or climatic variation, and, manifestly, it is out of the question that every uncertain case can be brought under such experimental conditions as those which have shown the real relations of the Loch Leven trout. Organic selection has much emphasized this difference between the logical and the practical ideas of species, and has supplied the taxonomist with a problem of which he has no solution in sight. It seems probable that the lack of such a solution is behind the most extreme of the opinions held by the authors of the respective theories of 'mutations' and 'isolation.'

Quite another modifying influence upon present methods of classification appears in the facts of analogous evolution, of which paleontologists have been accumulating evidence. If like environments tend to induce similar modifications in unrelated groups, it at once becomes evident that systems of classification based upon such likenesses of structure may not in all cases reflect the genetic connection which, since Darwin, we have believed them to approach. Therefore, classification in the modern sense being worthless if it fails to correspond to descent, it seems not unlikely that geographical considerations may come to enter more largely into the composition of genera than has hitherto been the case with conservative naturalists, for in a strictly genetic system it would not be permissible to place in the same genus species so widely separated by present or past geographical barriers that we are forced to believe that they can not have developed from the same source.

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ETHNIC TYPES AND ISOLATION.

RECENTLY several articles have appeared in this journal discussing geographical isolation as a factor in the differentiation of species, and the illustrative observations taken from both the animal and plant life of North America correspond in a way to well-known ethnographical facts. The writer does not intend to discuss the virtues of the isolation theory as a condition of biological variation, but wishes to call attention to the fact that such a theory seems to account for a number of differences in the culture of Indian tribes.

It is customary to divide the aboriginal inhabitants of North America into linguistic stocks and it is estimated that there are at least fifty distinct linguistic families north of Mexico. These were distributed in a very striking way. In the Mackenzie basin we have the Athapascan stock, around the Great Lakes, Hudson Bay and Labrador, down the Ohio River and east to the Atlantic Ocean, the great Algonquin group with an intrusive Iroquois stock in the vicinity of New York state. In the Gulf states were the Caddoan, the Muskhogean, and a number of small groups. The great plains and prairie area was dominated by the Sioux and Shoshone stocks. If in contrast to this we examine the Pacific coast we find in California alone twenty stocks and between the northern boundary and Alaska ten other stocks. The Pueblo region to the south presents conditions somewhat similar. Thus a brief résumé of the distribution of linguistic stocks in North America brings to view relations strikingly similar to the distribution of species as noted by President Jordan.

Some one has proposed to account for the great number of Indian languages in California by assuming that a few young children lost now and then in the isolated valleys of the country would, if they survived, develop new languages. While ethnologists do not take this theory seriously they often give expression to a similar view, viz., that a people without a written language living for a long time in a given area separated from the parent stock will gradually form a new order of speech. This is a theory of differentiation by

isolation. It has often been stated that the geographical character of California was such as to make it, if not the incubator of living stocks, at least their nursery.

However, no satisfactory explanation has been given for the great diversity of languages in North America. The fact that tribes have wandered from Canada to New Mexico and California and after ages of separation still retained their former language indicates a conservatism in linguistic change that renders the isolation theory an unsatisfactory one.

If, however, we do not consider linguistics at all and look at the cultural habits of the people in their more psychological aspects we find more reason for assuming isolation to be an important fact. Notwithstanding the great number of linguistic stocks in California all present cultures that can be distinguished from the cultures of other geographical areas by certain common characteristics. In the plains we find two large powerful stocks with a culture that had other distinctive characteristics in common. Again, in the east were the Iroquois and the Algonquin with the same culture. Plains culture stopped at the woods and woods culture stopped at the grass line; California culture kept to the west of the mountains and the plains culture to the east of them. Thus we have well-defined culture areas corresponding to well-defined geographical areas. In one case high mountains isolated a culture, in the other the woodlands were the cause of separation. The woodlands presented no great physical barriers to the plains people, but the latter had acquired food, shelter and transportation habits that made the woods uncomfortable and a place to be dreaded. A people accustomed to traveling over the free and open plains must have felt uneasy and afraid when traversing the woods, because of inability to see what was just beyond, and the people of the woods must have felt the insecurity of the plains because there were few hiding places and no one could travel without being seen. We all know how the at-home feeling ties us to the tenement or the palatial dwelling, as the case may be. Then, again, a people that had been trained to chase the buffalo on an open plain would not understand hunting in the woods and would be driven back to the plains by the demands of an empty stomach. It is difficult for a race to change its food habits, perhaps much more difficult than for us to change our most pampered ways. Transportation habits will hold a people to the watercourses, the upland, the lowland, etc., as the case may be. Even shelter habits may be binding, as the snow-house building of the Eskimo and the adobe wall-structure of the Pueblo. In general it seems that culture is often confined to a given area because the inhabitants are prevented by physical barriers and cultural habits, such as those of food, shelter, transportation, etc., from affiliation with the culture of other areas. The force of this theory in ethnography is augmented by the fact that the barriers are psychological rather than physical. Yet, as psychological structures they are erected upon physical foundations. It is the character of the surface and climate with the concomitant fauna and flora that reacts upon the ethnic life of the more primitive inhabitants of a given area.

