Many localities display the effects of varied igneous phenomena, such as the volcanic cones at Entrada Point, San Quentin Bay; enormous thicknesses of lava in the vicinity of Carmen and San José islands on the east side of the peninsula; an enigmatical mass of finely crystalline lava and volcanic glass composing the mass forming Pulpit Point; hot spring phenomena and lavas, with associated rocks, at San Carlos Bay, Sonora; tuffs, lavas and the like at Santa Rosalia. In addition, a wonderful variety of geological processes is seen to have worked elsewhere. The copper mines at Santa Rosalia, the gypsum deposits of San Marcos Island and the salt deposits of Carmen and San José islands were briefly studied.

The very steep shore-lines along most of the peninsula have been the subject of much comment. Some hold that the peninsula as a whole is a sinking unit, but there appear to be areas that have relatively risen. Contrary to the opinion of a few, it is believed that sufficient evidence exists to show the Pliocene strata not to have been contemporaneously deposited in many places. These observations may indicate that the peninsula has not acted tectonically as a single unit.

Represented among the material collected is apparently the first Pleistocene fauna from the entire Gulf of California region. Both the Pliocene and Pleistocene faunas collected have unprecedented richness in individuals and species and in perfection of preservation. These faunas have previously been very little known and may now be very fully known. Many new localities and their faunas are to be added to those already known from strata of various ages in this region. Species previously known only from Recent shells may now be reported as also occurring in the fossil state. Species new to science likewise are present. Variations among certain forms, temperature changes, relationships to other faunas and the like may be discerned. The marked tropical affinities of the faunas add to their interest. Besides new forms among the Recent shells collected, the ranges of a number of those previously described are to be extended. Correlations with California strata eventually may be more effectively suggested. Results of the nature above mentioned are now being traced. As work progresses these results will appear from time to time under the authorship of the writers of this account, or of others associated with them. The collections have been presented in their entirety to the department of geology, Stanford University, and are to be found there.

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SCIENTIFIC BOOKS

Geologie von Peru. By G. STEINMANN. 448 pp., 271 text figures, 9 plates and map. Carl Winters, Heidelberg, 1929.

THOSE who are interested in Andean geology have been looking forward for a long while to Steinmann's account of the geology of Peru. This may be regarded as the summation of his personal observations in South America, and of many years of study of collections by himself and his students, with the collaboration of Peruvian friends, especially Dr. Carlos I. Lisson, of Lima.

In the present work the map is credited to the latter, R. Stappenbeck contributes the account of the economic deposits and F. Sieberg the chapter on earthquakes.

The general plan is four pages of physiography forming Part 1; Part 2, comprising 278 pages devoted to the geological succession from pre-Cambrian to Quaternary; Part 3, of twenty-three pages devoted to geological history; Part 4, of sixteen pages devoted to the structure of the Andes; Part 5, of seventy-five pages devoted to economic geology; Part 6, of thirteen pages devoted to earthquakes.

To the pre-Cambrian are referred the gneisses, schists and granites as representing the Archean, although in most cases there is little satisfactory evidence of their age, and a second and supposed later series is termed the Phyllite formation and the suggestion is made that it may represent the Algonkian. This follows the traditional practice of geologists everywhere, but since similar rocks farther south in the Andes are both Mesozoic and Tertiary little credence can be given to these age determinations. For example, the Cerros de Amotape and Silla de Paita are mapped as Archean and the Cerro Illescas as Algonkian, and in all three cases the geological evidence is not more definite than that they are Carboniferous or older.

No Cambrian is known except east of the Andes. The so-called Silurian is Ordovician. Only lower Devonian has been recognized in Peru and this occurs near Huanuco and from Sicuani southeastward. Marine Carboniferous is found from the Amotapes to the Bolivian frontier. Continental Carboniferous on Paracas Peninsula, near Paita, in the Cerro de Pasco region, and near Abancai, is regarded as Lower Carboniferous (Mississippian), although much the most extensive collections known were made by the present reviewer, who regards their age as Upper Carboniferous (Pennsylvanian). No Permian is recognized.

