velocity associated with this oscillator, then the probability of the ejection of a K electron by a quantum of γ radiation is

$$P_i \simeq 2\left(\frac{Z}{a}\right)^2 \sum_j e^{\frac{2}{Z-2} S_{ij}/\sqrt{1-\beta^2_{ij}}}$$

when the α particle is initially in the state i. The S_{ij}'s are determined from the relative intensity of the lines emitted in transition from that state.

Take the particular case where $S_{12} = S_{02} = {}^1/_2$ and $\beta_{12} = \beta_{02} = \beta_{01}\sqrt{1 - \beta^2_{01}} = {}^1/_{200}$ then $P_1/P_2 = 4.3$.

This ratio is nearly the same as that of the internal conversion coefficient of γ rays from RaC. There the values of this coefficient can be divided roughly into two groups whose ratio is 1 to 4.

The extension of the analysis to take into account the dependence of P on the number of transitions possible from a given α particle level will account for the variation of the internal conversion factor from one state to another. Although the accuracy of the agreement cited above is probably accidental, it shows the type of dependence of this factor on the state in which the α particle may be present. Nothing further, however, can be definitely stated until the states of RaC are definitely known.

[4] Rutherford and Ellis, *Proc. Roy. Soc.*, **132**, 667 (1931).

[2] Bramley, *Proc. Nat. Acad. Sci.*, **17**, 579 (1931).

[3] Fowler, *Proc. Roy. Soc.*, **129**, 1 (1930).

[4] B. Swirles, *Ibid.*, **116**, 491 (1927).

AN UPPER OLIGOCENE MAMMALIAN FAUNA FROM SOUTHERN CALIFORNIA

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In a previous paper[1] the writer recorded the presence of upper Eocene land mammals in the Sespe deposits north of the Simi Valley, Ventura County, California. Immediately to the west of the Simi Valley occur the Las Posas Hills, where beds mapped as Sespe form a considerably thinner series of sediments. The chance discovery of fragmentary mammalian remains by Dr. W. S. W. Kew on exposures near the top of this section led to further exploration by field parties of the California Institute with the gratifying result that a large and varied vertebrate assemblage

has now been obtained. This important site, C. I. T. Vert. Pale. Loc. 126, has come to be called the Kew Quarry and will be referred to in future discussions of the occurrence and fauna under that name.

The Tertiary and Pleistocene sediments exposed in the Las Posas Hills or determined by the subsurface geology include the Domengine with overlying deposits assigned tentatively to the Tejon, the Sespe, Temblor, Santa Barbara and San Pedro. The sequence is shown in the columnar section (Fig. 1) which I am permitted to reproduce through courtesy of the Shell Company of California. As seen in this section, the Sespe is demarcated from Eocene marine strata below and from middle Miocene marine strata above by erosion intervals. Moreover, faulting which has affected the Sespe deposits below the fossiliferous horizon precludes opportunity to secure an accurate measure of the distance that separates this zone from the bottom of the Sespe. The fossil-bearing beds strike east and west and rest at a high angle, having a dip to the north of 50° or more at the site of the quarry. The sediments comprise maroon-colored clays and greenish sandstones. Immediately overlying the fossil horizon are cross-bedded sands in which occasionally coarse materials occur. Fragments of the maroon or red shale and pebbles of various rock types, several inches in diameter, were noted in the cross-bedded sands. An igneous rock of basaltic character, presumably related in age to the interbedded basic flow or intrusive sill occurring with the Miocene sediments which overlie the Sespe, passes through Sespe deposits in the vicinity of the horizon in which the fossil vertebrates are found. At one locality this basalt intrusive approached within two or three inches of an occurrence of fossil material.

