46. *On the Late Tertiary Orogenic Movement in Shinano Province, Japan.*

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Extending over the last nine years, the writer executed in cooperation with Mr. S. Koyama in Nagano a detailed geological survey of the central districts of the Province Shinano, forming a part of Edmund Naumann’s “Fossa Magna,” the zone of remarkable tectonic discontinuity at the eastern feet of the Hida and Akaishi Mountains. In the course of field works for a detailed mapping of stratified and massive rocks, the writer found it indispensable to distinguish the areas of the same angle of dips of Tertiary strata in a special map in order to elucidate the nature of their disturbances.

The writer divided a series of maps shown in figures, 1, 2 and 3, founded on thousands of actual measurements of the dips in the sedimentary formations. In Fig. 1 their areas have been divided into the five zones corresponding to inclinations of $90° - 75°$, $75° - 60°$, $60° - 45°$, $45° - 30°$ and $30° - 0°$ respectively. The isoclinic map thus constructed was simplified in another map (Fig. 2), in which it is intended to distinguish the intensely folded areas from the moderately folded or non-folded ones. For facilitating an interpretation of the two maps a third was constructed, in which the axes of synclines and anticlines alone were located.

According to the present writer’s study in Shinano Province the disjunction of blocks of older complexes in Central Japan occurred not later than the Lower Miocene epoch when the Moriya series had begun to deposit and after the outbreak of this geotectonic discontinuity in the region underwent a repetition of tectonic disturbances.

He believes it to be highly important to trace the history of the evolution of the trough-like area which came to emerge since Tertiary period. In the present paper he desires to report a sketch of the late Tertiary orogenic movement, shown in the maps to be published elsewhere. From these maps he learned some physical behaviors of the underlying rigid masses of the region.

1) Three maps accompanying the paper is not printed.
In the Tertiary formations which cover these blocks the writer came to see a complete cycle of deposition begun by a marine transgression and ending in a regression. During the depositions of the sediments he found no trace of a perceptible compression from either side, except local ones caused by the intrusion of quartz-diorite and block movements following the deposition, their effects being felt in the piling of some sediments in which are found clino-unconformities. As well known to geologists an intense folding took place, however, at the late Tertiary period along the great transverse rift zone and the coast of Japan Sea, north and northeast of the region.

The wedge-shaped folded area which occupies northwestern part of the map in Fig. 1 represents a tract hemmed in the two rigid masses; the eastern one being a Miocene terrain intruded by plutonic rocks of the same epoch and the western one, a Palæozoic with the late Mesozoic intrusion of granites.

The writer's study being restricted to a part of the area he is not entitled to enter into the interpretation on the origin of the orogenic force which caused the folding in the whole region adjoining Shinano. Yet, judging from the facts that there lay folded zones of Neogene strata in Misaka, Doshi and Tanzawa along the southern border of the eastern mass and another folded zone of Neogene in Tensu and Minobu, west of Fuji-San at the eastern foot of Akaishi Mountains, he believes it very likely the pressure to have exerted from both sides of the folded areas above named, in the period when the eastern mass shifted southwards and the western, eastwards or southeastwards.

An inspection of the annexed maps shows the following geologically significant facts of the Tertiary terrain in the middle Shinano districts.

Firstly: it is noticed that the non-folded areas are limited within the districts intruded by plutonic rocks; secondly: the intense folding coincides with zones of anticlinal axes while the moderate folding with the axes of syncline. The third fact is the apparition of the sharp delineation in boundaries between the intensely folded and moderately folded areas which traverse across general trends of folding, suggesting the presence of blocks different in degree of rigidity below the sediments.

From these facts discernible in Neogene strata, the writer arrived at the following inferences on the nature of the orogenic movements:—

The first fact points that the intrusives such as quartz-diorites in the Upper Miocene and pyroxene-porphyrites in the Lowest Pliocene strata had been rigid before the orogenic movement commenced, and the second suggests that the folding had occurred in the zone of
sediments free from igneous intrusions and resulted in a downwarping of the whole zone under the control of gravity.

For a proper interpretation of the third fact is needed a much more hazardous assumption. At the beginning of the deposition of the Neogene terrain in Shinano, tectonic disturbances had been caused by a tensional force along the eastern foot of Hida Mountains, and numerous fragments of rigid blocks were formed along the zone of dislocation, like fault breccias by faulting. The space between them should have been occupied by the magma, ascending from a deeper substratum.

Since the Neogene strata had been deposited on the foundations heterogeneous in rigidity at places on this assumption, they might have been forced to yield to a lateral pressure in different degrees of folding as shown in Fig. 1. Fig. 2 suggests on the other hand a mosaic structure of the foundation which was covered by younger sediments and make it difficult to detect by the usual method of representation.