At two or three localities supposed continental Trias is reported, and in the Cerro de Pasco region marine Trias is reported. The evidence upon which this last determination is based is very inconclusive and the absence of recognizable marine Triassic is of general interest, since the Andes is the only great mountain system where these rocks have not been found. The Jurassic is much less fully represented in the Peruvian Andes than farther south and Steinmann recognizes only the Lias, lower Oolite and upper Malm.

The Cretaceous is extensively developed and all the European stages are recognized, although the evidence on which this is based is often far from conclusive. As an example the Barremian stage may be cited. This is credited as wide-spread in Peru on the basis of a few very inconclusively determined fossils. Although cited from the Cordillera Blanca the Ellsworth expedition to that region found no Barremian, and it is certainly singular that what Steinmann calls Barremian in Peru should fail to show any resemblance to the highly characteristic Barremian fauna found in Colombia but should be comparable with certain European species.

Most of the Mesozoic fossils found in the Peruvian Andes are preserved as relatively poor casts and with the exception of some of the ammonites and echinoids have very little value for purposes of intercontinental correlation. Many instances of incorrect determinations could be pointed out but would unduly extend this review. What is figured as *Enallaster texanus* Roemer is not that species, as was clearly shown in 1922; Inflaticeras should be Perivinqueria; Ananchytes should be Echinocorys; Ostrea often should be Exogyra, etc. The lagoonal and continental Puca sandstone of Steinmann is considered to extend from northwestern Argentina entirely across Bolivia and Peru, although there is no evidence that the type area has any relationship to that of either the altiplanicie of Bolivia or that of northern Peru. The plants from Bolivia were considered Pliocene by the writer. This is not mentioned by Steinmann, who says "the plants indicate a (middle?) Tertiary (Miocene?) age."

One of the amazing correlations (p. 254) is that of the Pleistocene terraces of northwestern Peru with the glacial stages in the Alps and the marine terraces of the Mediterranean. The fact that these Peruvian terraces decline rapidly in elevation and merge south of Paita shows clearly that they are due to local changes in elevation of the land, and that they offer no physical basis for eustatic correlation. This part is profusely illustrated with text figures of fossils and synthetic geologic sections.

Part 3—"Geological History"—is really a brief summary statement of Part 2.

Part 4 on the "Structure of the Andes" is also very brief. In general it is the orthodox interpretation of the folding of the Andean geosyncline between a Pacific Coastal massif and the Brazilian shield. The Pacific massif is supposed to have sunk during the early Eocene. This early date is rendered doubtful by the absence of marine Tertiary in southern Coastal Peru, by the intense faulting of the marine Tertiary of northwestern Peru and by the lack of evidence of an ocean current corresponding to the modern Peruvian or Humboldt current even as late as the Miocene and the lack of community of faunas between the Zorritos fauna of northwestern Peru and the so-called Navidad fauna of Chile.

The Andes are regarded as essentially faulted mountains differing from the Alps in the absence of horizontal fault planes and overthrust sheets, in their less intensive folding and in their enormous amounts of plutonic and volcanic rocks. They are divided into three zones: an eastern or outer zone of intense faulting bordering the Brazilian shield and without overturned folds, thrust faulting, or magmas (amagmatische); a central zone of maximum faulting with overturned folds, imbricated thrust faulting and partly or wholly contemporaneous intrusions (Eu- and Hemimagmatische), and a western or inner fault zone of weak folding.

Part 5 is a useful enumeration and brief description of the principal mineral deposits, almost wholly descriptive rather than genetic in character; and Part 6 is a seemingly exhaustive discussion of earthquakes in Peru. The work closes with an excellent bibliography.

There can be no doubt of the usefulness of Steinmann's work, nor the value of his having brought together in one book all his information.

A feature that detracts somewhat from the permanency of the results presented is that tendency which finds its fullest expression in the Teutonic temperament of reaching conclusions on insufficient evidence and maintaining a dogmatic attitude thereafter; particularly is this evident in the ease and apparent precision of the correlations with the standard European section. Any one intimate with the situation knows that even in such a relatively limited stretch of time as the Upper Cretaceous and in as limited an area as Germany geologists have not reached anything like an agreement on correlation, and if there are uncertainties between such almost contiguous areas as Aachen and Westphalia, or Germany and France, it is surely paleontological malpractice to so definitely settle (sic) the geological history of a very imperfectly known area over twice that of Germany in another hemisphere.

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