

light near the convergent to arrange itself in the form of an hyperbola, but no definiteness in the position of the axes could be detected other than a tendency for the visible hyperbola to occupy a quadrant opening toward the north or northeast. At many times during the hour the auroral display covered large sections of the southern sky, and the writer can remember thinking of the peculiar lateral shifting of the curtain in certain auroras and wondering how this would look if it took place near the convergent, but saw no such movement. At times a shaft of light more or less meridional in direction lay across the convergent.

At the time the writer hoped that others were making similar observations and that it might be possible to determine the height of the point of convergence and he was somewhat surprised later to realize that his observations indicated the further fact of a change in the position of the convergent with reference to the stars which seemed only partly to be explained by their rotation. He only hopes that similar observations were made by others in different places and that the ones herein recorded are sufficiently accurate to make them of value. They at least have the merit of having been made by one who had no preconceived idea of what they might indicate, and who regrets, if they prove to have value, that he was unable to make use of more exact tools.

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#### THE DOMESTICATION OF THE LLAMA

TO THE EDITOR OF SCIENCE: A note in SCIENCE for March 15, 1918, by Mr. Philip Ainsworth Means, leads the reader to believe that the llama, alpaca, vicuña, and guanaco are distinct species and that the common belief is that all have been domesticated to some degree.

Prior to about 1890 there was great confusion regarding the specific status of these four animals, though the prevailing theory was that the llama had been derived from the guanaco and the alpaca from the vicuña. It is now known that the vicuña has never been domesticated, and that the alpaca and the llama are

both domesticated forms of the wild guanaco.<sup>1</sup> In view of the conspicuous differences between these two tame races of the guanaco it is easy to believe that a very long period of actual domestication has obtained, for the alpaca has been bred for his wool and the llama has been developed as a beast of burden as effectually as any of our races of domestic animals have been produced for special purposes by the most careful selective breeding.

The llama and the alpaca are not known in a wild state, though they of course occur, as do almost all other domesticated species, in a semi-wild or feral condition. They represent one of the rare cases of true domestication of an animal, and one of the still rarer cases where the ancestral species is known and still exists as a wild creature. Contrary to the statement in SCIENCE, they do breed freely in confinement; but since so many wild animals propagate regularly in captivity this can hardly be considered a test of true domestication.

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#### THE AUDIBILITY OF SOUND

REPLYING to the suggestion of Mr. Willard J. Fisher, in your issue of April 26, that an investigation be made of the area about Halifax with regard to audibility of the sound from the great explosion there, it may interest you to know that such an investigation was undertaken by the National Geographic Society not long after the occurrence of the explosion and that a quantity of data has been accumulated which is to be charted and tabulated as soon as other work will permit.

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#### SCIENTIFIC BOOKS

*The American Indian. An Introduction to the Anthropology of the New World.* By CLARK WISSELER, Curator of Anthropology in the American Museum of Natural History, New York City. New York, 1917. Pp. xiii, 435.

<sup>1</sup> Thomas, *Proc. Zool. Soc. London*, 1891, pp. 385-387.

It is now nearly thirty years since the appearance of Brinton's "American Race." Primarily an attempt at a linguistic classification, especially of the South American tribes, this volume gives in a very summary form a general survey of all the peoples of the New World. The generation which has elapsed since then has been extraordinarily prolific in the accumulation of new data, but until the publication of Dr. Wissler's volume, no serious attempt had been made either to gather together and correlate this great mass of new material, or to give a really adequate account of the peoples of America and their culture. The debt, therefore, which not only anthropologists but all who are in any way interested in the aborigines of the New World, owe to the author is great, for not only has he judiciously summarized and correlated the results of a host of special investigators, but he has drawn from these results general conclusions of wide importance, which gain greatly in their force by the careful consideration shown for the form and order of the presentation and discussion of the material.