The fact that so many linguistic stocks with the same culture are found in the same area is probably due to migration, for if a people do surmount the culture area barriers and survive they soon take up by imitation the habits of the older population, thus adopting the culture of the area. On the other hand, they retain their language and physical characteristics, which may be considered as habits of greater stability. The fact that California presents a culture area comprising a large number of linguistic stocks in contrast to the small number of stocks in other areas may be due to the physical barriers that have discouraged intermarriage and sociability, but not the dissemination of ideas or practical and religious knowledge. Thus the observed distribution of linguistic stocks is apparently not a contradiction to the assumption made in the foregoing.

Without attempting to enumerate all the factors that tend to isolate a culture area we may conclude that from a strict ethnic point of view types of culture are due to geographical isolation in concomitance with psycho-

physical conditions. We have based this discussion upon North American types because the physical aspect of the barriers are not so pronounced as in some other parts of the world and because we wished to emphasize the psychological aspect of these barriers. Although the writer knows nothing of the biological problem that has been discussed in these pages, he ventures to suggest that the habits of animals formed in response to environmental conditions may become psychological barriers to diffusion. There may be a kind of psychophysical at-home feeling that ties a species to certain areas.

CLARK WISSLER.

SPECIAL ARTICLES.

PHYSIOLOGICAL REGENERATION IN INSECTS.

MORGAN in 'Regeneration' (1901), p. 19, defines physiological regeneration as follows:

> Finally, there are certain normal changes that occur in animals and plants that are not the result of injury to the organism, and these have many points in common with the processes of regeneration. They are generally spoken of as processes of physiological regeneration. The annual moulting of the feathers of birds, the periodic loss and growth of the horns of stags, the breaking down of cells in the different parts of the body after they have been active for a time, and their replacement by new cells, the loss of the peristome in the protozoon, *Stentor*, and its renewal by a new peristome, are examples of physiological regeneration. This group of phenomena must also be included under the term 'regeneration' since it is not so sharply separated from that including those cases of regeneration after injury, or loss of a part, and both processes appear to involve the same factors.

Again, on p. 25 (*ibid.*), Morgan says that he will use the term physiological regeneration to include such changes "as the moulting and replacement of the feathers of birds, the replacement of teeth, etc.—changes that are a part of the life-cycle of the individual. In some cases it can be shown that these processes are clearly related to ordinary regeneration, as when a feather pulled out is formed anew without waiting for the next moulting period, and formed presumably out of the same rudiment that would have made the new feather in the ordinary moulting process."

Finally, on pp. 128–131 (*ibid.*), Morgan refers to the general fact that 'in the same animal certain organs may be continually worn away and as slowly replaced, and other organs replaced only at regular intervals,' and he lists a number of familiar instances of regularly recurring physiological regeneration, as the moulting of snakes, the throwing off of deer antlers and their renewing, and also the moulting of insects. As this is the only instance of physiological regeneration in insects mentioned by the author, and as it seems to be desirable to know, especially as a basis for any discussion of the relation between 'physiological regeneration' and the more familiar restorative phenomenon called simply 'regeneration,' of any other instances of physiological regeneration occurring among the lower animals—almost all the cited cases of physiological regeneration are among the vertebrates—I wish to point out briefly certain important and widespread phenomena in insect biology which should be included in the category of physiological regeneration processes. Indeed, Morgan specifically refers to the need of such further knowledge. "How far," he says, "physiological regeneration takes place in the tissues of the lower animals we do not know at present except in a few cases, but far from supposing it to be absent, it may be as well developed as in higher forms."

First may be mentioned the radical regeneration of the digestive epithelium of the ventriculus, common to all (?) insects, a phenomenon long known, albeit in a rather hazy way perhaps, to students of insect morphology, but in the last ten years carefully studied and satisfactorily worked out for a number of insect forms representing several widely separated orders. (See the papers of Mobusz, Rengel, Van Gehuchten, Needham and others.) This process consists of the constant senescence and complete degeneration of the nuclei and cytoplasm of the large epithelial cells of the ventricular portion of the alimentary canal and of the equally constant appearance of new nuclei in conspicuous small