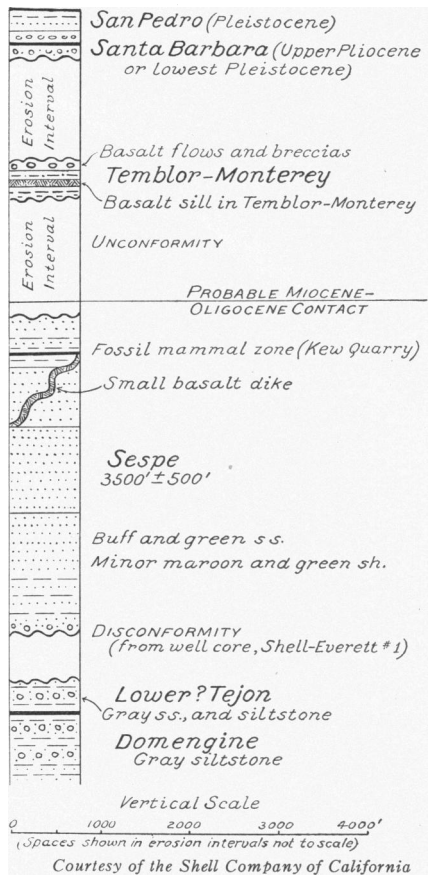

FIGURE 1

Cenozoic stratigraphic column in a section of the Las Posas Hills containing the Kew Quarry fauna, Ventura County, California.

The vertebrate remains were found to be concentrated within a known area of several hundred square feet. Skull and skeletal materials are abundant. Mammalian skulls exhibit particularly the effects of the intense deformation and pressure to which the fossil-bearing beds have been subjected. The specimens are squeezed, crushed and flattened but the teeth, curiously enough, are frequently well preserved. Crushing of the fossil remains may have occurred in part at least during the actual period of accumulation of the deposit.

The following mammals have been identified:

Subhyracodon
Miohippus
Camelid
Hypertragulus
Nimravus
Hoplophoneus
Mesocyon
Temnocyon
Pseudocynodictis?
Ischyromyid rodent
Palaeolagus?

Remains of large tortoises have also been found. Doubtless other forms will be added to this list. While a study of the specific relationships of individual types comprising the assemblage is now in progress, certain age relations of the fauna are already in evidence. The assemblage is clearly more advanced than that recorded from the Sespe north of the Simi Valley. The evolutionary advance which this fauna marks in the history of mammalian life beyond the stage represented by the Simi fauna may have required an elapse of time greater than that included within the Oligocene.

Vertebrate assemblages from the Californian region most nearly related in age to the Kew Quarry fauna are those recorded from the auriferous gravels of the Sierra Nevada, from Tecuya Canyon, southwestern Kern County and from the Sespe of South Mountain, Ventura County.

Whitney[2] recorded the presence of a rhinoceros and an elothere from Douglas Flat and Chili Gulch in Calaveras County. These mammals were described by Leidy as *Rhinoceros hesperius* and *Elotherium superbus* and compared with forms occurring in the John Day beds of Oregon and in the White River badlands of the Great Plains. More recently the former type has been assigned tentatively to the genus *Diceratherium*. Presumably the beds whence these specimens come antedate the andesitic gravels in which late Miocene or Pliocene mammalian remains are found. Of more certain stratigraphic position is the tortoise, *Stylemys calaverensis*,

described by Sinclair[3] from gravels of the rhyolitic epoch near Vallecito, also in Calaveras County.

The Tecuya fauna[4] includes the genus *Hypertragulus* and a rhinoceros determined as *Caenopus?* or *Diceratherium?* on the basis of very fragmentary materials.