The first thirteen chapters are given to a consideration of the major facts of the culture of the Indian throughout both continents. Beginning with the material culture, the fine arts, social grouping and regulations, ritualistic observances and mythology are treated in order. On the basis of these facts, the peoples of the two continents are grouped in fifteen culture areas, whose limits and characteristics are defined. Next the archeological data are summarized, with the result that twenty-four typical areas are recognized. Archeology having introduced the time element, such evidence as exists on the chronology of American cultures is presented, both dependent on stratigraphic as well as actual historic data. The linguistic and somatic characteristics and classifications are next passed in review, and the broad foundation thus completed for the suggestive and stimulating final three chapters. In the first of these the separate results of the classification on cultural, linguistic and somatic data are

correlated, and the influences and importance of migration and of environment are discussed. In the second, the larger questions of culture origins and of the association of culture traits are considered, with the resulting conclusion that culture must be studied and explained from the historical standpoint rather than the biological, which is here not applicable. Finally, in the concluding chapter, the ultimate questions of the origin and relationships of American culture and of the American peoples are outlined. Here the case for the virtual independence and purely local origin of New World culture is clearly and convincingly stated, although from the physical standpoint, the ultimate Asiatic origin of the Indian is demonstrated with equal force. In an appendix useful tables of linguistic stocks are given, bringing together for the first time in handy compass, the material for both continents. A selected bibliography, mainly of the more recent authorities, closes the volume.

It would be of little value to attempt to summarize in the space available, the great mass of material in the book; one can only point out a few of the more important general conclusions reached. One of these is this, that in the domain of material culture, the higher developments were nearly all concentrated in the area of intensive agriculture, and that it is probable that these higher cultural elements spread not singly, but often in association, *e. g.*, that the knowledge of and the making of pottery and textiles, spread with the use of agriculture. On the social side, the fundamental unity of type is pointed out, and evidence brought forward to show that clan organization, dual grouping, age-grades, secret societies and the totemic complex are not necessary stages in the evolution of society, but rather local developments, based on special conditions. This fundamental unity of the peoples of America and the independence of their culture is emphasized in many ways, and the point well made that all the varied attempts to derive the whole or portions of this culture from Asiatic or Polynesian sources, overlook the chrono-

logical factor, which in this case can be shown to be decisive. Perhaps the most suggestive portion of the volume is at the end, where Dr. Wissler brings out the ultimate common derivation of the American peoples and those of the great Mongoloid group in Asia. Summed up, his conclusions are that a detachment of the parent Mongoloid group came into America at a time when man had barely attained the stage of making polished stone implements. This period was not necessarily contemporaneous with the same development in Europe, for it may well have been even earlier. After this detached portion of the group had spread into the New World, climatic changes cut off the connection, and forced both the parent and the derived group toward the south. In the Old World, contact with other differentiated groups gave to the Asiatic branch culture stimuli; in the New World these were lacking, and the people developed in isolation. In the New World the rate of progress along the culture road was thus slower than in the Old, and we may well ask what another thousand years of uninterrupted growth would have produced.

Throughout the volume effective use is made of maps showing the distribution of the various features under discussion. If criticism were to be made of these, it would be in regard to the use of rigid rectilinear boundaries. In spite of the author's justification of this method on p. 242, it would seem that his purposes could have been equally attained by a little more adherence to the actual facts. It is also rather aggravating to find several cases where the map and the text do not agree. Thus on p. 59 it is said that the loom was probably developed in the area of intensive maize culture, and "from there it was diffused around the north coast of South America and down the east side," yet in the map, Fig. 20, there is no indication of its extension beyond western Venezuela. The plates and illustrations are in general excellent, but one may question the wisdom of reproducing the crude woodcuts from Wood's antiquated volumes, when more modern sources are available.

