a point on the Oxus corresponding to the western limit of the district called Khoja Saleh, and that, as the Afghans possessed this tract at the time of the earlier agreement, they should be allowed to retain it. This would, moreover, be in strict accordance with the principle laid down on that occasion; viz., that Afghanistan should be considered identical with the actual possessions of the Ameer Shere Ali.

To sum up the points presented by the Kham-i-Ab question, Russia has in her favor the specific mention of the name Khoja Saleh in the diplomatic documents. Beyond this fact, strong as it undoubtedly is, Russia does not seem to possess a weighty argument. On the other hand, there is the Afghan right of possession, unquestioned by anybody, going back for a long period, and confirmed in 1873. There is the recognition in 1873 of the Khanate of Akcha forming part of the dominions of Shere Ali, and consequently of Afghanistan. Finally, there is the practical fact that the Kham-i-Ab of the Afghans occupies almost the identical geographical site of the 'Khodsha Salor' of the Russians. Extraneous arguments may be easily introduced into the case by irresponsible writers; but these are really all the considerations that need affect the judgment of the two governments.

PACIFIC COAST WEATHER.

LIEUT. W. A. GLASSFORD, in charge of the Pacific coast division of the signal service at San Francisco, has lately presented a paper to the California academy of sciences on 'Weather types on the Pacific coast.' These types differ from those of the eastern United States in their relative lack of progressive motion, and consequently in their duration and in the less variability of the weather. Distinct areas of low pressure are rare in southern California, but increase in frequency northward, until they are most numerous about Vancouver's Island. The types recognized for the rainy season (winter) are, 1°, North Pacific cyclonic; low pressure over Oregon and Washington, high pressure in the Great Basin, with southerly gales along the coast, and general rains, heaviest in the north; 2°, interior anticyclonic; like the preceding, but with less distinct cyclonic conditions; the temperature is high with south-easterly winds; the warm 'Santa Anna' winds of Los Angeles occur under this distribution of pressures; 3°, North Pacific anticyclonic; high pressure in the north, and low in the south, giving clear weather with light, variable winds in the north, but with high winds and southerly gales on the coast of California; warm days and cool nights, often frosty; the dreaded dry 'north wind' of the Sacremento and San Joaquin valley prevails at this time; 4°, general cyclonic; a rare type, with very low pressure on the coast, giving severe storms of high southerly winds and heavy rain; 5°, South Pacific anticyclonic; moderately high pressure along the south-western coast of California, and no distinct centre of low pressure visible, but giving southerly rain-bearing winds; 6°, sub-normal type; irregular isobars and no decided gradients, with variable winds and weather. During the dry season (summer), the weather is very constant, with high pressure to the north-west over the cool ocean, and low pressure over the hot land to the south-east, northerly winds and no rain. The change from the wet season to the dry is indicated when the air temperature on the coast rises permanently over the ocean temperature. Lieutenant Glassford has also compiled an extended table of the rainfall on the Pacific coast from all sources, including some two hundred stations with records varying from one or two years up to thirty-seven (San Francisco and Sacramento). This was published in the San Francisco daily *Commercial news* for July 1, 1886. The maximum precipitation is given for Neah Bay, Washington Territory, where the annual average of nine years' record is 110.12 inches. Many other stations in the north exceed fifty and sixty inches a year. In the south, the minimum falls nearly to two inches, being 2.56 at Yuma, Arizona, from an eleven-year record. The lowest of all is a three-years' average for Bishop Creek, Cal., where the annual precipitation is only 1.31 inches. The table gives the months separately, as well as the yearly total, so that the seasonal variation is well brought out. In July and August only nine and ten stations respectively have over an inch of rain, and these are all in the north or in the interior; while no rain at all is given for eighty-two and ninety stations, and a number more have only a trace or one or two hundredths of an inch.

DR. ROMANES ON PHYSIOLOGICAL SELECTION.

DR. GEORGE J. ROMANES, who, in more than a literal sense, may be said to be the legatee of Darwin, publishes in *Nature* (Aug. 5, 12, 19) an abstract of a paper read before the Linnean society, entitled "Physiological selection: an additional suggestion on the origin of species."