No satisfactory comparison between the Kew Quarry fauna and that from the Sespe of South Mountain[5] can be made at present because of absence of oreodonts at the former locality and because of the dearth of fossil mammals on record from the latter region. While the beds containing *Promerycochoerus* (?) *hesperus* Stock may represent a higher horizon than that of the Kew Quarry, definite establishment of their stratigraphic position with reference to the latter must await the discovery of additional faunal evidence. The leptauchenids, whose stratigraphic

		Ventura Co. California	John Day Basin Oregon	Great Plains Rocky Mountains
Lower Miocene		South Mountain-Sespe (Promerycochoerus? Beds)	Upper John Day	Lower Rosebud
Oligocene	Upper	Las Posas Hills-Sespe (Kew Quarry)	Middle John Day Lower John Day	Leptauchenia Beds
	Middle			Oreodon Beds
	Lower			Titanotherium Beds
Upper Eocene		Simi-Sespe		?Duchesne Uinta C

FIGURE 2

Correlation chart showing time relations of Kew Quarry fauna to some early Tertiary vertebrate assemblages of western North America.

range extends lower in the Sespe section of South Mountain, may occur in deposits broadly equivalent to those containing the Kew Quarry fauna. If this is definitely determined their absence in the latter assemblage may be ascribed to environmental conditions unfavorable to the existence of these creatures at the time and place of accumulation of the organic remains in the Las Posas Hills horizon.

The presence of the rhinoceros *Subhyracodon* and of an ischyromyid rodent suggests a relation with the middle or upper White River Oligocene of the western Great Plains. The absence of titanotheres and of hyaenodonts and the presence of a horse clearly more advanced than *Mesohippus bairdii* indicate that the horizon is certainly of later age than the Titanotherium beds of the lower White River and later than the Oreodon beds of the middle White River. The carnivores and the camelid likewise suggest a later age. Presence of *Miohippus, Nimravus, Mesocyon* and

Temnocyon points rather strongly to a close bond with the John Day fauna of north-central Oregon.

In contrast to the diceratheres of the John Day, the hornless rhinoceroses of the Las Posas Hills-Sespe represent an earlier stage in the phylogenetic history of this group. Moreover, while the rodents of the John Day comprise a somewhat varied group, members of the family Ischyromyidae are absent. The presence of *Subhyracodon* and an ischyromyid rodent in the Kew Quarry horizon may be interpreted as indicating an age for this zone in the Sespe earlier than that of the John Day. On the other hand, these forms may have persisted for a longer period in the region of southern California than in the John Day basin of Oregon. The assemblage from the John Day deposits is regarded as upper Oligocene in age. In recent years, however, a lower Miocene age has been advocated for the John Day fauna, at least for that portion of the assemblage known from the upper John Day (*Promerycochoerus* beds). In view of the relationships which certain elements of the Kew Quarry fauna have with types occurring in the later White River and in the John Day, the age of this stage of the Sespe can be stated at present as being not later than lower Miocene or earlier than upper Oligocene. The time relations of the fauna may be tentatively expressed in the diagram, figure 2.

[1] Stock, C., *Proc Nat. Acad. Sci.*, **18**, 518–523 (1932).
[2] Whitney, J. D., *Mem. Mus. Comp. Zoöl Harvard*, **6**, 243–245 (1880).
[3] Sinclair, W. J., *Univ. Calif. Publ. Bull. Dept. Geol.*, **3**, 11 (1903).
[4] Stock, C., *Univ. Calif. Publ. Bull. Dept. Geol.*, **12**, 4 (1920).
[5] Stock, C., *Carnegie Inst. Wash. Publ.*, **404**, art. 3 (1930).

AN EXTENSION OF THE NEW EINSTEIN GEOMETRY[1]

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The geometry considered by Einstein[2] and Mayer in their "Unified Field Theory" leads to the consideration of an n-dimensional Riemannian space V_n with a metric tensor g_{ij}, to each point of which is associated an m-dimensional linear vector space V_m $(m > n)$, for which vector spaces a general linear connection is defined. For the general case $(m - n \neq 1)$ we find that the calculation of the $m - n$ "exceptional directions" is not unique, and that an additional postulate on the linear connection is necessary. Several of the theorems give new results even for $n = 4$, $m = 5$, the Einstein-Mayer case. It is of interest to note that the dependence of the Einstein-Mayer unified field equations on V_4 tensors is not only a