In dealing with so large a body of evidence, it is inevitable that many controversial points should be touched upon, and reference to a few of these may be made. There are also a few cases of apparent contradiction, and some errors of statement. Thus in the chapter on food areas, the squash is said (p. 18) to be cultivated in the northern half of the eastern maize area, whereas in the list of "Plants Cultivated by the Natives of the New World before 1492" (p. 20) the area of cultivation is given as "tropical America." Again, on p. 12, the original inhabitants of the Guanaco Area are said to have used the lasso in hunting, although later (p. 35) this instrument is declared to have been invented only after the introduction of the horse by Europeans. In showing the distribution of tailored garments (Fig. 23) it is somewhat doubtful whether the areas occupied by the Montagnais and Nascopie in Labrador, and by the Micmac in the Maritime Provinces, should be included. In Fig. 24, showing the distribution of types of footwear, the considerable use of the sandal in the southeastern states is not indicated. On p. 111 in describing the houses of the Californians, a somewhat incorrect impression is given, for the large and solidly built semi-subterranean, earth-covered lodges which were typical of much of the Central Californian region, are not referred to. In discussing the distribution of the grooved axe, its occurrence in South America is said to be limited to Ecuador, whereas it occurs outside this region, from northwest Argentina to Guiana.

In Chapter XIV., in discussing the several culture areas, Dr. Wissler is right in saying that the Eastern Woodland Area is one of which the "characterization is difficult." Granting this, it seems somewhat dubious to select the Central Algonkin group as the type, for if the northern is to be thrown out because of its similarities to the Mackenzie Area, the Iroquois and the Eastern because of southern influence, this geographically smallest portion lying southwest of the Great Lakes is equally disqualified by this same

southern influence as well as that of the Plains. The fact is, that the convenient lumping together of all the tribes of the northeast of the continent in one area can hardly be justified, and this region, territorially great and culturally quite varied, must be split up if we are to keep true to the facts. A similar difficulty arises in the attempt to bring all the peoples of the southern tip of South America together in one area. This involves the collocation of such different types as the Yaghan and Alikaluf, with the Araucanian and Guycuru, tribes which had little or nothing in common except the fact that they were non-agricultural.

Similar questions may well be raised in regard to Archeology. Thus it is not clear why the extreme southwest corner of the North Atlantic Area should be taken as the type for the whole region, when a large proportion of the characteristic elements given are demonstrably even more typical of the areas to the west and south. The map (Fig. 76) again, does not agree with the text in the limits given to the South Atlantic Area. The discussion of the Mississippi-Ohio Area is quite inadequate, as no attempt is made to give an idea of the more characteristic and peculiar types of mounds and earthworks in the Ohio Valley. In areas XIX. and XX. no mention whatever is made of the very abundant and characteristic well and chambered graves, whose importance in relation to cultures north and south is considerable, and which constitute perhaps the most striking single feature of this whole region.

In the chapter on linguistic classification, it is most unfortunate that a number of serious errors have crept into the map, Fig. 87, reproduced from that of Chamberlain, whose initials are incorrectly given. In Dr. Wissler's map five stocks given in his list are entirely omitted, viz., the Corabecan, Curacanean, Mainan, Puquinan, and Sanavironan; the following stocks are wrongly placed, No. 55, Ocoronan should be 65, Puquinan; No. 33, Enimagan should be 32, Curucanecan; No. 15, Canichanan should be 55, Ocoronan; No. 18 Caririan (in Northern Bolivia only)

should be 15, Canichanan. Errors of this sort seem rather inexcusable, when the map is merely a direct copy of Chamberlain's original.

In Chapter XIX., in speaking of the "migration factor," the author makes statements for which it seems difficult to give any justification. He says (p. 335) "migration is exceptional" and that when migrations do occur, "they all . . . are circumscribed movements in a single area." To speak of migratory movements extending over thousands of miles, as in the case of the Eskimo, Athabaskan, Tupi, Arawak, Carib, etc., as "circumscribed" is in itself rather staggering, but to declare that such movements of peoples were confined to a "single area" is simply a gross mis-statement of fact. If by "area" is meant "culture area," the cases of tribal movement from one to another are too numerous and too well known to need mention; if, as the remainder of the paragraph seems to indicate, Dr. Wissler means by "areas," regions of similar environment, the instances of transgression of these bounds by migrating tribes are still numerous. To take but a single case: just how does the author propose to make the known distribution of the Siouan tribes fit with his statement? Certainly the Biloxi of the sub-tropical Gulf coast, the Totero, Sara and Monacans of the Alleghanies of Virginia and North Carolina, the Crow of Montana and the Winnebago of Wisconsin can hardly be said to have been living in a "single area"!