The necessity of such an additional principle is made evident by considering three objections to natural selection as a theory of the origin of species. 1°. The difference between species and varieties in respect of mutual fertility. It is a fact

that many domesticated varieties, though differing from one another to a greater extent than many natural species, retain a perfect fertility among themselves. The consideration that sterility between natural species is not absolute, slightly changes but does not solve the problem. Mr. Darwin admitted the difficulty, and suggested the improbable hypothesis that the sterility was the incidental effect of uniform conditions of life on the generative system. 2°. The swamping effects of free intercrossing upon any individual variation would more than outweigh the action of natural selection; and to answer as Mr. Darwin does, that many individuals might simultaneously undergo the same modification, is to appeal to a highly improbable series of events, especially when it is remembered that, 3°, these specific distinctions are so often of a useless character. Mr. Darwin frankly admitted that many of these meaningless detailed distinctions, like the general distinction of sterility, were not explained by natural selection.

In view of these objections, Dr. Romanes thinks that the theory of natural selection has been misnamed. It is at once a different and a much broader theory, — different, because it explains the origin, not of species, but of adaptations of all kinds, morphological, physiological, and psychological; broader, because it accounts for these adaptations, whether they occur in species only, or also in genera, families, orders, or classes. To realize, on the one hand, that natural selection does not primarily explain the origin of species, but only the development of adaptations, and, on the other hand, that the distinctions which it does explain are not confined to species, is the key to the right understanding of this great biological principle. When natural selection did produce species, it was because accidentally the differences to which it gave rise were specific in character: its business was to evolve adaptations.

It is to one among these other causes which have been shown to be necessary for accounting for the origin of species that Dr. Romanes devotes special attention: he calls it the prevention of intercrossing with parent forms, or the evolution of species by independent variation.

The number of trifling variations, even in one generation, is enormous. The fact that natural selection preserves the useful ones alone, and yet can furnish 'the whole adaptive morphology of nature,' gives us a glimpse of the necessarily enormous number of non-surviving, useless variations. Now, if the possessors of any of these useless variations were prevented by any means from intercrossing with those who did not possess them, these unuseful variations would be perpetuated by heredity (witness our domesticated productions), and those varieties of the old species would gradually pass into a new species. On this principle, the opportunities for independent breeding without crossing with the parent forms explains the extraordinary prevalence of peculiar species in isolated oceanic islands. Geographical barriers and migrations can produce the same result. And this hypothesis is made doubly strong by the consideration, that, in these cases where the extinction of the variation has been prevented (by preventing the swamping effects of intercrossing with the parent form), the variations thus perpetuated are generally of a useless character. But the existence of natural barriers will not account for all cases of species-formation by independent variation, because some degree of sterility occurs between even closely allied species, and because closely allied species are not always separated by geographical barriers. The principle of physiological selection must be called in to complete the explanation.

Probably the most variable part of the organism is the reproductive system; and these variations are either in the direction of increased or of diminished fertility. These variations would be more commonly observed, were it not that by their very nature they lead to more or less immediate extinction. But if the sterility were confined largely to crossing between the parent and the varietal form, while the varietal form continued fertile *inter se*, the conditions for the formation of a new species would be furnished. The result of this would be, that, as before, some individuals living on the same area as the rest of their species would be prevented from having progeny with this rest. The only difference is, that in the former case the barrier was geographical: here it is physiological. It is understood, then, that wherever such a variation in the reproductive system occurs that diminishes the fertility between the varietal and the parent form, though retaining it among the varietal, this physiological barrier will end in dividing the species into two sections, each free to develop independent, distinct histories. On this principle, variations in parts other than the reproductive system, unless such variations were useful in character, would not be preserved; but, when the difference in respect of the reproductive system had set in, other differences would secondarily supervene by independent variation. To prevent an unfair objection, it may be added that this theory is not concerned with the kind or cause of this variation any more than that of natural selection: it sets out with the fact.

