SPECIAL ARTICLES

ANCIENT MIGRATION ROUTES OF CENTRAL ASIA[1]

The discovery by Andrews, Granger, Berkey and Borissiak of a central Asiatic vertebrate fauna from Upper Jurassic to Pleistocene time and onwards, between 40° and 50° N. Lat. and 60° and 120° E. Long., throws a new and important light on the world centers of origin and the routes of migration both of Reptilia and Mammalia. In Upper Jurassic and Lower Cretaceous times a Sauropoda center is revealed of several hundred miles east and west, between the 40th and 50th parallels. From this center (Chart I, 1) it appears probable that the giant sauropods migrated to every continent, including Australia, where they are recently reported in Queensland, to East Africa and the island of Madagascar (1–6). At three points the Mesozoic Mammalia occur in the same beds with the Sauropoda and it is possible that they followed routes 2, 3 and 6; also that the pro-Marsupialia may have entered Australia along route 5 in Lower Cretaceous time. After a 60,000,000-year interval the Mesozoic Mammalia gave rise to the giant mammals known as Proboscidea, including both mastodonts and elephants. Between Eocene and Pleistocene time the Proboscidea, originating in Africa (Chart II, 6), spread northward and eastward across the Jurassic Sauropoda center and reached every continent except Australia, so that in several regions their giant fossil remains are now found not far distant from the Lower Cretaceous beds in which occur the remains of the far more ancient sauropods. Originating in Africa in the Lower Eocene, the Proboscidea reached Europe, central Asia and India in the Lower Miocene, North America in the Middle Miocene and South America in the Upper Pliocene and early Pleistocene; no less than four distinct lines of proboscideans entered South America, including three mastodonts—the Andean and the Humboldtian, also the *Stegomastodon* from India—besides one true elephant which penetrated into French Guiana. A further point of interest is that in Pliocene and early Pleistocene times the Proboscidea were accompanied on at least three of their migration routes by primitive man. At two points remains of primitive Upper Pliocene man have been discovered with Upper Pliocene elephants. In the recently discovered central Asiatic center (7 A, B, C) a striking feature is the *absence* of the horses; up to Miocene time not a single equine has been discovered. This proves that there is a very important still to be explored area (8) north of the 50th parallel which, if it yields Tertiary horizons, will probably reveal the original adaptive radiation center not only of the horses but of the tapirs, rhinoceroses and titanotheres as well, because these small ancestral quadrupeds successively appear by *invasion* in the chief North American center (3), also on the 40th parallel;

[1] Abstract of paper read before the National Academy of Sciences, Princeton, November, 1929.

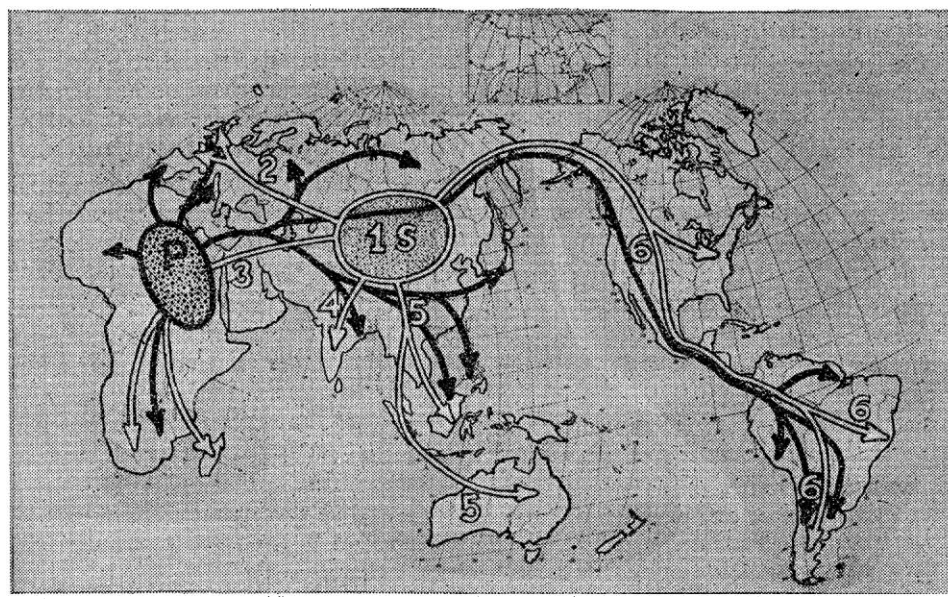

Chart I. MIGRATION LINES OF SAUROPODA (MESOZOIC), OF PROBOSCIDEA (CENOZOIC)

(1 S) Recently discovered (Andrews, Borissiak) central Asiatic origin of the Sauropoda in Lower Cretaceous time. Migration lines (double): (2) To western Europe, (3) to Africa and Madagascar, (4) to India, (5) to Australia, (6) to North America and South America.

(P) Cenozoic center, origin of the Proboscidea. Migration lines (solid) reversing in direction those of the Sauropoda: Africa to western Eurasia, India, Japan, the East Indies, North America and South America.

There is evidence that in Upper Pliocene and Lower Pleistocene times man may have followed the same migration route in India, western Europe, and south Africa, as the Upper Pliocene proboscideans.