A last word of criticism may perhaps be allowed in regard to the map at the end of the volume, showing the location of the more important North American tribes. There is no statement anywhere as to the date or period represented, but it is to be assumed that the intention was to show the locations at the time of the first European contact. If so, the map contains numerous errors. Thus the Ojibwa are shown far out in the plains west of Lake Winnipeg, while the Cree are extended almost to the base of the Rocky Mountains. These positions are certainly not those given by the earliest accounts which we have of these tribes, which are there con-

sistently placed much further to the east, and entirely outside the plains. One must also ask on what authority the Kickapoo are placed in southern Indiana, the Timuquana in southern Florida, the Arikara to the north of the Mandan, the Shasta in northeastern California and Nevada, the Quinaiaelt on the Oregon coast and the Tillamook in the Willamette Valley? These locations, so totally at variance with the accepted positions of these tribes, can only be due to carelessness in preparing the map, or to quite revolutionary new data which have come into Dr. Wissler's possession. Of the misprints noted, the following are the most important: p. 45, *asolepias* for *asclepias*, *apocyrum* for *apocynum*; p. 104, *rooms* for *roofs*; p. 182, *Guatavita* for *Guatavita*; p. 229, *Chaponec* for *Chiapanec*; p. 273, *northeast* for *northwest*; p. 292, *Hokan* for *Penutian*; p. 231, *Lecan* for *Changoan*.

The great excellence and value of Dr. Wissler's book, however, must not be thought to be impugned by these stray criticisms. He has accomplished a difficult task with conspicuous success, has drawn for us the first adequate picture of the aborigines of the whole of America, and has given us a volume to which specialist and layman alike may turn with confidence that they will find in it the latest results of study in this field, admirably arranged and clearly stated. To all who are in any way interested in the original Americans, the book will be indispensable.

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### SPECIAL ARTICLES

#### MASS MUTATION IN ZEA MAYS

THE principle of mass mutation, proposed by Bartlett on the ground of his researches on *Oenothera Reynoldsii* and *O. pratincola*, seems to me to be one of the most fertile discoveries made in the experimental study of the origin of new characters. In *O. Reynoldsii* the two first artificial generations were almost uniform, but in the third a splitting occurred, producing about 40 and 23 per cent. of two

new types, which were called *semiata* and *debilis*. In *O. pratincola*, which in a number of strains is constant with some stray mutations, one strain produced in the third generation four different types, called *formosa*, *albicans*, *revoluta* and *stricta*. The total percentage of these amounted to about 75 per cent.

In order to explain this sudden appearance in such large numbers Bartlett assumes that the fundamental mutation occurred in only one of the two gametes in a generation preceding the one in which the diversity became manifest. In the next generation it was masked by the dominance of the character transmitted through the other gamete. Segregation then occurs in the following generation and it bears a certain degree of resemblance to Mendelian segregation. But whereas the law of Mendel applies to hybrids between different species, varieties or races, here the splitting occurs within a single experimental pure line. The law of probability holds good for both cases, but the starting points are different. Mutational segregation is directly concerned with the origin of a new character, but Mendelian segregation assumes the pre-existence of all unit-characters involved. It should be remarked, however, that mass mutation is not necessarily limited to such cases, but may prove afterwards to embrace other types also.

It is now generally conceded that mutations take place ordinarily in the production of the sexual cells, some time before fecundation, probably at the time of synapsis. From this conception the conclusion directly follows that the copulation of two similarly mutated gametes must be rather rare. Far more frequent must be the instances in which a mutated sexual cell combines with a normal one. The first-named cases produced the full mutations, and the types with a doubled number of chromosomes, called *gigas*, are the clearest instances. Such forms have occurred in *Oenothera Lamarckiana*, *O. stenomeris*, *O. pratincola*, *O. grandiflora* and others. The individuals, due to the combination of mutated with non-mutated gametes may be called half mu-