It will be impossible in so brief a notice to do more than outline the evidence which Dr. Romanes

gathers in support of the hypothesis of physiological selection, on the segregation of the fit. Domesticated varieties cannot show much evidence for physiological selection, because breeders keep their strains separate artificially, and this kind of variation is not in their interest. They do show very strongly, however, how important it is to prevent intercrossing with the parent forms if the varietal form is to maintain itself. It is hardly possible that a species could be formed without the prevention of intercrossing with other forms : it is even difficult to imagine any single variation so intensely useful as to resist the swamping effects of free intercrossing. In the natural state the variation in question would not be noticed until the process were over ; and so, as is the case with natural selection, the process cannot be directly observed. But it can be proved that the kind of variation which the theory requires does occur in nature and under domestication. If the season of flowering or pairing were advanced or retarded (and changes in the environment would frequently produce the result), the conditions for physiological selection would be given.

But physiological selection will be best shown in what may be termed 'spontaneous variability of the reproductive system.' Of this fact we have evidence in *individuals* (e.g., Mr. Darwin observes that "it is by no means rare to find certain males and females which will not breed together, though both are known to be perfectly fertile with other males and females"), in *races* (e.g., under domestication, "the yellow and white varieties (of Verbascum), when crossed, produce less seed than the similarly colored varieties" — *Darwin*), in *species* (for, as the distinction between varieties and species is of degree only, and as the main distinction is as regards mutual sterility, every instance of sterility between parent and varietal forms is evidence of the action of physiological selection).

Dr. Romanes then proceeds to show that "the facts of organic nature are such as they ought to be, if it is true that physiological selection has played any considerable part in their causation ;" and to do this he shows that the three cardinal objections to the theory of natural selection — namely, sterility, intercrossing, and inutility — find a ready explanation in the hypothesis of physiological selection. In this evidence it is brought out that in all probability the variation in the reproductive system is the primitive and distinctive one in the formation of species, and not that it was developed as secondary to another specific distinction in any other part of the organism. In addition, it is shown that the theory is capable of explaining why species have multiplied, and have not become transmuted in a linear series, and that the large body of favorable evidence furnished by the geographical distribution of organic life is perhaps the strongest argument for the truth of the theory. For the details of these points, reference must be made to the original paper.

A word as to the relation of the theories of natural and of physiological selection. It has already been noticed that the kind of evidence on which each depends is alike ; that the former deals with the origin of genera, families, orders, and classes, even more than that of species, while the latter relates to species alone ; that the former perpetuates useful distinctions alone, while the latter takes up the non-adaptive kind. It remains to add, that the two theories are in no way opposed to one another, but are complementary and co-operative. Without physiological selection, natural selection would be overcome by the adverse influences of free intercrossing : without natural selection, physiological selection could perpetuate no differences of specific type other than those of mutual sterility and trivial details of structure, form, or color.

In conclusion, Dr. Romanes suggests the following experimental verification of his theory, and asks the co-operation of observers in different geographical areas. The experiment consists in taking well-marked natural varieties of plants, and testing the relative degrees of fertility, first within themselves, and next towards one another ; in continuing the process "in successive years over a number of natural varieties, by carefully conducted artificial fertilization, and by counting the seeds and tabulating the results."

LAUNHARDT'S MATHEMATICAL ECONOMICS.

Professor Launhardt has made what seems to us quite a notable contribution to the literature of mathematical economics in the volume before us. Whatever may be thought of the importance of investigations of this nature, it cannot be denied that the works of the principal writers on the mathematical theory of political economy — Cournot, Walras, Jevons, and perhaps others — are marked by insight as well as ingenuity, and in many respects by true scientific method as well as scientific form. They have nothing in common with that pseudo-science which we occasionally find endeavoring to conceal its emptiness behind a breastwork of mathematical formulas.

Professor Launhardt bases the theory of political economy on the Walras-Jevons idea of utility in

Mathematische begründung der volkswirthschaftslehre. By Wilhelm Launhardt. Leipzig, *Engelmann*, 1885. 8°.