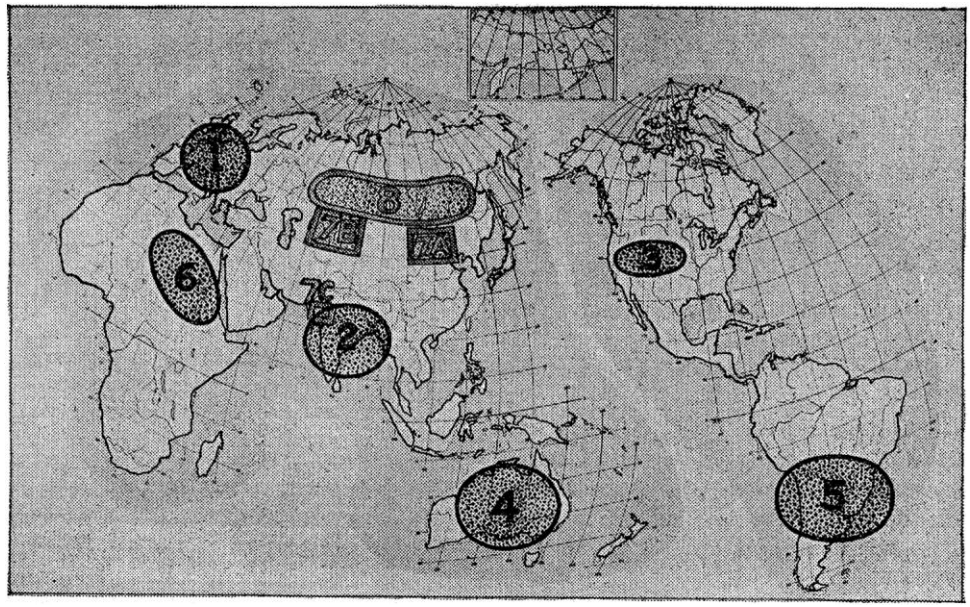

Chart II. WORLD CENTERS OF MAMMALIAN ORIGIN IN ORDER OF DISCOVERY

(1) Western Europe—Cuvier. (2) India and Burma—Falconer and Cautley. (3) Western America—Leidy, Marsh, and Cope. (4) Australia—Owen. (5) South America—Ameghino and Scott. (6) North Africa—C. W. Andrews and Osborn.

(7 A) East central Asiatic area—Roy C. Andrews (1922–1929). (7 B) West central Asiatic area—Borissiak. (7 C) Baluchistan area—Forster Cooper. (8) Unexplored north central Asiatic area, in which will probably be found the plains and uplands ancestors of the tapirs, horses, titanotheres, rhinoceroses. The chief adaptive radiation center of the odd-toed ungulates or Perissodactyla.

moreover the central Asiatic fauna (7 A, B, C) seems to point to a series of invasions from the north. During the early Tertiary, at least up to the close of Oligocene time, this center (7 A, B, C) was in close connection by migration with the North American center (3), and in Oligocene time it formed a close connection with the west European center (1). Another very striking feature of the central Asiatic center (7 A, B, C) is the absence of any trace of the Proboscidea until Miocene time, a fact which serves to establish north Africa (6) as the probable center of adaptive radiation of the Proboscidea, because all the primitive members both of the mastodontine and elephantine divisions have now been discovered in Africa. Accordingly from central Asia (7 A, B, C) and from north Africa (6) it now appears probable that India (2) was populated chiefly by heat-loving mastodonts and elephants and by offshoots of the great bovines and antelopines of Africa, because the adaptive radiation of these animals now seems to have had its center in the upland plateaus of that continent (6). Returning to the central Asiatic region (7 A, B, C), the mammalian fauna was not only extremely varied in Eocene and Upper Oligocene times but extremely flourishing, all the genera and species being represented by animals of relatively stupendous size. Aside from the absence of the horses and of other ancestral perissodactyls, it is important to note the absence as well of all trace of the Palaeotheres, the discovery of which by Cuvier in (1) aroused such excitement, and also of the ancestors of the great bovine family. This central Asiatic fauna, discovered by Andrews, Granger, Berkey and Borissiak, is accordingly highly characteristic of the Northern Hemisphere—it is the ancient Holarctic or North Hemispheral fauna of the world.

HENRY FAIRFIELD OSBORN
AMERICAN MUSEUM OF NATURAL HISTORY

THE STRUCTURAL CORRELATION OF GITOXIGENIN WITH DIGITOXIGENIN

IT has been the assumption that digitoxigenin and gitoxigenin, the two aglucones found in the principal cardiac glucosides of the digitalis plant, are structurally very closely related. Recent work from our laboratory as well as from that of Windaus and coworkers has brought partial confirmation of this assumption. However, to what extent the structural analogy between these substances may be developed remained to be determined. The solution of this question, which is of great importance in the problem of the structural chemistry of the digitalis glucosides, has now been practically completed. Our recent investigations, which will be published more fully elsewhere, have conclusively shown that gitoxigenin is hydroxydigitoxigenin. The hydroxyl group which is presumably of tertiary character is situated probably on a carbon atom adjoining the one which bears the other tertiary hydroxyl of digitoxigenin and which is involved in the isomerization to iso compounds.