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The Succession of Mammalian Forms within the Period in which Human Remains are Known to Occur in America

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THE SUCCESSION OF MAMMALIAN FORMS  
WITHIN THE PERIOD IN WHICH HUMAN  
REMAINS ARE KNOWN TO OCCUR  
IN AMERICA<sup>1</sup>

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INTRODUCTION

THIS paper is divided into two parts with a view to presenting first some general considerations which merit attention in the present study of the succession of mammalian life for the later Quaternary and, secondly, some facts which relate more specifically to the title of the address. It is a pleasure to acknowledge my indebtedness to Dr. John C. Merriam for the opportunity to discuss these topics at a symposium on "Early Man in America," with particular reference to the southwestern United States, before the American Society of Naturalists.

GENERAL CONSIDERATIONS

*Geological.* It is important to recognize at the outset the necessity of establishing the succession of mammalian species and genera on the firm foundation of accurate position of these types in sedimentary deposits. No dependable chronology can be realized unless this is accomplished. Furthermore, the superposition of faunas can best be determined if we establish the superposition of the strata containing these assemblages. Much has been accomplished in this direction in the Middle West, where mammalian forms are found in deposits laid down during the several stages of glacial advance and retreat, featuring Quaternary history in this region. Unfortunately, however, it is too frequently true that at specific localities faunas are but scantily represented, and our information is frequently based on relatively few types rather than on complete or fairly complete faunas.

<sup>1</sup> Contribution No. 196, Balch Graduate School of the Geological Sciences, California Institute of Technology.

While deposits and faunas of the north-central states form frequently a part of a sequence that can be connected directly with the history of the great continental ice-sheets of the Quaternary, this is less readily accomplished in regions more remotely situated from the immediate fronts of the advancing or retreating glaciers. While there is perhaps no less direct means of identifying events as belonging to Quaternary time in the region now comprising the great arid Southwest, the geological and paleontological episodes which have been recognized are as yet disconnected in large measure from the sequence of events as established in the regions immediately adjacent to the glaciated areas.

Still farther removed from the fronts of what were the great Quaternary ice-sheets is the Californian region of the Pacific Coast province. Here the evidence of changing climatic conditions during Quaternary time is available in the high mountain country, as, for example, in the Sierra Nevada and adjacent regions. Elsewhere, oscillations of the land have been in part responsible for the development of many well-defined terraces. In addition to the evidence of considerable movements of the land surface during the Quaternary, movements which incidentally have continued down to the present, this period is marked by an unusually complete physical record to be read in terms of hundreds and even thousands of feet of sediments. Terrace accumulations contain marine faunas which suggest warm water or cold water facies and are frequently interpreted as belonging to interglacial or glacial stages. While no complete assemblages of vertebrates are known from deposits regarded as belonging to the early Quaternary, the later Quaternary has been singularly productive in such representations. Unique among these are the asphalt beds and faunas, as, for example, Rancho La Brea, McKittrick and Carpinteria. While extraordinarily rich in its organic record this type of deposit suffers, along with less noteworthy occurrences, in lack of definite placement with regard to a standard sec-

tion for the Quaternary. One of the larger problems therefore in the Southwest and Far West is the correlation of specific biologic and physical events and the accurate placing of these events in the record of Quaternary time.

In the problem of correlating Quaternary faunas and deposits it is readily recognized that alluvial, lacustrine, fluvial and aeolian accumulations are of special importance because of their frequent wide distribution. Moreover, these may contain fairly complete representations of the animal assemblages in existence during the period of their deposition. The position of fossil materials in the stratigraphic sequence is generally clear and the occurrence of such materials, with reference to overlying and underlying deposits, readily determinable.

On the other hand, cave accumulations and the entombed life assemblages generally present discrete problems in Quaternary time. The relation of these occurrences to the history of the adjacent regions is in most instances established with difficulty or not at all. True, the time of their deposition may be recognized with reference to terrace development or to the laying down of a physical record elsewhere, but their chief importance seems to lie in the fact that the entombed organic remains point toward more or less antiquity and reflect to a certain extent the climatic conditions during the stage of their accumulation.

