epoch boundaries are necessarily more ambiguous stratigraphically than others.

In California where marine and non-marine formations are intercalated, discrepancy in correlation has sometimes appeared, the vertebrate determination being higher than the invertebrate. The divergence is accentuated in the middle Tertiary by some vertebrate paleontologists who arbitrarily state that the appearance of the horse genus *Hipparion* introduced the Pliocene. Application of this criterion would place the Puente, Mint Canyon, and Modelo in the Pliocene. The writer adheres to his correlation table published in 1930 (*Carnegie Inst. Washington Pub. 404*, p. 85) placing these formations in the Upper Miocene not only on the basis of invertebrate stratigraphy but also because of morphologic and time relationships of *Hipparion* in Europe, Asia, and North America.

10. OLAF P. JENKINS, State Division of Mines, San Francisco: Geomorphic Provinces of California as Outlined on the New State Geologic Map (abstract).

Major geomorphic provinces of California: (1) Great Valley of California, (2) Sierra Nevada, (3) Cascade Range, (4) Modoc Plateau, (5) Klamath Mountains, (6) Coast Ranges, (7) Transverse Ranges, (8) Peninsular Ranges (including Los Angeles Basin), (9) Colorado Desert, (10) Mojave Desert, and (11) Basin Ranges.

11. MASON L. HILL and M. L. NATLAND, Richfield Oil Corporation: An Exposure of the Red Mountain Fault, Ventura County (abstract).

One and a half to six inches of gouge sharply separates Pliocene formations which are 11,300 feet apart in a normal stratigraphic section.

12. ROBERT S. DIETZ and K. O. EMERY: Phosphorite on the Sea Floor Off Southern California (abstract).

Dredging operations on the Scripps Institution vessel during the past year have shown that phosphorite is extensively developed on the sea floor off Southern California. This deposit is found as large nodules or as a coating on other rocks. It is particularly abundant on the numerous banks that lie off this coast and is found also on most of the submarine slopes and on the sides of a few submarine canyons. These environments are characterized by general absence of recent sediments. Some glauconitic and foraminiferal sands are associated. The phosphorite is thought to be of recent origin and the deposition is probably continuing at the present time.

13. R. A. STIRTON, introduced by B. L. Clark, University of California, Berkeley: Significance of Tertiary Mammalian Faunas in Holarctic Correlation (abstract).

The epochs of a period in the Tertiary time scale are, supposedly, convenient terms of expression, and as such, have been altered somewhat from the original designations of Lyell by different authors. Many controversies have arisen in the arbitrary assignment of boundaries to these divisions. This article is concerned with Mio-Pliocene boundary, particularly in California.

From a study of certain living mammals, it is recognized that similar fossil forms realized a wide and rapid dispersal without appreciable evolutionary change and are useful in Holarctic correlation. Furthermore, the evidence shows that different plant associations were not effective barriers to

these mammals. Hence it is again suggested that the equid genus *Hipparion* be accepted as an indicator of the beginning of the Pliocene.

The late Tertiary time scale now in use on the Pacific Coast is based, primarily, on the early identifications of fossil vertebrates from the Coalinga area in California, and in part on the percentage methods as applied to the invertebrates. The horse teeth, *Neohipparion molle* Merriam, from the Jacalitos, which were used to mark the beginning of Pliocene time on the Pacific Coast, we now find to be very close in structural characters to Middle Pliocene forms elsewhere in America. From the evidence now available and in accordance with the above principles in intercontinental correlation, it is suggested that Pliocene time in California began with the Orinda, lower Chanac, upper Nerola and their equivalents.

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(Continued from page 1700)

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