Cave and fissure deposits are distinctly local in their occurrence, the stratigraphic succession of sedimentary and organic materials frequently presents difficulties in interpretation, and the possibilities of disturbance and intrusion are apparently greater than in the case of sediments laid down over broad areas. However, by the very nature of their deposition and occurrence, cave accumulations often preserve organic records of unusual type. This is particularly true in caves which remain dry or essentially so for long periods of time. Thus, for example, in Gypsum Cave, Nevada, in Aden Crater and in Shelter Cave, New Mexico, and elsewhere, unusually well-pre-

served remains, including the skin, hair, horny parts of claws, dried ligaments and dung of creatures now extinct, like the ground sloth (*Nothrotherium*), camel (*Camelops*) and four-horned antelope (*Tetrameryx*), have been encountered. It is reasonable to expect other occurrences of this type in the arid Southwest, where present climatic conditions favor the preservation of such materials. Furthermore, the service which a cave may render as a shelter for or as an abode of man facilitates the preservation of a record of man's presence and activity which is not apt to be encountered elsewhere. Among the evidences of man's occupancy of such sites may be not only artifacts but also his skeletal remains.

*Biological.* No attempt to ascertain the succession of faunas for Quaternary time will prove successful in the long run unless critical study is made of all organic materials derived from deposits of this age. This implies extreme care in the identification of organic remains not only with regard to forms that are clearly referable to extinct species, but even more so in the case of those types considered as identical with living species. Moreover, identification of material should include, wherever possible, not only the more diagnostic parts of mammals, namely, skulls and teeth, but also various skeletal structures. The extent to which skeletal parts have been utilized in the study and identification of Pleistocene birds makes it reasonably certain that similar studies among mammals might be conducted with profit.

It is perhaps unnecessary to dwell upon the need of certainty in the identification of species and upon the importance of recognizing that specific determination or allocation of a fossil form to a living type leads to weakness in the structure of basic data when not fully warranted by available material. Because of the comparatively restricted geographic distribution of a subspecies and its possible indication as to life zone and climate, even greater care must be exercised in the identification of fossil or subfossil material as belonging to a living sub-

species. The fact that a certain subspecies occurs in the region where a fossil has been found furnishes in itself absolutely no basis for referring the latter to the former. Specific and subspecific determinations form the basis for faunal lists and the latter become of paramount importance in any attempt to establish correlations on purely faunal grounds.

And here it seems desirable to emphasize the need for close affiliation of the paleontologist with the vertebrate zoologist. Particularly in the study of those species among fossil forms which appear to be intimately related to or are identical with species living to-day, the vertebrate zoologist with his knowledge of the taxonomy of modern forms, geographic distribution, zonal arrangement and climatic indications of living species and of ecology is in a position to supply information of considerable significance in an attempt to place subfossil and fossil assemblages in their correct sequence in Quaternary time. The study of a fossil or subfossil fauna from a specific locality would unquestionably be enhanced if the Recent fauna of the area in which the locality occurs is also carefully examined and determined.

#### SUCCESSION OF MAMMALIAN FORMS

The most striking contrast between mammalian faunas of proven Pleistocene age and those of the Recent in the southwestern United States is afforded by the more formidable carnivores and larger ungulates. Thus among the carnivora prevalent during the later Pleistocene, the dire wolf (*Aenocyon*), the great lion-like cat (*Felis atrox*), the sabre-tooth cat (*Smilodon californicus*) and the short-faced bear (*Arctotherium simum*) no longer survive, although in several instances smaller types occupy comparable or somewhat comparable positions in the living assemblages. Similarly, within the heterogeneous group of ungulates, the Proboscidea, ground sloths, camels and presumably horses have disappeared with the coming of Recent time.

Two views may be entertained with regard to this contrast, namely—(1) the extinction of the larger mammals has occurred in a comparatively short time, or (2) a gradual extinction has taken place in which case some forms survived longer than others. Viewing this history in the light of the geological background one may conclude that the latter is a more tenable hypothesis. While the Pleistocene as a whole represents a critical period in geological history the physical events which transpired during the later stages of the Quaternary, in the passage from glacial to post-glacial time, have left the impress of gradual rather than abrupt change.

If we regard the succession of mammalian types for the later Quaternary as one in which changing physical conditions are accompanied by changing life with gradual extinction of those mammals characteristic of the Ice Age, we ought to find among the several faunas recorded from this stage of geologic time a gradual change in the ratio of living to extinct forms. Thus the sequence of intermediate stages from typical Pleistocene to typical Recent should be marked by a smaller and smaller numerical representation of extinct forms with a concomitant increase in numerical representation of living forms as the Recent is approached.

In recent years a number of assemblages have come to light which by nature of their stratigraphic occurrence, unusual preservation, constituency or for other reasons give evidence of position in very late Quaternary time. In some instances attention has been focused upon them because of the presence of man, either as an integral part of these assemblages or as a type whose position is closely related in time. Among examples which may be cited from the Southwest and West are Clovis, New Mexico; Gypsum Cave, Nevada; Conkling Cavern, New Mexico; and Pit 10 at Rancho La Brea, California. Sites where unusually well-preserved remains of Pleistocene types of mammals have been found, distinctly suggestive of a very late stage of occurrence, are Fillmore, Utah; Aden Crater and Shelter Cave, New Mexico; and Gypsum Cave, Nevada.

Not all the faunas from these several localities have received sufficient intensive study to make available complete faunal lists. However, enough is known regarding the faunas from the former localities to warrant the statement that among mammals which survived into the period of early man are the ground sloth (*Nothrotherium*), the mammoth (*Parelephas?* cf. *columbi* (Falconer)), the horse *Equus*, camels (*Camelops* and *Tanupolama*), bison (*Bison* extinct species) and probably also the peccary (*Platygonus*). To this list should be added, on the basis of unusual preservation, the antelope *Tetrameryx* and probably its associate, *Capromeryx*. The species represented by these types are not in existence to-day, and of the nine genera given in the list, seven are extinct. It will be observed that none of the large carnivores is listed.

On this score one addition should be made, namely, *Aenocyon*, definitely recorded from Conkling Cave. Presence of this genus with *Camelops*, *Tanupolama* and *Nothrotherium* in beds whose vertical succession contain also human remains suggests that among the several faunas which bridge the gap from typical Pleistocene to typical Recent, that from Conkling Cave represents one of the older stages. On the other hand, appearance of greater age may in reality be due to a late survival at this locality of a larger number of characteristic Pleistocene types than is the case elsewhere. Aid in the solution of this problem doubtless will come from an analysis of the remainder of the fauna, especially with a view to determining how many of the remaining mammals represent Recent species. This implies likewise a study of man himself, for we are here, as well as elsewhere, in possession of little information concerning the physical characteristics on which his specific determination is based.

Presence of species of mammals, which have survived to-day, in typical Pleistocene assemblages, as for example in that of Rancho La Brea, makes it reasonably certain that many similar occurrences are to be recorded from the

period in which man is found. Thus at Clovis, the skunk (*Mephitis mephitis*) and the prairie dog (*Cynomys near ludovicianus*) may be cited as examples.

## DATING RECORDS OF EARLY MAN IN THE SOUTHWEST

DR. ERNST ANTEVS

MOST records of early man in North America have been found on the southern Great Plains and in adjacent regions of the southwestern states, well to the south of the region of continental glaciation. They have been found in lake deposits, river terraces, loess beds and caves. They consist mainly of implements, rarely of skeletal remains.

Without exception the dating of the finds is difficult. The several extinct large mammals, found in association with human records, may suggest an antiquity of at least some 4,000 years, since they had disappeared before the age of the Basket Makers,<sup>1</sup> but the actual times of extinction or extermination are not established. There is no known means of building up an absolute late-Quaternary geochronology in the Southwest. Dates in years must be borrowed from northeastern North America and from Sweden. The datings must be carried out through correlations of epochs and stages in the Southwest with stages in the two regions mentioned. The only known basis for such correlations is climate and various changes and conditions induced by climate in the physiography, flora and fauna.

In regard to time measures, we have for the post-glacial epoch Ragnar Lidén's unpublished geochronology based on an annually laminated, or varved, silt now forming in bays on the west side of the Gulf of Bothnia, owing to a yearly spring flood and a moderate summer flow of the rivers rising in the mountains. This silt contains some

<sup>1</sup> Edgar B. Howard, *Museum Journal*, University of Pennsylvania, Volume 24, 1935, pp. 53-171. See pp. 138, 150.